

# Orbiter API

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# 1 Orbiter API Reference Manual

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The Orbiter SDK Package contains this document in compiled HTML format (CHM) and in hyperlinked PDF format.

## 1.1 Introduction

This reference document contains the specification for the Orbiter Application Programming Interface (OAPI). The intended audience are developers who want to write DLL plugin modules for Orbiter. The document is *not* required for using Orbiter.

The programming interface allows the development of third party modules to enhance the functionality of the Orbiter core. Examples for modules are:

- new spacecraft (including custom flight models, instrument panels, etc.)
- new celestial bodies (including trajectory and atmospheric code)
- additional instruments, such as [MFD](#) (multifunctional display) modes
- global modules (networking, sound, etc.)

## 1.2 Contents

The following sections of this document are important for developers of Orbiter addon modules:

- Section [Orbiter API interface methods](#) contains a set of functions for getting and setting general simulation parameters in a running Orbiter simulation session. They are used by all types of plugin modules.
- The [VESSEL](#), [VESSEL2](#) and [VESSEL3](#) classes are the base classes for vessel definitions. They are particularly useful for developers who want to create their own spacecraft plugins.
- The [MFD](#) and [MFD2](#) classes provide an interface for creating new multifunctional display modes.
- The [oapi::GraphicsClient](#) class provides an interface between Orbiter and external render engine modules. It is interesting for developers who want to substitute Orbiter's default graphics module with their own render engine plugin.

## 2 Planet Modules

Planet modules can be used to control the motion of a planet (or any other celestial body, such as a moon, the sun, or an asteroid) within the solar system. This allows to implement sophisticated analytic ephemerides solutions which take into account perturbations from other celestial objects.

Planets which are not controlled via a DLL module are updated directly by Orbiter. Depending on the settings in the definition file, Orbiter either uses an unperturbed 2-body approximation, resulting in a conic section trajectory (e.g. an ellipse), or uses a dynamic update procedure based on the gravitational forces acting on the planet. Both methods have limitations: the 2- body approach ignores perturbations and is only valid if no massive bodies other than the orbit reference object are nearby. The dynamic update accumulates numerical errors over time, causing the orbits slowly to diverge from the correct trajectories.

By using a planet module, analytic perturbation solutions can be used which avoid the shortcomings of the methods described above. Perturbation solutions typically describe the perturbed orbit of a planet by expressing the state vectors as a trigonometric series. These series are valid over a limited period of time, after which they start to diverge. Examples of perturbation solutions used in Orbiter are the VSOP87 solution for the 8 major planets and the sun, or the ELP2000 solution for the moon.

Planet modules have one additional function: They can be used to define some atmospheric parameters, such as temperature, pressure and density as a function of altitude. Additional functions may be added to the planet module interface in the future.

### 2.1 First Steps:

To start on your planet module, you should create a new "dynamic link library" project with your C++ compiler. Add the *Orbiter.lib* and *Orbitersdk.lib* files to the project (*found in Orbitersdk\lib*). Add *Orbitersdk\include* to your include path. Create a C++ source file for your project, and add the essential API interface functions:

```
#define ORBITER_MODULE
#include "OrbiterAPI.h"
#include "CelbodyAPI.h"
```

```

DLLCLBK void InitModule (HINSTANCE hModule)
{
    // module initialisation
}

DLLCLBK void ExitModule (HINSTANCE hModule)
{
    // module cleanup
}

DLLCKBK CELBODY *InitInstance (OBJHANDLE hBody)
{
    // instance initialisation
    return new MyPlanet;
}

DLLCLBK void ExitInstance (CELBODY *body)
{
    // instance cleanup
    delete (MyPlanet*)body;
}

```

The first line defining `ORBITER_MODULE` is required to ensure that all initialisation functions are properly called by Orbiter.

`OrbiterAPI.h` contains the general API interface, and `CelBodyAPI.h` contains the planet module- specific interface, in particular the `CELBODY` class, which will be discussed below.

The `InitModule()` and `ExitModule()` methods are called only once per Orbiter session, when the DLL module is loaded or unloaded, respectively. They can be used to set up global parameters. You can omit them if your module doesn't need any such initialisation.

The `InitInstance()` and `ExitInstance()` functions are more important: You use them to create and destroy an instance of your planet class. This class is derived from `CELBODY`. In this example, we called it `MyPlanet`.

## 2.2 The CELBODY interface class

All communication between Orbiter and your planet module will be conducted via the methods of the derived planet class. You overload the various callback functions of the `CELBODY` class to add the required functionality. Check the API Reference manual for a complete list of class methods. A typical implementation might look like this:

```

class MyPlanet: public CELBODY
{
public:
    MyPlanet();
    bool bEphemeris() const;
    void clbkInit (FILEHANDLE cfg);
    int clbkEphemeris (double mjd, int req, double *ret);
    int clbkFastEphemeris (double simt, int req, double *ret);
};

MyPlanet::MyPlanet(): CELBODY()
{
    // add constructor code here
}

bool MyPlanet::bEphemeris() const
{
    return true; // class supports ephemeris calculation
}

void MyPlanet::clbkInit (FILEHANDLE cfg)
{
    // read parameters from config file (e.g. tolerance limits, etc)
    // perform any required initialisation (e.g. read perturbation terms from data files)
}

int MyPlanet::clbkEphemeris (double mjd, int req, double *ret)
{
    // return planet position and velocity for Modified Julian date mjd in ret
}

int MyPlanet::clbkFastEphemeris (double simt, int req, double *ret)
{
    // return interpolated planet position and velocity for simulation time simt in ret
}

```

*clbkEphemeris()* and *clbkFastEphemeris()* are the functions which will contain the actual ephemeris calculations for the planet at the requested time. *clbkEphemeris()* is only called by Orbiter if the planet's state at an arbitrary time is required (for example by an instrument calculating the position at some future time). When Orbiter updates the planet's position for the next simulation time frame, the *clbkFastEphemeris()* function will be called instead. This means that *clbkFastEphemeris()* will be called at each frame, each time advancing the time by a small amount. This can be used for a more efficient calculation. Instead of performing a full series evaluation, which can be lengthy, you may implement an interpolation scheme which performs the full calculation only occasionally, and interpolates between these samples to return the state at an intermediate time.

For both functions, the requested type of data is specified as a group of `EPHEM_xxx` bitflags in the `req` parameter. (see [CELBODY](#)) This can be any combination of position and velocity data for the celestial body itself and/or the barycentre of the system defined by the body and all its children (moons). The functions should calculate all required data, either in cartesian or polar coordinates, and fill the `ret` array with the results. `ret` contains 12 entries, used as follows:

`ret[0-2]`: true position

`ret[3-5]`: true velocity

`ret[6-8]`: barycentric position

`ret[9-11]`: barycentric velocity

Only the fields requested by `req` need to be filled. In cartesian coordinates, the position fields must contain the x, y and z coordinates in [m], and the velocity fields must contain the velocities  $dx/dt$ ,  $dy/dt$ ,  $dz/dt$  in [m/s]. In spherical polar coordinates, the position fields must contain longitude  $j$  [rad], latitude  $q$  [rad] and radial distance  $r$  [AU], and the velocity fields must contain the polar velocities  $dj/dt$  [rad/s],  $dq/dt$  [rad/s] and  $dr/dt$  [AU/s].

The functions should indicate the fields actually calculated via the return value. This is in particular important if not all requests could be satisfied (e.g. position and velocity was requested, but only position could be calculated). The return value is interpreted as a bitflag that can contain the same `EPHEM_xxx` flags as the `req` parameter. If all requests could be satisfied, it should be identical to `req`. In addition, the return value should contain additional flags indicating the properties of the returned data, including `EPHEM_POLAR` if the data are returned as spherical polar coordinates, or `EPHEM_TRUEISBARY` if the true and barycentric coordinates are identical (i.e. the celestial body does not have child bodies).

#### Note

The older standalone module callback functions (`opcXXX`) are obsolete and should no longer be used.

#### See also

[CELBODY](#)

## 3 Graphics Client Development

This page contains information for developers of plug-in graphics clients for the non-graphics version of Orbiter (Orbiter\_NG).

Graphics clients are DLL modules which contain the implementation of a client class derived from [oapi::GraphicsClient](#). They handle the device- specific aspects of rendering a 3-D window into the "orbiter world".

#### Contents:

- [Particle Streams HowTo](#)

## 4 Deleted and obsolete functions and methods

The following API function and class methods are no longer supported:

- [oapiGetStationByName\(\)](#)
- [oapiGetStationByIndex\(\)](#)
- [oapiGetStationCount\(\)](#)

## 5 Basics of orbital mechanics

This section of the manual contains a very brief summary of basic celestial mechanics. It is intended to clarify some of the concepts of various API functions in this reference document, but may also provide some useful general information for beginners.

### 5.1 Contents

[Elliptic orbits](#)  
[The orbit in space](#)  
[Kepler's equation](#)

### 5.2 Elliptic orbits

This page provides a summary of parameters for ideal 2-body orbital elements.

**Conic section:** The trajectory of an object under the influence of the gravitational field generated by a point mass follows a conic section. This may be either periodic (closed circular or elliptic orbit) or nonperiodic (open parabolic or hyperbolic orbit). The equation of a conic section with the focus in the origin is given in polar coordinates by

$$r = \frac{p}{1 + e \cos(\nu)}$$

with *eccentricity*  $e$  and *semi-latus rectum*  $p$ .

**Standard gravitational parameter:** In the following, the standard gravitational parameter is defined as the product of the gravitational constant  $G$  and the mass  $M$  of the central body at focus  $F$ :

$$\mu = GM$$

#### 5.2.1 Elliptic orbits

Elliptic (closed) orbits are characterised by an eccentricity  $e < 1$ . A special case are circular orbits ( $e = 0$ ).

**Semi-major axis (a):** The longest semi-diameter of the ellipse. The distance from the centre (C) through one of the foci (F) to the edge of the ellipse (A). The semi-major axis can be calculated from the parameters of the conic section as

$$a = \frac{p}{1 - e^2}$$

**Semi-minor axis (b):** The shortest semi-diameter of the ellipse. The distance from the centre (C) to the edge of the ellipse, at right angles to the major axis. The semi-minor axis can be calculated from the parameters of the conic section as

$$b = \frac{p}{\sqrt{1 - e^2}} = a\sqrt{1 - e^2}$$

**Periapsis:** The periapsis (A) (perigee for Earth orbits, perilune for lunar orbits) is the lowest point of the orbit, i.e. the point of the ellipse closest to focus F. The periapsis distance  $r_{pe} = FA$  is given by

$$r_{pe} = \frac{p}{1 + e} = (1 - e)a$$

**Apoapsis:** The apoapsis (B) (apogee for Earth orbits, apolune for lunar orbits) is the highest point of the orbit, i.e. the point of the ellipse farthest from focus F. The apoapsis distance  $r_{ap} = FB$  is given by

$$r_{ap} = \frac{p}{1 - e} = (1 + e)a$$

**True anomaly:** The true anomaly ( $\nu$ ) of an orbiting object (P) is the angle AFP between P and periapsis A, measured at F.

**Orbital period:** According to Kepler's third law, the square of the period  $T$  of an orbiting body is proportional to the cube of the semi-major axis  $a$  of the orbit.  $T$  is given by

$$T = 2\pi \sqrt{\frac{a^3}{\mu}}$$

**Orbital speed:** The orbital speed  $v$  as a function of radius  $r$  is given by

$$v = \sqrt{\mu \left( \frac{2}{r} - \frac{1}{a} \right)}$$

Maximum and minimum speed occur at periapsis and apoapsis, respectively:

$$v_{\text{pe}} = \sqrt{\frac{(1+e)\mu}{(1-e)a}}, \quad v_{\text{ap}} = \sqrt{\frac{(1-e)\mu}{(1+e)a}}$$

The mean orbital speed is given by

$$\bar{v} = \frac{2\pi a}{T} = \sqrt{\frac{\mu}{a}} = na$$

where the mean angular motion  $n$  is defined as

$$n = \frac{2\pi}{T}$$

**Specific orbital energy:** (or vis-viva energy)  $E$  is the sum of potential energy  $E_p$  and kinetic energy  $E_k$  of an orbiting body.  $E$  is constant along the orbit:

$$E = E_k + E_p = \frac{v^2}{2} - \frac{\mu}{r} = -\frac{1}{2} \frac{\mu^2}{h^2} (1 - e^2)$$

where  $h$  is the specific angular momentum of the orbiting body.

For specific types of orbit,  $E$  is given by

$$E = \begin{cases} -\frac{\mu}{2a} & \text{if } e < 1 \\ 0 & \text{if } e = 1 \\ \frac{\mu}{2a} & \text{if } e > 1 \end{cases}$$

### 5.3 The orbit in space

The orientation of the orbital trajectory in space, relative to the reference body, is defined by three parameters (in addition to the two parameters describing the shape):

- inclination
- longitude of ascending node
- longitude of periapsis

The position of the orbiting object along the orbit is defined by an additional parameter, the true longitude.

The orientation of an orbit in space is defined with respect to a frame of reference. For planetary orbits, the reference is usually given by the plane of the ecliptic and direction of the vernal equinox. For satellites in Earth orbit, the equatorial plane usually defines the reference plane.

**Inclination:** The *inclination*  $i$  defines the tilt of the orbital plane against the reference plane. The intersection of the orbital plane with the reference plane is denoted as the *line of nodes*.

**Ascending and descending node:** The line of nodes always passes through the orbit reference body (S). The *nodes*  $N_1$  and  $N_2$  are the points where the orbital trajectory intersects the reference plane. If the direction of orbit

is such that the orbiting body passes the plane of the ecliptic from south to north at  $N_1$ , then  $N_1$  is the *ascending node*, and  $N_2$  is the *descending node*.

**Longitude of ascending node:** The angle between the reference direction  $\Upsilon$  and node  $N_1$  is the *longitude of the ascending node* ( $\theta$ ).

**Argument of periapsis:** The angle between node  $N_1$  and periapsis A is the *argument of periapsis* ( $\omega$ ).

**Longitude of periapsis:** The sum  $\varpi = \theta + \omega$  is called the *longitude of periapsis*.

**True longitude:** The sum of longitude of periapsis and true anomaly,

$$L = \varpi + \nu = \theta + \omega + \nu$$

is called the *true longitude* of the orbiting body.

### 5.3.1 Mean longitude

Consider a vector originating in S and moving in the plane of the orbit with mean angular velocity  $n$ , passing through point A at time  $t_0$ .

**Mean anomaly:** At time  $t$ , the vector is located at *mean anomaly*  $M = n(t - t_0)$  relative to periapsis A.

**Mean longitude:** The *mean longitude* of the orbiting body is the sum of mean anomaly and longitude of periapsis:

$$l = \theta + \omega + n(t - t_0) = \varpi + n(t - t_0)$$

The *mean longitude at the epoch* is defined as the mean longitude at  $t=0$ , given by

$$\varepsilon = \varpi - nt_0$$

The mean longitude can then be written as

$$l = nt + \varepsilon.$$

The mean anomaly is given by

$$M = n(t - t_0) = l - \varpi = nt + \varepsilon - \varpi$$

## 5.4 Kepler's equation

### 5.4.1 True and eccentric anomaly

To find the position P of an orbiting body at some time  $t$ , we need to find its true anomaly  $\nu$  at that time. Calculating true anomaly is not trivial for eccentric orbits, because the velocity of the orbiting body is continually changing.

**Eccentric anomaly:** Define a circle with radius  $a$  (semi-major axis of the orbit ellipse) whose centre coincides with the centre of the ellipse. Project object position P perpendicular to the semi-major axis onto the circle (Q). Then the *eccentric anomaly*  $E$  is defined as the angle ACQ between periapsis A and Q, measured at the centre C of the circle.

The relationship between orbit radius  $r$  and eccentric anomaly  $E$  is given by

$$r = a(1 - e \cos E)$$

The relationship between true anomaly  $\nu$  and  $E$  is given by

$$\tan \frac{\nu}{2} = \sqrt{\frac{1+e}{1-e}} \tan \frac{E}{2}$$

With these equations, position P can be calculated when eccentric anomaly  $E$  is known.  $E$  is calculated for a given time  $t$  by solving *Kepler's equation*.

### 5.4.2 Kepler's equation

Consider a vector rotating around C at constant angular velocity  $n$ , given by the orbiter's mean motion. If the vector passes A at time  $t_0$ , then its angle with A at time  $t$  is given by

$$M(t) = n(t - t_0)$$

$M$  is called the *mean anomaly*. Kepler's equation defines a relation between mean anomaly  $M$  and eccentric anomaly  $E$ :

$$E(t) - e \sin E(t) = M(t) = n(t - t_0)$$

It cannot be solved for  $E$  in closed form, and must generally be solved iteratively.

## 6 Particle Streams HowTo

Particle streams are a component of Orbiter graphics clients (see [Graphics Client Development](#)).

Particle streams can be used to create visual effects for contrails, exhaust and plasma streams, reentry heating, condensation, etc.

The management of particle streams is almost entirely the responsibility of the graphics client. The orbiter core notifies the client only

- to request a new particle stream for a vessel object
- to detach a stream from its object (e.g. if the object is deleted)

The implementation details for the particle streams, including render options, are left to the client.

### 6.1 Adding particle stream support

To add particle stream support to a graphics client, the following steps are required:

- Create one or more classes derived from [oapi::ParticleStream](#)
- Overload the particle stream-related callback methods of [oapi::GraphicsClient](#), including
  - [oapi::GraphicsClient::clbkCreateParticleStream\(\)](#)
  - [oapi::GraphicsClient::clbkCreateExhaustStream\(\)](#)
  - [oapi::GraphicsClient::clbkCreateReentryStream\(\)](#)

By default, these methods return NULL pointers, i.e. don't provide particle stream support. Your overloaded methods should create an instance of an appropriate derived particle stream class and return a pointer to it.

**Important:** The client must keep track of all particle streams created. In particular, the orbiter core never deletes any particle streams it has obtained from the client. Particle stream management and cleanup must be provided by the client.

### 6.2 Attaching and detaching streams

Once a particle stream has been created, it must be connected to a vessel instance (provided by the `hVessel` parameter in each of the particle stream-related callback functions of the graphics client). To connect the particle stream to the vessel, use one of the [oapi::ParticleStream::Attach\(\)](#) methods using the provided vessel handle. The particle emission point and emission direction are relative to the associated vessel.

Sometimes Orbiter will call the [oapi::ParticleStream::Detach\(\)](#) method for a stream. This is usually in response to deletion of the vessel. Therefore, the stream should no longer make use of the vessel reference after it has been detached. In particular, no new particles should be generated.

**Important:** After Orbiter has detached a particle stream, it will no longer access it. The client is free to delete the particle stream instance once it has been detached. Generally, the stream should be deleted after all the remaining particles in the stream have expired.

## 6.3 Deleting streams

Generally, streams should only be deleted after they have been detached and after all remaining particles have expired. Deleting a stream with active particles will create a visual inconsistency and should be avoided. The only exception is the cleanup at the end of a simulation session.

When a stream is deleted while still attached to its object, Orbiter will call the stream's `Detach` method during the destruction process.

# 7 Vessel module concepts

## 7.1 Docking port management

Docking ports allow individual vessel objects to connect with each other, forming a superstructure. Orbiter automatically calculates the physical properties of the superstructure from the properties of the individual constituents. In particular, the following properties are managed by Orbiter:

- total mass: The mass of the superstructure is the sum of masses of the individual vessels
- centre of mass. The centre of mass of the superstructure is calculated from the individual vessel masses and their relative position
- inertia tensor: A simplified rigid-body model is applied to calculate an inertia tensor for the superstructure.
- effects of forces: any forces acting on individual vessels (thrust, drag, lift, etc.) are transformed into the superstructure frame and applied.

The superstructure model allows to apply the effect of forces calculated for individual vessels onto the superstructure. For example, a thrust force that acts along the centre of gravity of an individual vessel may induce a torque on the superstructure, depending on the relative position of the vessel with respect to the superstructure centre of mass.

Currently, superstructures are only supported in free flight, *not* when landed on a planetary surface. The reason is the difficulty of calculating the interaction of the composite structure with the surface. This may be addressed in the future.

## 7.2 Attachment management

Similar to docking ports, attachment points allow to connect two or more vessel objects. There are a few important differences:

- Docking ports establish peer connections, attachments establish parent-child hierarchies: A parent vessel can have multiple attached children, but each child can only be attached to a single parent.
- Attachments use a simplified physics engine: the root parent alone defines the object's trajectory (both for freespace and atmospheric flight). The children are assumed to have no influence on flight behaviour.
- Orbiter establishes docking connections automatically if the docking ports of two vessels are brought close to each other. Attachment connections are only established by API calls.
- Currently, docking connections only work in freeflight. Attachments also work for landed vessels.

Attachment connections are useful for attaching small objects to larger vessels. For example, Orbiter uses attachments to connect payload items to the Space Shuttle's cargo bay or the tip of the RMS manipulator arm (see Orbiter\SDK\samples\Atlantis).

Attachment points use an identifier string (up to 8 characters) which can provide a method to establish compatibility. For example, the Atlantis RMS arm tip will only connect to attachment points with an id string that contains "GS" in the first 2 characters (it ignores the last 6 characters). Now let's assume somebody creates another Shuttle (say a Buran) with its own RMS arm. He could then allow it to

- grapple exactly the same objects as Atlantis, by checking for "GS".
- grapple a subset of objects grappable by Atlantis, by checking additional characters, for example "GSX".
- grapple all objects grappable by Atlantis, plus additional objects, for example by checking for "GS" or "GX".
- grapple entirely different objects, for example by checking for "GX".

To connect a satellite into the payload bay, Atlantis uses the id "XS" (This means that the payload bay connection can not be used for grapping. To allow a satellite to be grappled and stored in the payload bay, it must define both a "GS" and an "XS" attachment point).

## 8 Orbiter program flow and module callback order

This section defines the program flow of the Orbiter frame loop and the order in which module callback functions are called by Orbiter.

### 8.1 Contents

[The frame update loop and vessel module callback functions](#)  
[progflow2](#)  
[progflow3](#)

### 8.2 The frame update loop and vessel module callback functions

#### 8.2.1 Frame update diagram

The program flow diagram below illustrates the events in the Orbiter frame update loop and the calling order of [VESSEL2](#) callback functions. The `clbkPreStep` and `clbkPostStep` methods are called for every vessel at each frame update. Other callback functions are only called when the associated event has occurred. Some callback functions such as `clbkPanelRedrawEvent` may be called multiple times for a vessel in a single frame.

See also

[VESSEL2::clbkSetClassCaps](#), [VESSEL2::clbkLoadStateEx](#), [VESSEL2::clbkPostCreation](#), [VESSEL2::clbkPreStep](#), [VESSEL2::clbkPostStep](#), [VESSEL2::clbkVisualCreated](#), [VESSEL2::clbkVisualDestroyed](#), [VESSEL3::clbkDrawHUD](#), [VESSEL3::clbkRenderHUD](#), [VESSEL2::clbkRCSMode](#), [VESSEL2::clbkADCtrlMode](#), [VESSEL2::clbkHudMode](#), [VESSEL2::clbkMFDMode](#), [VESSEL2::clbkLoadGenericCockpit](#), [VESSEL3::clbkLoadPanel2D](#), [VESSEL3::clbkPanelMouseEvent](#), [VESSEL3::clbkPanelRedrawEvent](#), [VESSEL2::clbkLoadVC](#), [VESSEL2::clbkVCMouseEvent](#), [VESSEL2::clbkVCRewdrawEvent](#), [VESSEL2::clbkConsumeDirectKey](#), [VESSEL2::clbkConsumeBufferedKey](#), [VESSEL2::clbkSaveState](#)

#### 8.3 `progflow2`

#### 8.4 `progflow3`

## 9 Todo List

### Member [oapi::GraphicsClient::clbkGetSurfaceDC \(SURFHANDLE surf\)](#)

This method should be moved into the GDIClient class

### Member [oapi::GraphicsClient::clbkReleaseSurfaceDC \(SURFHANDLE surf, HDC hDC\)](#)

This method should be moved into the GDIClient class

### File [OrbiterAPI.h](#)

Check functions in [VESSELSTATUS2::arot](#) and [oapiGetPlanetObliquityMatrix\(\)](#), minus sign has changed a place in a matrix. Is this correct??

class CameraMode documentation

## 10 Deprecated List

### Member [MFD::SelectDefaultFont \(HDC hDC, DWORD i\) const](#)

This method is deprecated. MFD implementations should derive from [MFD2](#) and use the device-independent [MFD2::GetDefaultFont](#) method instead.

### Member [MFD::SelectDefaultPen \(HDC hDC, DWORD i\) const](#)

This method is deprecated. MFD implementations should derive from [MFD2](#) and use the device-independent [MFD2::GetDefaultPen](#) method instead.

### Member [MFD::Title \(HDC hDC, const char \\*title\) const](#)

This method is deprecated. MFD implementations should derive from [MFD2](#) and use the device-independent [MFD2::Title](#) method instead.

### Member [MFD::Update \(HDC hDC\)=0](#)

This method is deprecated. MFD implementations should derive from [MFD2](#) and use the device-independent [MFD2::Update\(oapi::Sketchpad\\*\)](#) method instead.

### globalScope> Member [oapiCreateSurface \(int width, int height\)](#)

This function has been superseded by [oapiCreateSurfaceEx](#)

#### Parameters

<i>width</i>	width of surface bitmap (pixels)
<i>height</i>	height of surface bitmap (pixels)

#### Returns

Handle to the new surface.

#### Note

The bitmap contents are undefined after creation, so the surface must be repainted fully before mapping it to the screen.

The surface is created with the OAPISURFACE\_RENDERTARGET, OAPISURFACE\_GDI and OAPISURFACE\_SKETCHPAD attributes (see [Surface and texture attributes](#)). For more control over the surface attributes, e.g. if you want to use the surface as a texture, use [oapiCreateSurfaceEx](#) instead.

Surfaces should be destroyed by calling [oapiDestroySurface](#) when they are no longer needed.

#### See also

[oapiCreateSurfaceEx](#), [oapiDestroySurface](#)

### globalScope> Member [oapiCreateTextureSurface \(int width, int height\)](#)

This function has been superseded by [oapiCreateSurfaceEx](#)

## Parameters

<i>width</i>	width of surface bitmap (pixels)
<i>height</i>	height of surface bitmap (pixels)

## Returns

handle of new texture surface

## Note

Use this function instead of oapiCreateSurface if you want the surface to be used as a surface texture for a 3-D object, for example via a call to oapiSetTexture.

This is equivalent to calling oapiCreateSurfaceEx with the OAPISURFACE\_TEXTURE attribute.

For maximum compatibility, the surface should be square, and dimensions powers of 2, for example 64x64, 128x128, 256x256, etc. Note that older video cards may not support textures larger than 256x256.

Surfaces should be destroyed by calling oapiDestroySurface when they are no longer needed.

**globalScope > Member [oapiGetAirspeedVector \(OBJHANDLE hVessel, VECTOR3 \\*speedvec\)](#)**

This method has been replaced by [oapiGetAirspeedVector\(OBJHANDLE, REFFRAME, VECTOR3\\*\)](#)

**globalScope > Member [oapiGetAtmPressureDensity \(OBJHANDLE hVessel, double \\*pressure, double \\*density\)](#)**

This function has been replaced by oapiGetAtm.

**globalScope > Member [oapiGetFocusAirspeed \(double \\*airspeed\)](#)**

This method has been replaced by [oapiGetAirspeed\(\)](#)

**globalScope > Member [oapiGetFocusAirspeedVector \(VECTOR3 \\*speedvec\)](#)**

This method has been replaced by [oapiGetAirspeedVector\(OBJHANDLE, REFFRAME, VECTOR3\\*\)](#)

**globalScope > Member [oapiGetFocusAtmPressureDensity \(double \\*pressure, double \\*density\)](#)**

This function has been replaced by oapiGetAtm.

**globalScope > Member [oapiGetFocusShipAirspeedVector \(VECTOR3 \\*speedvec\)](#)**

This method has been replaced by [oapiGetAirspeedVector\(OBJHANDLE, REFFRAME, VECTOR3\\*\)](#)

**globalScope > Member [oapiGetMFDModeSpec \(char \\*name, MFDMODESPEC \\*\\*spec=0\)](#)**

This function has been replaced by [oapiGetMFDModeSpecEx](#)

## See also

[oapiGetMFDModeSpecEx](#)

**globalScope > Member [oapiGetShipAirspeedVector \(OBJHANDLE hVessel, VECTOR3 \\*speedvec\)](#)**

This method has been replaced by [oapiGetAirspeedVector\(OBJHANDLE, REFFRAME, VECTOR3\\*\)](#)

**globalScope > Member [oapiGetStationByIndex \(int index\)](#)**

Stations are no longer distinguished from vessels. This function does not perform any action other than writing a warning to the log file. Use [oapiGetVesselByIndex](#) instead.

**globalScope > Member [oapiGetStationByName \(char \\*name\)](#)**

Stations are no longer distinguished from vessels. This function does not perform any action other than writing a warning to the log file. Use [oapiGetVesselByName](#) instead.

**globalScope > Member [oapiGetStationCount \(\)](#)**

Stations are no longer distinguished from vessels. This function always returns 0. Use [oapiGetVesselCount](#) instead.

**globalScope > Member [oapiRegisterMFDMode \(MFDMODESPEC &spec\)](#)**

This function has been replaced by [oapiRegisterMFDMode\(MFDMODESPEC&\)](#).

See also

[oapiRegisterMFDMODE\(MFDMODESPECEx&\)](#)

**globalScope > Member [oapiTriggerPanelRedrawArea \(int panel\\_id, int area\\_id\)](#)**

This function is unsafe because it can be used by vessels who don't own the current cockpit visuals. Use [VE->SSEL::TriggerPanelRedrawArea](#) instead.

**globalScope > Member [oapiTriggerRedrawArea \(int panel\\_id, int vc\\_id, int area\\_id\)](#)**

This function is unsafe because it can be used by vessels who don't own the current cockpit visuals. Use [VE->SSEL::TriggerRedrawArea](#) instead.

**globalScope > Member [opcCloseRenderViewport \(\)](#)**

This function has been replaced by [oapi::Module::clbkSimulationEnd](#).

**Note**

Plugins should no longer implement this function. Instead they should create an instance of a class derived from [oapi::Module](#) during [InitModule](#) that overloads the [oapi::Module::clbkSimulationEnd](#) method, and register it with [oapiRegisterModule](#).

[opcCloseRenderViewport](#) is called by Orbiter only if no instance of [oapi::Module](#) is created and registered during [InitModule](#), or if a registered module does not overload the [oapi::Module::clbkSimulationEnd](#) method.

**globalScope > Member [opcDeleteVessel \(OBJHANDLE hVessel\)](#)**

This function has been replaced by [oapi::Module::clbkDeleteVessel](#).

**Parameters**

<i>hVessel</i>	object handle for the vessel being destroyed.
----------------	---

**Note**

Plugins should no longer implement this function. Instead they should create an instance of a class derived from [oapi::Module](#) during [InitModule](#) that overloads the [oapi::Module::clbkDeleteVessel](#) method, and register it with [oapiRegisterModule](#).

[opcDeleteVessel](#) is called by Orbiter only if no instance of [oapi::Module](#) is created and registered during [InitModule](#), or if a registered module does not overload the [oapi::Module::clbkDeleteVessel](#) method.

**globalScope > Member [opcFocusChanged \(OBJHANDLE hGainsFocus, OBJHANDLE hLosesFocus\)](#)**

This function has been replaced by [oapi::Module::clbkFocusChanged](#).

**Parameters**

<i>hGainsFocus</i>	handle of vessel receiving the input focus
<i>hLosesFocus</i>	handle of vessel losing focus

**Note**

Plugins should no longer implement this function. Instead they should create an instance of a class derived from [oapi::Module](#) during [InitModule](#) that overloads the [oapi::Module::clbkFocusChanged](#) method, and register it with [oapiRegisterModule](#).

[opcFocusChanged](#) is called by Orbiter only if no instance of [oapi::Module](#) is created and registered during [InitModule](#), or if a registered module does not overload the [oapi::Module::clbkFocusChanged](#) method.

**globalScope > Member [opcOpenRenderViewport \(HWND hRenderWindow, DWORD width, DWORD height, B->OOL fullscreen\)](#)**

This function has been replaced by [oapi::Module::clbkSimulationStart](#).

**Parameters**

<i>hRenderWindow</i>	render window handle
<i>width</i>	viewport width [pixel]
<i>height</i>	viewport height [pixel]
<i>fullscreen</i>	flag for fullscreen mode

**Note**

Plugins should no longer implement this function. Instead they should create an instance of a class derived from [oapi::Module](#) during [InitModule](#) that overloads the [oapi::Module::clbkSimulationStart](#) method, and register it with [oapiRegisterModule](#).

[opcOpenRenderViewport](#) is called by Orbiter only if no instance of [oapi::Module](#) is created and registered during [InitModule](#), or if a registered module does not overload the [oapi::Module::clbkSimulationStart](#) method.

**globalScope > Member [opcPause](#) (bool pause)**

This function has been replaced by [oapi::Module::clbkPause](#).

**Parameters**

<i>pause</i>	pause/resume state: true if simulation has been paused, false if simulation has been resumed.
--------------	---

**Note**

Plugins should no longer implement this function. Instead they should create an instance of a class derived from [oapi::Module](#) during [InitModule](#) that overloads the [oapi::Module::clbkPause](#) method, and register it with [oapiRegisterModule](#).

[opcPause](#) is called by Orbiter only if no instance of [oapi::Module](#) is created and registered during [InitModule](#), or if a registered module does not overload the [oapi::Module::clbkPause](#) method.

**globalScope > Member [opcPostStep](#) (double simt, double simdt, double mjd)**

This function has been replaced by [oapi::Module::clbkPostStep](#).

**Parameters**

<i>simt</i>	current simulation time [s]
<i>simdt</i>	length of the last time step [s]
<i>mjd</i>	simulation time in Modified Julian Date format [days]

**Note**

Plugins should no longer implement this function. Instead they should create an instance of a class derived from [oapi::Module](#) during [InitModule](#) that overloads the [oapi::Module::clbkPostStep](#) method, and register it with [oapiRegisterModule](#).

[opcPostStep](#) is called by Orbiter only if no instance of [oapi::Module](#) is created and registered during [InitModule](#), or if a registered module does not overload the [oapi::Module::clbkPostStep](#) method.

**globalScope > Member [opcPreStep](#) (double simt, double simdt, double mjd)**

This function has been replaced by [oapi::Module::clbkPreStep](#).

**Parameters**

<i>simt</i>	simulation time after the currently processed step [s]
<i>simdt</i>	length of the currently processed step [s]
<i>mjd</i>	simulation time after the currently processed step in Modified Julian Date format [days]

**Note**

Plugins should no longer implement this function. Instead they should create an instance of a class derived from [oapi::Module](#) during [InitModule](#) that overloads the [oapi::Module::clbkPreStep](#) method, and register it with [oapiRegisterModule](#).

[opcPreStep](#) is called by Orbiter only if no instance of [oapi::Module](#) is created and registered during [InitModule](#), or if a registered module does not overload the [oapi::Module::clbkPreStep](#) method.

**globalScope**> **Member** [opcTimeAccChanged \(double new\\_warp, double old\\_warp\)](#)

This function has been replaced by [oapi::Module::clbkTimeAccChanged](#).

#### Parameters

<i>new_warp</i>	new time acceleration factor
<i>old_warp</i>	old time acceleration factor

#### Note

Plugins should no longer implement this function. Instead they should create an instance of a class derived from [oapi::Module](#) during [InitModule](#) that overloads the [oapi::Module::clbkTimeAccChanged](#) method, and register it with [oapiRegisterModule](#).

[opcTimeAccChanged](#) is called by Orbiter only if no instance of [oapi::Module](#) is created and registered during [InitModule](#), or if a registered module does not overload the [oapi::Module::clbkTimeAccChanged](#) method.

#### Member [VESSEL2::clbkDrawHUD](#) (int mode, const [HUDPAINTSPEC](#) \*hps, [HDC](#) hDC)

This method contains a device-dependent drawing context and may not work with all graphics clients. It has been superseded by [VESSEL3::clbkDrawHUD](#).

#### Note

For vessels derived from [VESSEL3](#) orbiter will not call this method, but will call the [VESSEL3::clbkDrawHUD](#) method instead. The [VESSEL3](#) version uses a generic *Sketchpad* drawing context instead of a [HDC](#).

#### See also

[VESSEL3::clbkDrawHUD](#), [The frame update loop and vessel module callback functions](#)

#### Member [VESSEL3::RegisterPanelArea](#) (PANELHANDLE hPanel, int id, const [RECT](#) &pos, const [RECT](#) &texpos, int draw\_event, int mouse\_event, int bemode)

This method has been superseded by [VESSEL4::RegisterPanelArea](#).

#### Parameters

<i>hPanel</i>	panel handle
<i>id</i>	area identifier
<i>pos</i>	area boundary coordinates (mesh coordinates)
<i>texpos</i>	area boundary (texture coordinates)
<i>draw_event</i>	event flags for redraw event triggers (see <a href="#">Panel redraw event identifiers</a> )
<i>mouse_event</i>	event flags for mouse event triggers (see <a href="#">Mouse event identifiers</a> )
<i>bemode</i>	flag for texture background provided to redraw callback function (see <a href="#">Panel area texture mapping identifiers</a> )

#### Returns

Always returns 0.

#### Note

This method activates a rectangular area of the panel for receiving mouse and redraw events. *pos* specifies the borders of the area in 'logical' coordinates (0,0,width,height) as specified by [SetPanelBackground](#). Registered mouse events within this area will trigger a call to [VESSEL2::clbkPanelMouseEvent](#).

If the area needs to be able to update the panel texture, it should pass an appropriate redraw flag in *draw\_event*, and specify the texture coordinates of the redraw area in *texpos*.

If the panel contains multiple background textures, only the first texture can be redrawn with this function. To redraw other textures in the background texture array, use [VESSEL4::RegisterPanelArea](#) instead.

For backward compatibility, this method automatically adds the [PANEL\\_REDRAW\\_GDI](#) and [PANEL\\_REDRAW\\_SKETCHPAD](#) flags to *draw\_event*. If GDI and/or Sketchpad access to the area drawing surface is not required, using [VESSEL4::RegisterPanelArea](#) can improve graphics performance.

See also

[VESSEL4::RegisterPanelArea](#)

**Member [VESSEL::ClearMeshes \(\) const](#)**

This version is obsolete and has been replaced by [VESSEL::ClearMeshes\(bool\)const](#).

Note

Equivalent to [ClearMeshes\(true\)](#). This method is only retained for backward compatibility, and may be removed in future versions.

See also

[ClearMeshes\(bool\)const](#)

**Member [VESSEL::Create \(const char \\*name, const char \\*classname, const VESSELSTATUS &status\) const](#)**

This method has been replaced with [oapiCreateVessel](#) and [oapiCreateVesselEx](#).

**Member [VESSEL::CreateVariableDragElement \(double \\*drag, double factor, const VECTOR3 &ref\) const](#)**

This method has been replaced with [CreateVariableDragElement\(const double\\*,double,const VECTOR3&\)](#)const.

**Member [VESSEL::DelThrusterGroup \(THGROUP\\_HANDLE &thg, THGROUP\\_TYPE thgt, bool delth=false\) const](#)**

This method has been replaced by [VESSEL::DelThrusterGroup\(THGROUP\\_HANDLE,bool\)const](#).

Parameters

<i>thg</i>	thruster group handle (NULL on return)
<i>thgt</i>	thruster group type (see <a href="#">Thruster and thruster-group parameters</a> )
<i>delth</i>	thruster destruction flag (see notes)

Returns

*true* on success.

Note

If *delth==true*, all thrusters associated with the group will be destroyed. Note that this can have side effects if the thrusters were associated with multiple groups, since they are removed from all those groups as well.

See also

[DelThrusterGroup\(THGROUP\\_TYPE,bool\)const](#), [CreateThrusterGroup](#), [DelThruster](#), [Thruster](#) and [thruster-group parameters](#)

**Member [VESSEL::GetBankMomentScale \(\) const](#)**

This method has been replaced by [VESSEL::GetYawMomentScale](#).

Returns

yaw moment scale factor

Note

The method is misnamed. It refers to the vessel's yaw moment.

See also

[GetYawMomentScale](#)

**Member [VESSEL::GetHorizonAirspeedVector \(VECTOR3 &v\) const](#)**

This method has been replaced by [VESSEL::GetAirspeedVector](#)

**Member [VESSEL::GetNavRecv \(DWORD n\) const](#)**

This method has been replaced by [VESSEL::GetNavChannel](#)

## Parameters

<i>n</i>	receiver index ( $\geq 0$ )
----------	-----------------------------

## Returns

Receiver channel [0..639]. If index *n* is out of range, the return value is 0.

**Member `VESSEL::GetShipAirspeedVector (VECTOR3 &v) const`**

This method has been replaced by `VESSEL::GetAirspeedVector`

**Member `VESSEL::GetTouchdownPoints (VECTOR3 &pt1, VECTOR3 &pt2, VECTOR3 &pt3) const`**

This method has been replaced by `VESSEL::GetTouchdownPoint(TOUCHDOWNVTX&,DWORD)const`

## Parameters

<i>pt1</i>	touchdown point of nose wheel (or equivalent)
<i>pt2</i>	touchdown point of left main wheel (or equivalent)
<i>pt3</i>	touchdown point of right main wheel (or equivalent)

## Note

The function returns 3 reference points defining the vessel's surface contact points when touched down on a planetary surface (e.g. landing gear).

This function is superseded by `GetTouchdownPoint(TOUCHDOWNVTX&,DWORD)const`, which provides access to additional parameters and can be used for touchdown points  $\geq 3$ .

## See also

[GetTouchdownPoint](#), [SetTouchdownPoints](#), [GetCOG\\_elev](#)

**Member `VESSEL::IncEngineLevel (ENGINETYPE eng, double dlevel) const`**

This method has been replaced by `VESSEL::IncThrusterGroupLevel`.

## Parameters

<i>eng</i>	engine group identifier
<i>dlevel</i>	thrust increment

## Note

Use negative *dlevel* to decrease the engine's thrust level.

Levels are clipped to valid range.

## See also

[IncThrusterGroupLevel](#), [SetEngineLevel](#)

**Member `VESSEL::ParseScenarioLine (char *line, VESSELSTATUS *status) const`**

This function is retained for backward compatibility only. New modules should overload the `VESSEL2::clbkLoadStateEx` function and use `VESSEL::ParseScenarioLineEx` for default state parsing.

## Parameters

<i>line</i>	line to be interpreted
<i>status</i>	state parameter set

## See also

[ParseScenarioLineEx](#), [VESSELSTATUS](#)

**Member `VESSEL::SaveDefaultState (FILEHANDLE scn) const`**

Use a call to the base class `VESSEL2::clbkSaveState` from within the overloaded callback function instead.

## Parameters

<i>scn</i>	scenario file handle
------------	----------------------

## Note

This method saves the vessel's default state parameters (such as position, velocity, orientation, etc.) to a scenario file.

This functionality is now included in the default implementation of [VESSEL2::clbkSaveState](#). Therefore, vessel classes which overload this method to save custom vessel parameters should call the base class method to allow Orbiter to save the default vessel parameters.

## See also

[VESSEL2::clbkSaveState](#)

**Member [VESSEL::SetBankMomentScale \(double scale\) const](#)**

This method has been replaced by [VESSEL::SetYawMomentScale](#).

## Parameters

<i>scale</i>	scale factor for slip angle moment.
--------------	-------------------------------------

## Note

The method is misnamed. It refers to the vessel's yaw moment.

## See also

[SetYawMomentScale](#)

**Member [VESSEL::SetCOG\\_elev \(double h\) const](#)**

This method is obsolete and should no longer be used. It has been replaced by [VESSEL::SetTouchdownPoints](#).

**Member [VESSEL::SetEngineLevel \(ENGINETYPE eng, double level\) const](#)**

This method has been replaced by [VESSEL::SetThrusterGroupLevel](#).

## Parameters

<i>eng</i>	engine group identifier
<i>level</i>	thrust level [0..1]

## See also

[SetThrusterGroupLevel](#), [IncEngineLevel](#)

**Member [VESSEL::SetExhaustScales \(EXHAUSTTYPE exh, WORD id, double lscale, double wscale\) const](#)**

This method no longer performs any action. It has been replaced by the [VESSEL::AddExhaust](#) methods.

## See also

[AddExhaust\(THRUSTER\\_HANDLE,double,double,SURFHANDLE\)const](#), [AddExhaust\(THRUSTER\\_HANDLE,double,double,SURFHANDLE\)const](#), [AddExhaust\(THRUSTER\\_HANDLE,double,double,const VECTOR3&,const VECTOR3&,SURFHANDLE\)const](#)

**Member [VESSEL::SetMeshVisibleInternal \(UINT idx, bool visible\) const](#)**

This method is obsolete and has been replaced by [VESSEL::SetMeshVisibilityMode](#).

## Note

By default, a vessel is not rendered when the camera is in internal (cockpit) view. This function can be used to force rendering of some or all of the vessel's meshes.

## See also

[SetMeshVisibilityMode](#)

**Member [VESSEL::SetNavRecv \(DWORD n, DWORD ch\) const](#)**

This method has been replaced by [VESSEL::SetNavChannel](#)

**Parameters**

<i>n</i>	receiver index ( $\geq 0$ )
<i>ch</i>	channel ( $\geq 0$ )

**Returns**

*false* on error (index out of range), *true* otherwise

**Member `VESSEL::SetTouchdownPoints (const VECTOR3 &pt1, const VECTOR3 &pt2, const VECTOR3 &pt3) const`**

This method has been replaced by `VESSEL::SetTouchdownPoints(const TOUCHDOWNVTX*,DWORD)const`

**Parameters**

<i>pt1</i>	touchdown point of nose wheel (or equivalent)
<i>pt2</i>	touchdown point of left main wheel (or equivalent)
<i>pt3</i>	touchdown point of right main wheel (or equivalent)

**Note**

The points are the positions at which the vessel's undercarriage (or equivalent) touches the surface, specified in local vessel coordinates.

The order of points is significant since it defines the direction of the normal. The points should be specified such that the cross product  $pt3-pt1 \times pt2-pt1$  defines the horizon "up" direction for the landed vessel (given a left-handed coordinate system).

Modifying the touchdown points during the simulation while the vessel is on the ground can result in jumps due to instantaneous position changes (infinite acceleration). To avoid this, the touchdown points should be modified gradually by small amounts over time (proportional to simulation time steps).

This method is retained only for backward compatibility. Vessels should now use `SetTouchdownPoints(const TOUCHDOWNVTX*,DWORD)const` to define a convex hull of touchdown points.

The touchdown stiffness and damping parameters are guessed according to the vessel empty mass. Therefore, `SetTouchdownPoints` should be called *after* defining the empty vessel mass with `SetEmptyMass`.

**See also**

[GetTouchdownPoints](#), [GetCOG\\_elev](#), `SetTouchdownPoints(const TOUCHDOWNVTX*, DWORD)const`  
[SetEmptyMass](#)

## 11 Bug List

**Member `MFD::ButtonLabel (int bt)`**

This function should really return a `const char*`

**Member `VESSEL::AddAnimationComponent (UINT anim, double state0, double state1, MGROUP_TRANSFORM *trans, ANIMATIONCOMPONENT_HANDLE parent=NULL) const`**

When defining a scaling transformation as a child of a parent rotation, only homogeneous scaling is supported, i.e.  $scale.x = scale.y = scale.z$  is required.

**See also**

[CreateAnimation](#), [DelAnimationComponent](#), [Animation flags](#)

## 12 Module Index

### 12.1 Modules

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## 13 Hierarchical Index

### 13.1 Class Hierarchy

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## 14 Class Index

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## 15 File Index

### 15.1 File List

Here is a list of all documented files with brief descriptions:

<b>Orbitersdk/include/CelBodyAPI.h</b>	Contains interface classes for celestial bodies: <b>CELBODY</b> and <b>CELBODY2</b>	588
<b>Orbitersdk/include/DrawAPI.h</b>	2-D surface drawing support interface	589
<b>Orbitersdk/include/MFDAPI.h</b>	Class interfaces for <b>MFD</b> instruments and <b>MFD</b> modes	590
<b>Orbitersdk/include/OrbiterAPI.h</b>	General API interface functions	591
<b>Orbitersdk/include/VesselAPI.h</b>	Contains the class interfaces for vessel objects ( <b>VESSEL</b> , <b>VESSEL2</b> , <b>VESSEL3</b> )	629

## 16 Module Documentation

### 16.1 Ephemeris data format bitflags

#### Macros

- `#define EPHEM_TRUEPOS 0x01`  
*true body position*
- `#define EPHEM_TRUEVEL 0x02`  
*true body velocity*
- `#define EPHEM_BARYPOS 0x04`  
*barycentric position*
- `#define EPHEM_BARYVEL 0x08`  
*barycentric velocity*
- `#define EPHEM_BARYISTRUE 0x10`  
*body has no child objects*
- `#define EPHEM_PARENTBARY 0x20`  
*ephemerides are computed in terms of the barycentre of the parent body's system*
- `#define EPHEM_POLAR 0x40`  
*data is returned in polar format*

#### 16.1.1 Detailed Description

Ephemeris data format bitflags

## 16.2 Configuration parameter identifiers

### Macros

- `#define CFGPRM_SURFACEMAXLEVEL 0x0001`
- `#define CFGPRM_SURFACEREFLECT 0x0002`
- `#define CFGPRM_SURFACERIPPLE 0x0003`
- `#define CFGPRM_SURFACELIGHTS 0x0004`
- `#define CFGPRM_SURFACELIGHTBRT 0x0006`
- `#define CFGPRM_ATMHAZE 0x0007`
- `#define CFGPRM_ATMFOG 0x0008`
- `#define CFGPRM_CLOUDS 0x0009`
- `#define CFGPRM_CLOUDSHADOWS 0x000A`
- `#define CFGPRM_PLANETARIUMFLAG 0x000B`
- `#define CFGPRM_STARRENDERPRM 0x000C`
- `#define CFGPRM_AMBIENTLEVEL 0x000E`
- `#define CFGPRM_VESSELSHADOWS 0x000F`
- `#define CFGPRM_OBJECTSHADOWS 0x0010`
- `#define CFGPRM_OBJECTSPECULAR 0x0011`
- `#define CFGPRM_CSHERETEXTURE 0x0013`
- `#define CFGPRM_CSHEREINTENS 0x0014`
- `#define CFGPRM_LOCALLIGHT 0x0015`
- `#define CFGPRM_MAXLIGHT 0x0016`
- `#define CFGPRM_RESOLUTIONBIAS 0x0017`
- `#define CFGPRM_WIREFRAME 0x0018`
- `#define CFGPRM_ELEVATIONMODE 0x0019`
- `#define CFGPRM_PANELMFDHUDSIZE 0x001A`
- `#define CFGPRM_TILEPATCHRES 0x001B`
- `#define CFGPRM_TILELOADFLAGS 0x001C`

### 16.2.1 Detailed Description

Used by `GraphicsClient::GetConfigParam()`

### 16.2.2 Macro Definition Documentation

#### 16.2.2.1 `#define CFGPRM_AMBIENTLEVEL 0x000E`

Ambient light level (brightness of unlit nonemissive surfaces) in the range 0-255.

Parameter type:

DWORD

#### 16.2.2.2 `#define CFGPRM_ATMFOG 0x0008`

Flag for rendering distance fog within planetary atmospheres

Parameter type:

bool

16.2.2.3 `#define CFGPRM_ATMHAZE 0x0007`

Flag for rendering "atmospheric haze" over planets with atmospheres

Parameter type:

bool

16.2.2.4 `#define CFGPRM_CLOUDS 0x0009`

Flag for rendering planetary cloud layers

Parameter type:

bool

16.2.2.5 `#define CFGPRM_CLOUDSHADOWS 0x000A`

Flag for rendering cloud shadows on the planet surface

Parameter type:

bool

16.2.2.6 `#define CFGPRM_CSPHEREINTENS 0x0014`

Flag for rendering intensity of celestial sphere background textures

Parameter type:

double

16.2.2.7 `#define CFGPRM_CSPHERETEXTURE 0x0013`

File path for celestial sphere background textures

Parameter type:

\*char

16.2.2.8 `#define CFGPRM_ELEVATIONMODE 0x0019`

Mesh interpolation method for planetary surfaces (0=none, 1=linear, 2=cubic)

Parameter type:

int

16.2.2.9 `#define CFGPRM_LOCALLIGHT 0x0015`

Flag for enabling local light sources

Parameter type:

bool

16.2.2.10 `#define CFGPRM_MAXLIGHT 0x0016`

Max number of light sources

Parameter type:

int

16.2.2.11 #define CFGPRM\_OBJECTSHADOWS 0x0010

Flag for rendering object shadows on the planet surface

Parameter type:

bool

16.2.2.12 #define CFGPRM\_OBJECTSPECULAR 0x0011

Flag for enabling specular reflections from objects

Parameter type:

bool

16.2.2.13 #define CFGPRM\_PANELMFDHUDSIZE 0x001A

Size of texture surface used for rendering panel MFDs and VC HUD (multiple of 2, usually 256 or 512)

Parameter type:

int

16.2.2.14 #define CFGPRM\_PLANETARIUMFLAG 0x000B

Bit flag for "planetarium mode" elements. For a description of the available bit flags, see [Bit flags for planetarium mode elements](#)

Parameter type:

DWORD

16.2.2.15 #define CFGPRM\_RESOLUTIONBIAS 0x0017

Planet tile resolution bias

Parameter type:

double

16.2.2.16 #define CFGPRM\_STARRENDERPRM 0x000C

Parameters for rendering stars on the celestial sphere.

Parameter type:

struct StarRenderPrm

16.2.2.17 #define CFGPRM\_SURFACELIGHTBRT 0x0006

Brightness factor for emissive city light textures (0-1)

Parameter type:

double

16.2.2.18 #define CFGPRM\_SURFACELIGHTS 0x0004

Flag for rendering emissive textures ("city lights") on the unlit side of planetary surfaces.

Parameter type:

bool

16.2.2.19 #define CFGPRM\_SURFACEMAXLEVEL 0x0001

Max. level of detail for rendering planetary surfaces

Parameter type:

DWORD

16.2.2.20 #define CFGPRM\_SURFACEREFLECT 0x0002

Flag for rendering planet surfaces with specular reflections (e.g. for oceans)

Parameter type:

bool

16.2.2.21 #define CFGPRM\_SURFACERIPPLE 0x0003

Flag for rendering specular reflections with microtexture ("ripples")

Parameter type:

bool

16.2.2.22 #define CFGPRM\_TILEPATCHRES 0x001B

Scaling power n of planet surface patch mesh resolution  $2^{<< n}$  Valid range: [4,5,6]

Parameter type:

int

16.2.2.23 #define CFGPRM\_VESSELSHADOWS 0x000F

Flag for rendering vessel shadows on the planet surface

Parameter type:

bool

16.2.2.24 #define CFGPRM\_WIREFRAME 0x0018

Render meshes as wireframe models?

Parameter type:

bool

### 16.3 Render parameter identifiers

/\*\*

See also

GraphicsClient::clbkGetRenderParam()

## 16.4 Bit flags for planetarium mode elements

## 16.5 Bit flags for blitting operations

## 16.6 Some useful general constants

### Variables

- const double **PI** = 3.14159265358979323846
  - pi*
- const double **PI05** = 1.57079632679489661923
  - pi/2*
- const double **PI2** = 6.28318530717958647693
  - pi\*2*
- const double **RAD** = **PI**/180.0
  - factor to map degrees to radians*
- const double **DEG** = 180.0/**PI**
  - factor to map radians to degrees*
- const double **C0** = 299792458.0
  - speed of light in vacuum [m/s]*
- const double **TAUA** = 499.004783806
  - light time for 1 AU [s]*
- const double **AU** = **C0**\***TAUA**
  - astronomical unit (mean geocentric distance of the sun) [m]*
- const double **GGRAV** = 6.67259e-11
  - gravitational constant [m^3 kg^-1 s^-2]*
- const double **G** = 9.81
  - gravitational acceleration [m/s^2] at Earth mean radius*
- const double **ATMP** = 101.4e3
  - atmospheric pressure [Pa] at Earth sea level*
- const double **ATMD** = 1.293
  - atmospheric density [kg/m^3] at Earth sea level*

### 16.6.1 Detailed Description

## 16.7 Defines and Enumerations

### Modules

- Ephemeris data format bitflags
- Handles
- Surface and texture attributes
- Mesh group editing flags
- Bitflags for EXHAUSTSPEC flags field.
- Light beacon shape parameters
- Listentryflag
- Listclbkflag
- Animation flags
- Identifiers for frames of reference
- Thruster and thruster-group parameters
- Airfoil orientation
- Aerodynamic control surface types
- Control surface axis orientation
- Identifiers for visual events
- Navigation mode identifiers
- Navigation mode bitflags
- Manual control mode identifiers
- Manual control device identifiers
- RCS mode identifiers
- HUD mode identifiers
- MFD mode identifiers
- MFD identifiers
- Panel neighbour identifiers
- Panel redraw event identifiers
- Mouse event identifiers
- Panel area texture mapping identifiers
- Generic vessel message identifiers
- Vessel mesh visibility flags
- Navigation radio transmitter types
- Object parameter flags
- Keyboard key identifiers
- Logical key ids

### 16.7.1 Detailed Description

## 16.8 Structure definitions

### Classes

- struct **COLOUR4**  
*colour definition*
- struct **NTVERTEX**  
*vertex definition including normals and texture coordinates*
- struct **MESHGROUP**  
*Defines a mesh group (subset of a mesh).*
- struct **MESHGROUPEX**  
*extended mesh group definition*
- struct **GROUPEDITSPEC**  
*Structure used by [oapiEditMeshGroup](#) to define the group elements to be replaced or modified.*
- struct **GROUPREQUESTSPEC**  
*Structure used by [oapiGetMeshGroup](#) containing data buffers to be filled with vertex and index data.*
- struct **MATERIAL**  
*material definition*
- struct **ATMCONST**  
*Planetary atmospheric constants structure.*

### 16.8.1 Detailed Description

## 16.9 Handles

### Typedefs

- **typedef void \* OBJHANDLE**  
*Handle for objects (vessels, stations, planets)*
- **typedef void \* SUPERVESSELHANDLE**  
*Handle for vessel superstructures.*
- **typedef void \* VISHANDLE**  
*Handle for visuals.*
- **typedef void \* MESHHANDLE**  
*Handle for meshes.*
- **typedef int \* DEVMESSHHANDLE**  
*Handle for graphics-client-specific meshes.*
- **typedef void \* SURFHANDLE**  
*Handle for bitmap surfaces and textures (panels and panel items)*
- **typedef void \* PANELHANDLE**  
*Handle for 2D instrument panels.*
- **typedef void \* FILEHANDLE**  
*Handle for file streams.*
- **typedef void \* INTERPRETERHANDLE**  
*Handle for script interpreters.*
- **typedef void \* THRUSTER\_HANDLE**  
*Handle for thrusters.*
- **typedef void \* THGROUP\_HANDLE**  
*Handle for logical thruster groups.*
- **typedef void \* PROPELLANT\_HANDLE**  
*Propellant resource handle.*
- **typedef void \* PSTREAM\_HANDLE**  
*Handle for particle streams.*
- **typedef void \* DOCKHANDLE**  
*Handle for vessel docking ports.*
- **typedef void \* ATTACHMENTHANDLE**  
*Handle for vessel passive attachment points.*
- **typedef void \* AIRFOILHANDLE**  
*Handle for vessel airfoils.*
- **typedef void \* CTRLSURFHANDLE**  
*Handle for vessel aerodynamic control surfaces.*
- **typedef void \* NAVHANDLE**  
*Handle for a navigation radio transmitter (VOR, ILS, IDS, XPDR)*
- **typedef void \* ANIMATIONCOMPONENT\_HANDLE**  
*Handle for animation components.*
- **typedef void \* LAUNCHPADITEM\_HANDLE**  
*Handle for custom items added to Launchpad "Extra" list.*
- **typedef void \* NOTEHANDLE**  
*Handle for onscreen annotation objects.*
- **typedef void \* ELEVHANDLE**  
*Handle for elevation query managers.*

### 16.9.1 Detailed Description

## 16.10 Identifiers for special render surfaces

### Macros

- `#define RENDERTGT_NONE ((SURFHANDLE)-1)`  
*no surface*
- `#define RENDERTGT_MAINWINDOW 0`

#### 16.10.1 Detailed Description

#### 16.10.2 Macro Definition Documentation

##### 16.10.2.1 `#define RENDERTGT_MAINWINDOW 0`

main render target

## 16.11 Vectors and matrices

### Classes

- union **VECTOR3**  
*3-element vector*
- union **VECTOR4**  
*4-element vector*
- union **MATRIX3**  
*3x3-element matrix*

### Functions

- **VECTOR3 \_V** (double x, double y, double z)  
*Vector composition.*
- void **veccpy** (**VECTOR3** &a, const **VECTOR3** &b)  
*Vector copy.*
- **VECTOR3 operator+** (const **VECTOR3** &a, const **VECTOR3** &b)  
*Vector addition.*
- **VECTOR3 operator-** (const **VECTOR3** &a, const **VECTOR3** &b)  
*Vector subtraction.*
- **VECTOR3 operator\*** (const **VECTOR3** &a, const double f)  
*Multiplication of vector with scalar.*
- **VECTOR3 operator/** (const **VECTOR3** &a, const double f)  
*Division of vector by a scalar.*
- **VECTOR3 & operator+=** (**VECTOR3** &a, const **VECTOR3** &b)  
*Vector addition-assignment  $a += b$ .*
- **VECTOR3 & operator-=** (**VECTOR3** &a, const **VECTOR3** &b)  
*Vector subtraction-assignment  $a -= b$ .*
- **VECTOR3 & operator\*= **(VECTOR3 &a, const double f)  
*Vector-scalar multiplication-assignment  $a *= f$ .*****
- **VECTOR3 & operator/= **(VECTOR3 &a, const double f)  
*Vector-scalar division-assignment  $a /= f$ .*****
- **VECTOR3 operator-** (const **VECTOR3** &a)  
*Vector unary minus  $-a$ .*
- double **dotp** (const **VECTOR3** &a, const **VECTOR3** &b)  
*Scalar (inner, dot) product of two vectors.*
- **VECTOR3 crossp** (const **VECTOR3** &a, const **VECTOR3** &b)  
*Vector (cross) product of two vectors.*
- double **length** (const **VECTOR3** &a)  
*Length (L2-norm) of a vector.*
- double **length2** (const **VECTOR3** &a)  
*Length squared of a vector.*
- double **dist** (const **VECTOR3** &a, const **VECTOR3** &b)  
*Distance between two points.*
- void **normalise** (**VECTOR3** &a)  
*Normalise a vector.*
- **VECTOR3 unit** (const **VECTOR3** &a)  
*Returns normalised vector.*
- **MATRIX3 \_M** (double m11, double m12, double m13, double m21, double m22, double m23, double m31, double m32, double m33)

- **MATRIX3 identity ()**  
*Returns the identity matrix.*
- **MATRIX3 outerp (const VECTOR3 &a, const VECTOR3 &b)**  
*Outer product of two vectors.*
- **MATRIX3 operator+ (const MATRIX3 &A, double s)**  
*Sum of matrix and scalar.*
- **MATRIX3 operator- (const MATRIX3 &A, double s)**  
*Difference of matrix and scalar.*
- **MATRIX3 operator\* (const MATRIX3 &A, double s)**  
*Product of matrix and scalar.*
- **MATRIX3 operator/ (const MATRIX3 &A, double s)**  
*Quotient of matrix and scalar.*
- **MATRIX3 & operator\*=(MATRIX3 &A, double s)**  
*Matrix-scalar product-assignment  $A *= s$ .*
- **MATRIX3 & operator/=(MATRIX3 &A, double s)**  
*Matrix-scalar division-assignment  $A /= s$ .*
- **VECTOR3 mul (const MATRIX3 &A, const VECTOR3 &b)**  
*Matrix-vector multiplication.*
- **VECTOR3 tmul (const MATRIX3 &A, const VECTOR3 &b)**  
*Matrix transpose-vector multiplication.*
- **MATRIX3 mul (const MATRIX3 &A, const MATRIX3 &B)**  
*Matrix-matrix multiplication.*
- **MATRIX3 rotm (const VECTOR3 &axis, double angle)**  
*Construct a rotation matrix from an axis and an angle.*
- **MATRIX4 identity4 ()**  
*Returns the identity matrix.*
- **MATRIX4 mul (const MATRIX4 &A, const MATRIX4 &B)**  
*Matrix-matrix multiplication for 4-matrices.*

### 16.11.1 Detailed Description

Vectors and matrices are used to represent positions, velocities, translations, rotations, etc. in the 3-dimensional object space. Orbiter provides the VECTOR3 and MATRIX3 structures for 3-D vectors and matrices. A number of utility functions allow common operations such as matrix-vector products, dot and vector products, etc.

### 16.11.2 Function Documentation

#### 16.11.2.1 MATRIX3\_M ( double m11, double m12, double m13, double m21, double m22, double m23, double m31, double m32, double m33 ) [inline]

Matrix composition.

Returns a matrix composed of the provided elements.

**Returns**  

$$\begin{pmatrix} m_{11} & m_{12} & m_{13} \\ m_{21} & m_{22} & m_{23} \\ m_{31} & m_{32} & m_{33} \end{pmatrix}$$

#### 16.11.2.2 VECTOR3\_V ( double x, double y, double z ) [inline]

Vector composition.

Returns a vector composed of the three provided arguments

## Parameters

<i>x</i>	x-component
<i>y</i>	y-component
<i>z</i>	z-component

## Returns

vector defined as (x,y,z)

16.11.2.3 `VECTOR3 crossp ( const VECTOR3 & a, const VECTOR3 & b )` [inline]

Vector (cross) product of two vectors.

## Parameters

in	<i>a</i>	First vector operand
in	<i>b</i>	Second vector operand

## Returns

Vector product  $\mathbf{a} \times \mathbf{b}$

16.11.2.4 `double dist ( const VECTOR3 & a, const VECTOR3 & b )` [inline]

Distance between two points.

## Parameters

in	<i>a</i>	First point
in	<i>b</i>	Second point

## Returns

Distance between a and b

16.11.2.5 `double dotp ( const VECTOR3 & a, const VECTOR3 & b )` [inline]

Scalar (inner, dot) product of two vectors.

## Parameters

in	<i>a</i>	First vector operand
in	<i>b</i>	Second vector operand

## Returns

Scalar product  $\mathbf{a} \cdot \mathbf{b}$

16.11.2.6 `double length ( const VECTOR3 & a )` [inline]

Length (L2-norm) of a vector.

## Parameters

<i>a</i>	Vector operand
----------	----------------

## Returns

Vector norm  $|\mathbf{a}|_2$

## 16.11.2.7 double length2 ( const VECTOR3 &amp; a ) [inline]

Length squared of a vector.

## Parameters

a	Vector operand
---	----------------

## Returns

Vector norm  $|\mathbf{a}|_2^2$ 16.11.2.8 **VECTOR3 mul ( const MATRIX3 & A, const VECTOR3 & b )** [inline]

Matrix-vector multiplication.

## Parameters

in	A	matrix operand
in	b	vector operand

## Returns

Result of  $\mathbf{Ab}$ 16.11.2.9 **MATRIX3 mul ( const MATRIX3 & A, const MATRIX3 & B )** [inline]

Matrix-matrix multiplication.

## Parameters

in	A	First matrix operand
in	B	Second matrix operand

## Returns

Result of  $\mathbf{AB}$ 16.11.2.10 **MATRIX4 mul ( const MATRIX4 & A, const MATRIX4 & B )** [inline]

Matrix-matrix multiplication for 4-matrices.

## Parameters

in	A	First matrix operand
in	B	Second matrix operand

## Returns

Result of  $\mathbf{AB}$ 16.11.2.11 **void normalise ( VECTOR3 & a )** [inline]

Normalise a vector.

Resizes the argument vector to length 1.

## Parameters

in, out	a	Vector argument
---------	---	-----------------

## Note

The length of a must be greater than 0.

16.11.2.12 **VECTOR3 operator\* ( const VECTOR3 & a, const double f )** [inline]

Multiplication of vector with scalar.

## Parameters

<i>a</i>	vector operand
<i>f</i>	scalar operand

## Returns

Result of element-wise  $a*f$ .

16.11.2.13 MATRIX3 operator\* ( const MATRIX3 & *A*, double *s* ) [inline]

Product of matrix and scalar.

## Parameters

in	<i>A</i>	Matrix operand (left)
in	<i>s</i>	scalar operand (right)

## Returns

$A*s$  (element-wise product of *A* and *s*)

16.11.2.14 VECTOR3& operator\*=( VECTOR3 & *a*, const double *f* ) [inline]

Vector-scalar multiplication-assignment  $a *= f$ .

## Parameters

in, out	<i>a</i>	Left-hand vector operand
in	<i>f</i>	Right hand scalar operand

## Returns

Replaces *a* with element-wise  $a*f$  and returns the result.

16.11.2.15 MATRIX3& operator\*=( MATRIX3 & *A*, double *s* ) [inline]

Matrix-scalar product-assignment  $A *= s$ .

## Parameters

in	<i>A</i>	Matrix operand (left)
in	<i>s</i>	scalar operand (right)

## Returns

Replaces *A* with element-wise product  $A*s$  and returns the result.

16.11.2.16 VECTOR3 operator+ ( const VECTOR3 & *a*, const VECTOR3 & *b* ) [inline]

Vector addition.

## Parameters

<i>a</i>	first vector operand
<i>b</i>	second vector operand

## Returns

Result of  $a+b$ .

16.11.2.17 MATRIX3 operator+ ( const MATRIX3 & *A*, double *s* ) [inline]

Sum of matrix and scalar.

## Parameters

in	<i>A</i>	Matrix operand (left)
in	<i>s</i>	scalar operand (right)

## Returns

$A+s$  (element-wise sum of  $A$  and  $s$ )

16.11.2.18 **VECTOR3& operator+=( VECTOR3 & a, const VECTOR3 & b )** [inline]

Vector addition-assignment  $a += b$ .

## Parameters

in, out	<i>a</i>	Left-hand vector operand
in	<i>b</i>	Right-hand vector operand

## Returns

Replaces  $a$  with  $a+b$  and returns the result.

16.11.2.19 **VECTOR3 operator-( const VECTOR3 & a, const VECTOR3 & b )** [inline]

Vector subtraction.

## Parameters

<i>a</i>	first vector operand
<i>b</i>	second vector operand

## Returns

Result of  $a-b$ .

16.11.2.20 **VECTOR3 operator-( const VECTOR3 & a )** [inline]

Vector unary minus  $-a$ .

## Parameters

in	<i>a</i>	Vector operand
----	----------	----------------

## Returns

Negative vector  $(-a.x, -a.y, -a.z)$

16.11.2.21 **MATRIX3 operator-( const MATRIX3 & A, double s )** [inline]

Difference of matrix and scalar.

## Parameters

in	<i>A</i>	Matrix operand (left)
in	<i>s</i>	scalar operand (right)

## Returns

$A-s$  (element-wise difference of  $A$  and  $s$ )

16.11.2.22 **VECTOR3& operator-=( VECTOR3 & a, const VECTOR3 & b )** [inline]

Vector subtraction-assignment  $a -= b$ .

## Parameters

in, out	<i>a</i>	Left-hand vector operand
in	<i>b</i>	Right-hand vector operand

## Returns

Replaces *a* with *a*-*b* and returns the result.

16.11.2.23 **VECTOR3 operator/ ( const VECTOR3 & *a*, const double *f* ) [inline]**

Division of vector by a scalar.

## Parameters

<i>a</i>	vector operand
<i>f</i>	scalar operand

## Returns

Result of element-wise *a*/*f*.

16.11.2.24 **MATRIX3 operator/ ( const MATRIX3 & *A*, double *s* ) [inline]**

Quotient of matrix and scalar.

## Parameters

in	<i>A</i>	Matrix operand (left)
in	<i>s</i>	scalar operand (right)

## Returns

*A*/*s* (element-wise quotient of *A* and *s*)

## Note

*s* != 0 is required.

16.11.2.25 **VECTOR3& operator/= ( VECTOR3 & *a*, const double *f* ) [inline]**

Vector-scalar division-assignment *a* /= *f*.

## Parameters

in, out	<i>a</i>	Left-hand vector operand
in	<i>f</i>	Right-hand scalar operand

## Returns

Replaces *a* with element-wise *a*/*f* and returns the result.

16.11.2.26 **MATRIX3& operator/= ( MATRIX3 & *A*, double *s* ) [inline]**

Matrix-scalar division-assignment *A* /= *s*.

## Parameters

in	<i>A</i>	Matrix operand (left)
in	<i>s</i>	scalar operand (right)

## Returns

Replaces *A* with element-wise quotient *A*/*s* and returns the result.

## Note

*s* != 0 is required.

16.11.2.27 MATRIX3 outerp ( const VECTOR3 & *a*, const VECTOR3 & *b* ) [inline]

Outer product of two vectors.

## Parameters

in	<i>a</i>	First vector operand
in	<i>b</i>	Second vector operand

## Returns

Outer product  $\mathbf{ab}^T$ , where **a** and **b** represent column vectors.

16.11.2.28 MATRIX3 rotm ( const VECTOR3 & *axis*, double *angle* ) [inline]

Construct a rotation matrix from an axis and an angle.

## Parameters

<i>axis</i>	rotation axis direction (must be normalised)
<i>angle</i>	rotation angle [rad]

## Returns

rotation matrix

16.11.2.29 VECTOR3 tmul ( const MATRIX3 & *A*, const VECTOR3 & *b* ) [inline]

Matrix transpose-vector multiplication.

## Parameters

in	<i>A</i>	matrix operand
in	<i>b</i>	vector operand

## Returns

Result of  $\mathbf{A}^T \mathbf{b}$

16.11.2.30 VECTOR3 unit ( const VECTOR3 & *a* ) [inline]

Returns normalised vector.

Returns a vector of length 1 with the same direction as the argument vector.

**Parameters**

in	a	Vector argument
----	---	-----------------

**Returns**

Normalised vector.

**Note**

The length of a must be greater than 0.

**16.11.2.31 void veccopy ( VECTOR3 & a, const VECTOR3 & b ) [inline]**

Vector copy.

Copies the element values from the source to the target vector.

**Parameters**

out	a	target vector
in	b	source vector

## 16.12 Surface and texture attributes

### Macros

- `#define OAPISURFACE_TEXTURE 0x0001`  
*Surface can be used as a texture (e.g. by associating it with a mesh)*
- `#define OAPISURFACE_RENDERTARGET 0x0002`  
*Surface can be rendered to by the graphics device.*
- `#define OAPISURFACE_GDI 0x0004`  
*A HDC context can be requested from the surface for GDI drawing.*
- `#define OAPISURFACE_SKETCHPAD 0x0008`  
*A Sketchpad context can be requested from the surface for Sketchpad drawing.*
- `#define OAPISURFACE_MIPMAPS 0x0010`  
*Create a full chain of mipmaps for the surface. If loaded from file, add any missing mipmap levels.*
- `#define OAPISURFACE_NOMIPMAPS 0x0020`  
*Don't create mipmaps. If loaded from file, ignore any mipmap levels present.*
- `#define OAPISURFACE_ALPHA 0x0040`  
*Create an alpha channel for the surface. If loaded from file, add an alpha channel if required.*
- `#define OAPISURFACE_NOALPHA 0x0080`  
*Don't create an alpha channel. If loaded from file, strip any existing alpha channel.*
- `#define OAPISURFACE_UNCOMPRESS 0x0100`  
*Create an uncompressed surface. If loaded from file, uncompress if required.*
- `#define OAPISURFACE_SYSMEM 0x0200`  
*Create the surface in system (host) memory.*
- `#define OAPISURFACE_RENDER3D 0x0400`  
*Create a surface that can act as a target for rendering a 3D scene.*

### 16.12.1 Detailed Description

These bitflags are used during texture creation or loading to specify what they will be used for. This information is required by the graphics clients to initialise and optimise the surfaces accordingly.

### See also

[oapiCreateSurfaceEx](#), [oapiLoadSurfaceEx](#)

## 16.13 Mesh group editing flags

### Macros

- `#define GRPEDIT_SETUSERFLAG 0x00001`  
*replace the group's UsrFlag entry with the value in the `GROUPEDITSPEC` structure.*
- `#define GRPEDIT_ADDUSERFLAG 0x00002`  
*Add the UsrFlag value to the group's UsrFlag entry.*
- `#define GRPEDIT_DELUSERFLAG 0x00004`  
*Remove the UsrFlag value from the group's UsrFlag entry.*
- `#define GRPEDIT_VTXCRDX 0x00008`  
*Replace vertex x-coordinates.*
- `#define GRPEDIT_VTXCRDY 0x00010`  
*Replace vertex y-coordinates.*
- `#define GRPEDIT_VTXCRDZ 0x00020`  
*Replace vertex z-coordinates.*
- `#define GRPEDIT_VTXCRD (GRPEDIT_VTXCRDX | GRPEDIT_VTXCRDY | GRPEDIT_VTXCRDZ)`  
*Replace vertex coordinates.*
- `#define GRPEDIT_VTXNMLX 0x00040`  
*Replace vertex x-normals.*
- `#define GRPEDIT_VTXNMLY 0x00080`  
*Replace vertex y-normals.*
- `#define GRPEDIT_VTXNMLZ 0x00100`  
*Replace vertex z-normals.*
- `#define GRPEDIT_VTXNML (GRPEDIT_VTXNMLX | GRPEDIT_VTXNMLY | GRPEDIT_VTXNMLZ)`  
*Replace vertex normals.*
- `#define GRPEDIT_VTXTEXU 0x00200`  
*Replace vertex texture u-coordinates.*
- `#define GRPEDIT_VTXTEXV 0x00400`  
*Replace vertex texture v-coordinates.*
- `#define GRPEDIT_VTXTEX (GRPEDIT_VTXTEXU | GRPEDIT_VTXTEXV)`  
*Replace vertex texture coordinates.*
- `#define GRPEDIT_VTX (GRPEDIT_VTXCRD | GRPEDIT_VTXNML | GRPEDIT_VTXTEX)`  
*Replace vertices.*
- `#define GRPEDIT_VTXCRDADDX 0x00800`  
*Add to vertex x-coordinates.*
- `#define GRPEDIT_VTXCRDADDY 0x01000`  
*Add to vertex y-coordinates.*
- `#define GRPEDIT_VTXCRDADDZ 0x02000`  
*Add to vertex z-coordinates.*
- `#define GRPEDIT_VTXCRDADD (GRPEDIT_VTXCRDADDX | GRPEDIT_VTXCRDADDY | GRPEDIT_VTXCRDADDZ)`  
*Add to vertex coordinates.*
- `#define GRPEDIT_VTXNMLADDX 0x04000`  
*Add to vertex x-normals.*
- `#define GRPEDIT_VTXNMLADDY 0x08000`  
*Add to vertex y-normals.*
- `#define GRPEDIT_VTXNMLADDZ 0x10000`  
*Add to vertex z-normals.*
- `#define GRPEDIT_VTXNMLADD (GRPEDIT_VTXNMLADDX | GRPEDIT_VTXNMLADDY | GRPEDIT_VTXNMLADDZ)`

- *Add to vertex normals.*  
• `#define GRPEDIT_VTXTEXADDU` 0x20000
- *Add to vertex texture u-coordinates.*  
• `#define GRPEDIT_VTXTEXADDV` 0x40000
- *Add to vertex texture v-coordinates.*  
• `#define GRPEDIT_VTXTEXADD (GRPEDIT_VTXTEXADDU | GRPEDIT_VTXTEXADDV)`
- *Add to vertex texture coordinates.*  
• `#define GRPEDIT_VTXADD (GRPEDIT_VTXCRDADD | GRPEDIT_VTXNMLADD | GRPEDIT_VTXEXADD)`
- `#define GRPEDIT_VTXMOD (GRPEDIT_VTX | GRPEDIT_VTXADD)`

#### 16.13.1 Detailed Description

These constants can be applied to the *flags* field of the [GROUPEDITSPEC](#) structure to define which parts of a mesh group are to be modified.

##### Note

The `GRPEDIT_SETUSERFLAG`, `GRPEDIT_ADDUSERFLAG` and `GRPEDIT_DELUSERFLAG` flags are mutually exclusive. Only one can be used at a time.

##### See also

[GROUPEDITSPEC](#), [oapiEditMeshGroup](#)

## 16.14 Bitflags for EXHAUSTSPEC flags field.

### Macros

- `#define EXHAUST_CONSTANTLEVEL 0x0001`  
*exhaust level is constant*
- `#define EXHAUST_CONSTANTPOS 0x0002`  
*exhaust position is constant*
- `#define EXHAUST_CONSTANTDIR 0x0004`  
*exhaust direction is constant*

### 16.14.1 Detailed Description

#### See also

[EXHAUSTSPEC](#)

## 16.15 Local lighting interface

### Classes

- class [LightEmitter](#)  
*Base class for defining a light source that can illuminate other objects.*
- class [PointLight](#)  
*Class for isotropic point light source.*
- class [SpotLight](#)  
*Class for directed spot light sources.*

### 16.15.1 Detailed Description

The classes in this group define local light sources.

### See also

[VESSEL3::AddPointLight](#), [VESSEL3::AddSpotLight](#)

## 16.16 Light beacon shape parameters

### Macros

- `#define BEACONSHAPE_COMPACT 0`  
*compact beacon shape*
- `#define BEACONSHAPE_DIFFUSE 1`  
*diffuse beacon shape*
- `#define BEACONSHAPE_STAR 2`  
*star-shaped beacon*

### 16.16.1 Detailed Description

#### See also

[BEACONLIGHTSPEC](#)

## 16.17 Listentryflag

See also

[LISTENTRY](#)

## 16.18 Listclbkflag

See also

[LISTENTRY](#)

## 16.19 Animation flags

### Macros

- `#define LOCALVERTEXLIST ((UINT)(-1))`  
*flags animation component as explicit vertex list*
- `#define MAKEGROUPARRAY(x) ((UINT*)x)`  
*casts a vertex array into a group*

### 16.19.1 Detailed Description

#### See also

[VESSEL::AddAnimationComponent](#)

## 16.20 Identifiers for frames of reference

### Enumerations

- enum **REFFRAME** { **FRAME\_GLOBAL**, **FRAME\_LOCAL**, **FRAME\_REFLOCAL**, **FRAME\_HORIZON** }
- Identifiers for frames of reference.*

#### 16.20.1 Detailed Description

#### 16.20.2 Enumeration Type Documentation

##### 16.20.2.1 enum **REFFRAME**

Identifiers for frames of reference.

#### Enumerator

- FRAME\_GLOBAL** global (ecliptic) frame  
**FRAME\_LOCAL** local object frame  
**FRAME\_REFLOCAL** local reference object frame  
**FRAME\_HORIZON** local horizon frame

## 16.21 Thruster and thruster-group parameters

### Enumerations

- enum **ENGINETYPE** { **ENGINE\_MAIN**, **ENGINE\_RETRO**, **ENGINE\_HOVER**, **ENGINE\_ATTITUDE** }  
*Thruster group identifiers (obsolete)*
- enum **EXHAUSTTYPE** { **EXHAUST\_MAIN**, **EXHAUST\_RETRO**, **EXHAUST\_HOVER**, **EXHAUST\_CUSTOM** }
- enum **THGROUP\_TYPE** {  
**THGROUP\_MAIN**, **THGROUP\_RETRO**, **THGROUP\_HOVER**, **THGROUP\_ATT\_PITCHUP**,  
**THGROUP\_ATT\_PITCHDOWN**, **THGROUP\_ATT\_YAWLEFT**, **THGROUP\_ATT\_YAWRIGHT**, **THGROUP\_ATT\_BANKLEFT**,  
**THGROUP\_ATT\_BANKRIGHT**, **THGROUP\_ATT\_RIGHT**, **THGROUP\_ATT\_LEFT**, **THGROUP\_ATT\_UP**,  
**THGROUP\_ATT\_DOWN**, **THGROUP\_ATT\_FORWARD**, **THGROUP\_ATT\_BACK**, **THGROUP\_USER** = 0x40 }

*Thruster group types.*

### 16.21.1 Detailed Description

### 16.21.2 Enumeration Type Documentation

#### 16.21.2.1 enum **ENGINETYPE**

Thruster group identifiers (obsolete)

##### Enumerator

- ENGINE\_MAIN** main thrusters
- ENGINE\_RETRO** retro thrusters
- ENGINE\_HOVER** hover thrusters
- ENGINE\_ATTITUDE** attitude (RCS) thrusters

#### 16.21.2.2 enum **THGROUP\_TYPE**

Thruster group types.

##### See also

[VESSEL::CreateThrusterGroup](#)

##### Enumerator

- THGROUP\_MAIN** main thrusters
- THGROUP\_RETRO** retro thrusters
- THGROUP\_HOVER** hover thrusters
- THGROUP\_ATT\_PITCHUP** rotation: pitch up
- THGROUP\_ATT\_PITCHDOWN** rotation: pitch down
- THGROUP\_ATT\_YAWLEFT** rotation: yaw left
- THGROUP\_ATT\_YAWRIGHT** rotation: yaw right
- THGROUP\_ATT\_BANKLEFT** rotation: bank left
- THGROUP\_ATT\_BANKRIGHT** rotation: bank right
- THGROUP\_ATT\_RIGHT** translation: move right
- THGROUP\_ATT\_LEFT** translation: move left
- THGROUP\_ATT\_UP** translation: move up

**THGROUP\_ATT\_DOWN** translation: move down

**THGROUP\_ATT\_FORWARD** translation: move forward

**THGROUP\_ATT\_BACK** translation: move back

**THGROUP\_USER** user-defined group

## 16.22 Airfoil orientation

### Enumerations

- enum [AIRFOIL\\_ORIENTATION](#) { [LIFT\\_VERTICAL](#), [LIFT\\_HORIZONTAL](#) }

*Lift vector orientation for airfoils.*

#### 16.22.1 Detailed Description

#### 16.22.2 Enumeration Type Documentation

##### 16.22.2.1 enum [AIRFOIL\\_ORIENTATION](#)

Lift vector orientation for airfoils.

Defines the orientation of an airfoil by the direction of the lift vector generated (vertical or horizontal).

#### See also

[VESSEL::CreateAirfoil](#), [VESSEL::CreateAirfoil2](#), [VESSEL::CreateAirfoil3](#)

#### Enumerator

***LIFT\_VERTICAL*** lift direction is vertical (e.g. elevator)

***LIFT\_HORIZONTAL*** lift direction is horizontal (e.g. rudder)

## 16.23 Aerodynamic control surface types

### Enumerations

- enum **AIRCTRL\_TYPE** {  
    **AIRCTRL\_ELEVATOR**, **AIRCTRL\_RUDDER**, **AIRCTRL\_AILERON**, **AIRCTRL\_FLAP**,  
    **AIRCTRL\_ELEVATORTRIM**, **AIRCTRL\_RUDDERTRIM** }

*Control surfaces provide attitude and drag control during atmospheric flight.*

#### 16.23.1 Detailed Description

#### 16.23.2 Enumeration Type Documentation

##### 16.23.2.1 enum **AIRCTRL\_TYPE**

Control surfaces provide attitude and drag control during atmospheric flight.

#### See also

[VESSEL::CreateControlSurface](#), [VESSEL::CreateControlSurface2](#), [VESSEL::CreateControlSurface3](#)

#### Enumerator

- AIRCTRL\_ELEVATOR** elevator control (pitch control)
- AIRCTRL\_RUDDER** rudder control (yaw control)
- AIRCTRL\_AILERON** aileron control (bank control)
- AIRCTRL\_FLAP** flaps (lift, drag control)
- AIRCTRL\_ELEVATORTRIM** elevator trim
- AIRCTRL\_RUDDERTRIM** rudder trim

## 16.24 Control surface axis orientation

### Macros

- `#define AIRCTRL_AXIS_AUTO 0`  
*Constants to define the rotation axis and direction of aerodynamic control surfaces.*
- `#define AIRCTRL_AXIS_YPOS 1`  
*y-axis (vertical), positive rotation*
- `#define AIRCTRL_AXIS_YNEG 2`  
*y-axis (vertical), negative rotation*
- `#define AIRCTRL_AXIS_XPOS 3`  
*x-axis (transversal), positive rotation*
- `#define AIRCTRL_AXIS_XNEG 4`  
*x-axis (transversal), negative rotation*

### 16.24.1 Detailed Description

### 16.24.2 Macro Definition Documentation

#### 16.24.2.1 `#define AIRCTRL_AXIS_AUTO 0`

Constants to define the rotation axis and direction of aerodynamic control surfaces.

#### See also

[VESSEL::CreateControlSurface](#), [VESSEL::CreateControlSurface2](#), [VESSEL::CreateControlSurface3](#)automatic orientation

## 16.25 Identifiers for visual events

### Macros

- `#define EVENT_VESSEL_INSMESH 0`  
*Insert a mesh (context: mesh index)*
- `#define EVENT_VESSEL_DELMESH 1`  
*Delete a mesh (context: mesh index, or -1 for all)*
- `#define EVENT_VESSEL_MESHVISMODE 2`  
*Set mesh visibility mode (context: mesh index)*
- `#define EVENT_VESSEL_RESETANIM 3`  
*Reset animations.*
- `#define EVENT_VESSEL_CLEARANIM 4`  
*Clear all animations (context: `UINT` (1=reset animations, 0=leave animations at current state))*
- `#define EVENT_VESSEL_DELANIM 5`  
*Delete an animation (context: animation index)*
- `#define EVENT_VESSEL_NEWANIM 6`  
*Create a new animation (context: animation index)*
- `#define EVENT_VESSEL_MESHOFS 7`  
*Shift a mesh (context: mesh index)*
- `#define EVENT_VESSEL_MODMESHGROUP 8`  
*A mesh group has been modified.*

### 16.25.1 Detailed Description

These constants define events that are sent from the Orbiter core to visual instances in a graphics client. The client receives these notifications via the `oapi::GraphicsClient::clbkVisEvent` callback function, where the first parameter is the event identifier, and the second parameter is a message-specific context value.

## 16.26 Navigation mode identifiers

### Macros

- `#define NAVMODE_KILLROT 1`  
*"Kill rotation" mode*
- `#define NAVMODE_HLEVEL 2`  
*"Hold level with horizon" mode*
- `#define NAVMODE_PROGRADE 3`  
*"Prograde" mode*
- `#define NAVMODE_RETROGRADE 4`  
*"Retrograde" mode*
- `#define NAVMODE_NORMAL 5`  
*"Normal to orbital plane" mode*
- `#define NAVMODE_ANTINORMAL 6`  
*"Anti-normal to orbital plane" mode*
- `#define NAVMODE_HOLDALT 7`  
*"Hold altitude" mode*

### 16.26.1 Detailed Description

These constants are used to refer to the built-in "auto-navigation" modes, mostly for maintaining specific vessel attitudes via use of RCS thrusters.

### See also

[VESSEL::ActivateNavmode](#), [VESSEL::DeactivateNavmode](#), [VESSEL::ToggleNavmode](#), [VESSEL::GetNavmodeState](#)

## 16.27 Navigation mode bitflags

### Macros

- `#define NAVBIT_KILLROT 0x01`
- `#define NAVBIT_HLEVEL 0x02`
- `#define NAVBIT_PROGRADE 0x04`
- `#define NAVBIT_RETROGRADE 0x08`
- `#define NAVBIT_NORMAL 0x10`
- `#define NAVBIT_ANTINORMAL 0x20`
- `#define NAVBIT_HOLDALT 0x40`

#### 16.27.1 Detailed Description

## 16.28 Manual control mode identifiers

### Macros

- `#define MANCTRL_ATTMODE 0`  
*current attitude mode*
- `#define MANCTRL_REVMODE 1`  
*reverse of current attitude mode*
- `#define MANCTRL_ROTMODE 2`  
*rotational attitude modes only*
- `#define MANCTRL_LINMODE 3`  
*linear attitude modes only*
- `#define MANCTRL_ANYMODE 4`  
*rotational and linear modes*

### 16.28.1 Detailed Description

Constants used to identify attitude control modes for manual input.

### See also

[VESSEL::GetManualControlLevel](#)

## 16.29 Manual control device identifiers

### Macros

- `#define MANCTRL_KEYBOARD 0`  
*keyboard input*
- `#define MANCTRL_JOYSTICK 1`  
*joystick input*
- `#define MANCTRL_ANYDEVICE 2`  
*input from any device*

### 16.29.1 Detailed Description

Constants used to identify manual input devices.

### See also

[VESSEL::GetManualControlLevel](#)

## 16.30 RCS mode identifiers

### Macros

- `#define RCS_NONE 0`  
*None (RCS off)*
- `#define RCS_ROT 1`  
*Rotational mode.*
- `#define RCS_LIN 2`  
*Linear (translational) mode.*

### 16.30.1 Detailed Description

These constants are used to define the operation mode of the reaction control system (RCS) of a vessel.

### See also

[VESSEL::GetAttitudeMode](#), [VESSEL::SetAttitudeMode](#)

## 16.31 HUD mode identifiers

### Macros

- `#define HUD_NONE 0`  
*No mode (turn HUD off)*
- `#define HUD_ORBIT 1`  
*Orbit HUD mode.*
- `#define HUD_SURFACE 2`  
*Surface HUD mode.*
- `#define HUD_DOCKING 3`  
*Docking HUD mode.*

#### 16.31.1 Detailed Description

These constants are used to refer to the built-in HUD (head-up display) modes.

## 16.32 MFD mode identifiers

### Macros

- `#define MFD_REFRESHBUTTONS -1`  
*Refresh MFD buttons.*
- `#define MFD_NONE 0`  
*No mode (turn MFD off)*
- `#define MFD_ORBIT 1`  
*Orbit MFD mode.*
- `#define MFD_SURFACE 2`  
*Surface MFD mode.*
- `#define MFD_MAP 3`  
*Map MFD mode.*
- `#define MFD_HSI 4`  
*HSI (horizontal situation indicator) MFD mode.*
- `#define MFD_LANDING 5`  
*VTOL support MFD mode.*
- `#define MFD_DOCKING 6`  
*Docking support MFD mode.*
- `#define MFD_OPLANEALIGN 7`  
*Orbital plane alignment MFD mode.*
- `#define MFD_OSYNC 8`  
*Orbit synchronisation MFD mode.*
- `#define MFD_TRANSFER 9`  
*Transfer orbit MFD mode.*
- `#define MFD_COMMs 10`  
*Communications MFD mode.*
- `#define MFD_USERTYPE 64`  
*User-defined MFD mode.*
- `#define BUILTIN_MFD_MODES 10`  
*Number of built-in MFD modes.*

### 16.32.1 Detailed Description

These constants are used to refer to the built-in MFD (multifunctional display) modes.

## 16.33 MFD identifiers

### Macros

- `#define MAXMFD 12`  
*Max. number of MFD displays per panel.*
- `#define MFD_LEFT 0`  
*Left default MFD display.*
- `#define MFD_RIGHT 1`  
*Right default MFD display.*
- `#define MFD_USER1 2`  
*User-defined MFD display 1.*
- `#define MFD_USER2 3`  
*User-defined MFD display 2.*
- `#define MFD_USER3 4`  
*User-defined MFD display 3.*
- `#define MFD_USER4 5`  
*User-defined MFD display 4.*
- `#define MFD_USER5 6`  
*User-defined MFD display 5.*
- `#define MFD_USER6 7`  
*User-defined MFD display 6.*
- `#define MFD_USER7 8`  
*User-defined MFD display 7.*
- `#define MFD_USER8 9`  
*User-defined MFD display 8.*
- `#define MFD_USER9 10`  
*User-defined MFD display 9.*
- `#define MFD_USER10 11`  
*User-defined MFD display 10.*

### 16.33.1 Detailed Description

## 16.34 Panel neighbour identifiers

### Macros

- `#define PANEL_LEFT 0`  
*left neighbour*
- `#define PANEL_RIGHT 1`  
*right neighbour*
- `#define PANEL_UP 2`  
*above neighbour*
- `#define PANEL_DOWN 3`  
*below neighbour*

### 16.34.1 Detailed Description

#### See also

[oapiSwitchPanel](#)

## 16.35 Panel redraw event identifiers

### Macros

- `#define PANEL_REDRAW_NEVER 0x0000`  
*Don't generate redraw events.*
- `#define PANEL_REDRAW_ALWAYS 0x0001`  
*Generate event at each frame.*
- `#define PANEL_REDRAW_MOUSE 0x0002`  
*Generate event on mouse event.*
- `#define PANEL_REDRAW_INIT 0x0003`  
*Initialisation event.*
- `#define PANEL_REDRAW_USER 0x0004`  
*User-generated event.*
- `#define PANEL_REDRAW_GDI 0x1000`  
*Allow GDI access during redraw events.*
- `#define PANEL_REDRAW_SKETCHPAD 0x2000`  
*Allow Sketchpad access during redraw events.*

### 16.35.1 Detailed Description

These constants are used to refer to cockpit area redraw event types during panel area registration and by the event handlers.

## 16.36 Mouse event identifiers

### Macros

- `#define PANEL_MOUSE_IGNORE 0x00`  
*Don't generate mouse events.*
- `#define PANEL_MOUSE_LBUTTONDOWN 0x01`  
*Left button down event.*
- `#define PANEL_MOUSE_RBUTTONDOWN 0x02`  
*Right button down event.*
- `#define PANEL_MOUSE_LBUTTONUP 0x04`  
*Left button release event.*
- `#define PANEL_MOUSE_RBUTTONUP 0x08`  
*Right button release event.*
- `#define PANEL_MOUSE_LBPRESSION 0x10`  
*Left button down (continuous)*
- `#define PANEL_MOUSE_RBPRESSION 0x20`  
*Right button down (continuous)*
- `#define PANEL_MOUSE_DOWN 0x03`  
*Composite down event.*
- `#define PANEL_MOUSE_UP 0x0C`  
*Composite release event.*
- `#define PANEL_MOUSE_PRESSED 0x30`  
*Composite down (continuous)*
- `#define PANEL_MOUSE_ONREPLAY 0x40`  
*Create mouse events during replay.*

#### 16.36.1 Detailed Description

These constants are used to refer to cockpit mouse event types during panel area registration and by the event handlers.

### Note

PANEL\_MOUSE\_IGNORE and PANEL\_MOUSE\_ONREPLAY are used only during area registration. Areas with the PANEL\_MOUSE\_IGNORE attribute never generate mouse events. Areas with the PANEL\_MOUSE\_ONREPLAY attribute generate mouse events also during replay sessions (off by default).

## 16.37 Panel area texture mapping identifiers

### Macros

- `#define PANEL_MAP_NONE 0x00`  
*area texture is undefined (i.e. should be completely redrawn)*
- `#define PANEL_MAP_BACKGROUND 0x01`  
*area texture contains a copy of the panel background*
- `#define PANEL_MAP_CURRENT 0x02`  
*area texture contains a copy of the current panel state*
- `#define PANEL_MAP_BGONREQUEST 0x03`  
*area texture is undefined, but panel background can be requested*
- `#define PANEL_MAP_DIRECT 0x04`  
*provide the entire input surface to redraw functions without clipping*

### 16.37.1 Detailed Description

The constants are used during panel area instantiations for defining how the panel area texture is presented to the redraw callback function.

#### Note

`PANEL_MAP_NONE` is the most efficient option if the area texture is completely redrawn at each redraw event.  
`PANEL_MAP_BGONREQUEST` is more efficient than `PANEL_MAP_BACKGROUND` if the area texture may not need to be updated at each redraw event.

## 16.38 Generic vessel message identifiers

### Macros

- `#define VMSG_LUAINTERPRETER 0x0001`  
*initialise Lua interpreter*
- `#define VMSG_LUAINSTANCE 0x0002`  
*create Lua vessel instance*
- `#define VMSG_USER 0x1000`  
*base index for user-defined messages*

### 16.38.1 Detailed Description

## 16.39 Vessel mesh visibility flags

### Macros

- `#define MESHVIS_NEVER 0x00`  
*Mesh is never visible.*
- `#define MESHVIS_EXTERNAL 0x01`  
*Mesh is visible in external views.*
- `#define MESHVIS_COCKPIT 0x02`  
*Mesh is visible in all internal (cockpit) views.*
- `#define MESHVIS_ALWAYS (MESHVIS_EXTERNAL|MESHVIS_COCKPIT)`  
*Mesh is always visible.*
- `#define MESHVIS_VC 0x04`  
*Mesh is only visible in virtual cockpit internal views.*
- `#define MESHVIS_EXTPASS 0x10`  
*Visibility modifier: render mesh during external pass, even for internal views.*

### 16.39.1 Detailed Description

These constants determine the visibility of vessel meshes in specific camera modes.

### See also

[VESSEL::SetMeshVisibilityMode](#), [VESSEL::GetMeshVisibilityMode](#)

## 16.40 Navigation radio transmitter types

### Macros

- `#define TRANSMITTER_NONE 0`
- `#define TRANSMITTER_VOR 1`
- `#define TRANSMITTER_VTOL 2`
- `#define TRANSMITTER_ILS 3`
- `#define TRANSMITTER_IDS 4`
- `#define TRANSMITTER_XPDR 5`

### 16.40.1 Detailed Description

#### See also

[oapiGetNavType](#)

## 16.41 Object parameter flags

### Macros

- `#define OBJPRM_PLANET_SURFACEMAXLEVEL 0x0001`

*Max. resolution level for planet surface rendering. (Parameter type: DWORD)*
- `#define OBJPRM_PLANET_SURFACERIPPLE 0x0002`

*Flag for ripple effect on reflective surfaces (Parameter type: bool)*
- `#define OBJPRM_PLANET_HAZEEXTENT 0x0003`

*Bleed-in factor of atmospheric haze into planet disc. (Parameter type: double; range: 0-0.9)*
- `#define OBJPRM_PLANET_HAZEDENSITY 0x0004`

*Density at which the horizon haze is rendered (basic density is calculated from atmospheric density) Default: 1.0. (Parameter type: double)*
- `#define OBJPRM_PLANET_HAZESHIFT 0x0005`
- `#define OBJPRM_PLANET_HAZECOLOUR 0x0006`
- `#define OBJPRM_PLANET_FOGPARAM 0x0007`
- `#define OBJPRM_PLANET_SHADOWCOLOUR 0x0008`
- `#define OBJPRM_PLANET_HASCLOUDS 0x0009`
- `#define OBJPRM_PLANET_CLOUDALT 0x000A`
- `#define OBJPRM_PLANET_CLOUDROTATION 0x000B`
- `#define OBJPRM_PLANET_CLOUDSHADOWCOL 0x000C`

*Depth of cloud shadows (parameter type: float)*
- `#define OBJPRM_PLANET_CLOUDMICROTEX 0x000D`
- `#define OBJPRM_PLANET_CLOUDMICROALTMIN 0x000E`
- `#define OBJPRM_PLANET_CLOUDMICROALTMAX 0x000F`
- `#define OBJPRM_PLANET_HASRINGS 0x0010`
- `#define OBJPRM_PLANET_RINGMINRAD 0x0011`
- `#define OBJPRM_PLANET_RINGMAXRAD 0x0012`
- `#define OBJPRM_PLANET_ATTENUATIONALT 0x0013`

*Altitude [m] up to which an atmosphere attenuates light cast from the sun on a spacecraft. (Parameter type: double)*
- `#define OBJPRM_PLANET_TILEENGINE 0x0014`

*Planet tile engine version (1 or 2) (Parameter type: int)*
- `#define OBJPRM_PLANET_CLOUDTILEENGINE 0x0015`

*Planet cloud tile engine version (1 or 2) (Parameter type: int)*
- `#define OBJPRM_PLANET_ATMTINTCOLOUR 0x0016`

*Atmospheric tint colour. This colour is mixed into the surface textures when seen through an atmospheric layer. (Parameter type: VECTOR3)*
- `#define OBJPRM_PLANET_CLOUDMAXLEVEL 0x0017`

*Max. resolution level for cloud layer rendering (Parameter type: int)*
- `#define OBJPRM_PLANET_CLOUDOVERSATURATE 0x0018`

*Enhance cloud brightness? (Parameter type: bool)*
- `#define OBJPRM_PLANET_HORIZONEXCESS 0x0019`

*Extend horizon visibility radius (avoid disappearing mountaintop artefacts) (Parameter type: double)*
- `#define OBJPRM_PLANET_TILEBBEXCESS 0x0020`

*Extend tile bounding box (avoid disappearing tiles for irregular shaped bodies) (Parameter type: double)*

### 16.41.1 Detailed Description

Used by [oapiGetObjectParam\(\)](#)

## 16.42 Orbiter API interface methods

### Modules

- Object access functions
- Vessel creation and destruction
- Body functions
- Vessel functions
- Coordinate transformations
- Camera functions
- Functions for planetary bodies
- Elevation data-related functions
- Surface base interface
- Time functions
- Navigation radio transmitter functions
- Script interpreter functions
- Visual and mesh functions
- HUD, MFD and panel functions
- Drawing support functions
- Surface functions
- Custom MFD mode definition
- Virtual cockpit functions
- Customisation - custom menu, dialogs
- File IO Functions
- Utility functions
- User input functions
- Onscreen annotations
- Obsolete functions

### Functions

- OAPIFUNC bool `oapiRegisterGraphicsClient (oapi::GraphicsClient *gc)`  
*Register graphics client class instance.*
- OAPIFUNC int `oapiGetOrbiterVersion ()`  
*Returns the version number of the Orbiter core system.*
- int `oapiGetModuleVersion ()`  
*Returns the API version number against which the module was linked.*
- OAPIFUNC HINSTANCE `oapiGetOrbiterInstance ()`  
*Returns the instance handle for the running Orbiter application.*
- OAPIFUNC const char \* `oapiGetCmdLine ()`  
*Returns a pointer to the command line with which Orbiter was invoked.*
- OAPIFUNC void `oapiGetViewportSize (DWORD *w, DWORD *h, DWORD *bpp=0)`  
*Returns the dimensions of the render viewport.*
- OAPIFUNC void `oapiRegisterModule (oapi::Module *module)`  
*Register a module interface class instance.*
- OAPIFUNC char \* `oapiDebugString ()`  
*Returns a pointer to a string which will be displayed in the lower left corner of the viewport.*
- OAPIFUNC void `oapiGetBarycentre (OBJHANDLE hObj, VECTOR3 *bary)`  
*Returns the global position of the barycentre of a complete planetary system or a single planet-moons system.*
- OAPIFUNC SURFHANDLE `oapiRegisterExhaustTexture (char *name)`  
*Request a custom texture for vessel exhaust rendering.*
- OAPIFUNC SURFHANDLE `oapiRegisterReentryTexture (char *name)`  
*Request a custom texture for vessel reentry flame rendering.*

- OAPIFUNC **SURFHANDLE oapiRegisterParticleTexture** (char \*name)
- OAPIFUNC void **oapiSetShowGrapplePoints** (bool show)
- OAPIFUNC bool **oapiGetShowGrapplePoints** ()
- OAPIFUNC double **oapiGetInducedDrag** (double cl, double A, double e)  
*Aerodynamics helper function.*
- OAPIFUNC double **oapiGetWaveDrag** (double M, double M1, double M2, double M3, double cmax)  
*Aerodynamics helper function.*

#### 16.42.1 Detailed Description

The functions in this section provide a general framework to retrieve and set Orbiter simulation parameters from an addon module. For a linear list of oapi functions, constants and enumerations, see [OrbiterAPI.h](#). For vessel-specific parameters see also the [VESSEL](#) class.

#### 16.42.2 Function Documentation

##### 16.42.2.1 OAPIFUNC char\* oapiDebugString ( )

Returns a pointer to a string which will be displayed in the lower left corner of the viewport.

###### Returns

Pointer to debugging string.

###### Note

This function should only be used for debugging purposes. Do not use it in published modules!  
The returned pointer refers to a global char[256] in the Orbiter core. It is the responsibility of the module to ensure that no overflow occurs.  
If the string is written to more than once per time step (either within a single module or by multiple modules) the last state before rendering will be displayed.  
A typical use would be:

```
1 sprintf (oapiDebugString(), "my value is %f", myvalue);
```

##### 16.42.2.2 OAPIFUNC void oapiGetBarycentre ( OBJHANDLE *hObj*, VECTOR3 \* *bary* )

Returns the global position of the barycentre of a complete planetary system or a single planet-moons system.

###### Parameters

<i>hObj</i>	celestial body handle
<i>bary</i>	pointer to vector receiving barycentre data

###### Note

The barycentre is the centre of mass of a distribution of objects. In this case, all involved celestial bodies are considered point masses, and the barycentre is defined as

$$\vec{r}_B = \left( \sum_i m_i \right)^{-1} \sum_i m_i \vec{r}_i$$

*hObj* must be the handle of a celestial body.

The summation involves the body itself and all its secondaries, e.g. a planet and its moons.

The barycentre of a star (0th level object) is always the origin (0,0,0).

The barycentre of an object without associated secondaries is identical to its position.

#### 16.42.2.3 OAPIFUNC const char\* oapiGetCmdLine ( )

Returns a pointer to the command line with which Orbiter was invoked.

##### Returns

Pointer to orbiter command line string.

##### Note

This method can be used to pass custom parameters to a module directly from the orbiter command line.

#### 16.42.2.4 OAPIFUNC double oapiGetInducedDrag ( double $c_l$ , double $A$ , double $e$ )

Aerodynamics helper function.

This is a helper function which is useful when implementing the callback function calculating the aerodynamics coefficients for an airfoil (see [VESSEL::CreateAirfoil](#)). It computes the lift-induced component  $c_{D,i}$  of the drag coefficient as a function of lift coefficient  $c_L$ , wing aspect ratio  $A$ , and wing efficiency factor  $e$ , as

$$c_{D,i} = \frac{c_L^2}{\pi A e}$$

##### Parameters

$c_l$	lift coefficient
$A$	wing aspect ratio
$e$	wing efficiency factor

##### Returns

Induced drag coefficient  $c_{D,i}$

##### Note

The full drag coefficient required by the airfoil callback function consists of several components: profile drag  $c_{D,e}$ , induced drag  $c_{D,i}$  and wave drag  $c_{D,w}$

$$c_D = c_{D,e} + c_{D,i} + c_{D,w}$$

where  $c_{D,e}$  is caused by skin friction and pressure components, and  $c_{D,w}$  is a result of the shock wave and flow separation in transonic and supersonic flight.

The wing aspect ratio is defined as  $b^2/S$ , where  $b$  is the wing span, and  $S$  is the wing area.

The efficiency factor depends on the wing shape. The most efficient wings are elliptical, with  $e = 1$ . For all other shapes,  $e < 1$ .

This function can be interpreted slightly differently by moving the angle of attack-dependency of the profile drag into the induced drag component:

$$c_D = c_{D,0} + c'_{D,i} + c_{D,w}$$

where  $c_{D,0}$  is the zero-lift component of the profile drag, and  $c'_{D,i}$  is a modified induced drag obtained by replacing the shape factor  $e$  with the Oswald efficiency factor. See Programmer's Guide for more details.

#### 16.42.2.5 int oapiGetModuleVersion ( )

Returns the API version number against which the module was linked.

##### Returns

module version number

**Note**

Orbiter version numbers are derived from the build date. The version number is constructed as (year%100)\*10000 + month\*100 + day, resulting in a decimal version number of the form YYMMDD

**See also**

[oapiGetOrbiterVersion](#)

**16.42.2.6 OAPIFUNC HINSTANCE oapiGetOrbiterInstance ( )**

Returns the instance handle for the running Orbiter application.

**Returns**

Orbiter instance handle

**16.42.2.7 OAPIFUNC int oapiGetOrbiterVersion ( )**

Returns the version number of the Orbiter core system.

**Returns**

version number

**Note**

Orbiter version numbers are derived from the build date. The version number is constructed as (year%100)\*10000 + month\*100 + day, resulting in a decimal version number of the form YYMMDD

**See also**

[oapiGetModuleVersion](#)

**16.42.2.8 OAPIFUNC void oapiGetViewportSize ( DWORD \* w, DWORD \* h, DWORD \* bpp = 0 )**

Returns the dimensions of the render viewport.

**Parameters**

<i>w</i>	pointer to viewport width [pixel]
<i>h</i>	pointer to viewport height [pixel]
<i>bpp</i>	pointer to colour depth [bits per pixel]

**Note**

This function writes the viewport width, height and (optionally) colour depth values into the variables pointed to by the function parameters.

For fullscreen modes, the viewport size corresponds to the fullscreen resolution. For windowed modes, the viewport size corresponds to the client area of the render window.

**16.42.2.9 OAPIFUNC double oapiGetWaveDrag ( double *M*, double *M1*, double *M2*, double *M3*, double *cmax* )**

Aerodynamics helper function.

This is a helper function which is useful when implementing the callback function calculating the aerodynamics coefficients for an airfoil (see [VESSEL::CreateAirfoil](#)). It uses a simple model to compute the wave drag component

of the drag coefficient,  $c_{D,w}$ . Wave drag significantly affects the vessel drag around Mach 1, and falls off towards lower and higher airspeeds. This function uses the following model:

$$c_{D,w} = \begin{cases} 0 & \text{if } M < M_1 \\ c_m \frac{M - M_1}{M_2 - M_1} & \text{if } M_1 < M < M_2 \\ c_m & \text{if } M_2 < M < M_3 \\ c_m \frac{(M_3^2 - 1)^{1/2}}{(M^2 - 1)^{1/2}} & \text{if } M > M_3 \end{cases}$$

where  $0 < M_1 < M_2 < 1 < M_3$  are characteristic Mach numbers, and  $c_m$  is the maximum wave drag coefficient at transonic speeds.

#### Parameters

$M$	current Mach number
$M_1$	characteristic Mach number
$M_2$	characteristic Mach number
$M_3$	characteristic Mach number
$cmax$	maximum wave drag coefficient $c_m$

#### Returns

Wave drag coefficient  $c_{D,w}$

#### Note

The model underlying this function assumes a piecewise linear wave drag profile for  $M < M_3$ , and a decay with  $(M^2 - 1)^{-1/2}$  for  $M > M_3$ . If this profile is not suitable for a given airfoil, the programmer must implement wave drag manually.

#### See also

[oapiGetInducedDrag](#), [VESSEL::CreateAirfoil](#)

### 16.42.2.10 OAPIFUNC SURFHANDLE oapiRegisterExhaustTexture ( `char * name` )

Request a custom texture for vessel exhaust rendering.

#### Parameters

<code>name</code>	exhaust texture file name (without path and extension)
-------------------	--

#### Returns

texture handle

#### Note

The exhaust texture must be stored in DDS format in Orbiter's default texture directory.

If the texture is not found the function returns NULL.

The texture can be used to define custom textures in [VESSEL::AddExhaust](#).

#### See also

[oapiRegisterReentryTexture](#), [oapiRegisterParticleTexture](#)

### 16.42.2.11 OAPIFUNC bool oapiRegisterGraphicsClient ( `oapi::GraphicsClient * gc` )

Register graphics client class instance.

Graphics clients plugins should use this function to register the class instance instead of [oapiRegisterModule](#).

**Parameters**

<i>gc</i>	pointer to graphics client instance
-----------	-------------------------------------

**Returns**

true if client was registered successfully

**16.42.2.12 OAPIFUNC void oapiRegisterModule ( *oapi::Module* \* *module* )**

Register a module interface class instance.

Plugin modules that use an interface class instance derived from *oapi::Module* must register it with this function during module initialisation (typically in the body of *InitModule*).

**Parameters**

<i>module</i>	pointer to the interface class instance
---------------	---

**Note**

The DLL should *not* delete the module instance in *ExitModule*. Orbiter destroys all registered modules automatically when required.

**16.42.2.13 OAPIFUNC SURFHANDLE oapiRegisterReentryTexture ( *char* \* *name* )**

Request a custom texture for vessel reentry flame rendering.

**Parameters**

<i>name</i>	reentry texture file name (without path and extension)
-------------	--

**Returns**

texture handle

**Note**

The exhaust texture must be stored in DDS format in Orbiter's default texture directory.

If the texture is not found the function returns NULL.

The texture can be used to define custom textures in [VESSEL::SetReentryTexture\(\)](#).

**See also**

[oapiRegisterExhaustTexture](#), [oapiRegisterParticleTexture](#)

## 16.43 Object access functions

### Functions

- OAPIFUNC **OBJHANDLE** oapiGetObjectByName (char \*name)  
*Returns a handle for a named simulation object.*
- OAPIFUNC **OBJHANDLE** oapiGetObjectByIndex (int index)  
*Returns a handle for an indexed simulation object.*
- OAPIFUNC **DWORD** oapiGetObjectCount ()  
*Returns the number of objects currently present in the simulation.*
- OAPIFUNC **int** oapiGetObjectType (**OBJHANDLE** hObj)  
*Returns the type of an object identified by its handle.*
- OAPIFUNC **const void \*** oapiGetObjectParam (**OBJHANDLE** hObj, **DWORD** paramtype)  
*Returns an object-specific configuration parameter.*
- OAPIFUNC **OBJHANDLE** oapiGetVesselByName (char \*name)  
*Returns the handle of a vessel identified by its name.*
- OAPIFUNC **OBJHANDLE** oapiGetVesselByIndex (int index)  
*Returns the handle of a vessel identified by its reference index.*
- OAPIFUNC **DWORD** oapiGetVesselCount ()  
*Returns the number of vessels currently present in the simulation.*
- OAPIFUNC **bool** oapisVessel (**OBJHANDLE** hVessel)  
*Checks if the specified handle is a valid vessel handle.*
- OAPIFUNC **OBJHANDLE** oapiGetGbodyByName (char \*name)  
*Returns the handle of a celestial body (sun, planet or moon) identified by its name.*
- OAPIFUNC **OBJHANDLE** oapiGetGbodyByIndex (int index)  
*Returns the handle of a celestial body (sun, planet or moon) indentified by its list index.*
- OAPIFUNC **DWORD** oapiGetGbodyCount ()  
*Returns the number of celestial bodies (sun, planets and moons) currently present in the simulation.*
- OAPIFUNC **OBJHANDLE** oapiGetBaseByName (**OBJHANDLE** hPlanet, char \*name)  
*Returns the handle of a surface base on a given planet or moon.*
- OAPIFUNC **OBJHANDLE** oapiGetBaseByIndex (**OBJHANDLE** hPlanet, int index)  
*Returns the handle of a surface base on a planet or moon given by its list index.*
- OAPIFUNC **DWORD** oapiGetBaseCount (**OBJHANDLE** hPlanet)  
*Returns the number of surface bases defined for a given planet.*
- OAPIFUNC **void** oapiGetObjectName (**OBJHANDLE** hObj, char \*name, int n)  
*Returns the name of an object.*
- OAPIFUNC **OBJHANDLE** oapiGetFocusObject ()  
*Returns the handle for the current focus object.*
- OAPIFUNC **OBJHANDLE** oapiSetFocusObject (**OBJHANDLE** hVessel)  
*Switches the input focus to a different vessel object.*
- OAPIFUNC **VESSEL \*** oapiGetVesselInterface (**OBJHANDLE** hVessel)  
*Returns a **VESSEL** class instance for a vessel.*
- OAPIFUNC **VESSEL \*** oapiGetFocusInterface ()  
*Returns the **VESSEL** class instance for the current focus object.*
- OAPIFUNC **CELBODY \*** oapiGetCelbodyInterface (**OBJHANDLE** hBody)  
*Returns a **CELBODY** interface instance for a celestial body, if available.*

### 16.43.1 Detailed Description

### 16.43.2 Function Documentation

#### 16.43.2.1 OAPIFUNC **OBJHANDLE** oapiGetBaseByIndex ( **OBJHANDLE** hPlanet, **int** index )

Returns the handle of a surface base on a planet or moon given by its list index.

## Parameters

<i>hPlanet</i>	handle of the planet or moon on which the base is located
<i>index</i>	list index ( $0 \leq \text{index} < \text{oapiGetBaseCount}(\text{hPlanet})$ )

## Returns

Base object handle, or NULL if index out of range.

## See also

[oapiGetBaseCount](#), [oapiGetBaseByName](#), [oapiGetBasePlanet](#)

16.43.2.2 OAPIFUNC OBJHANDLE [oapiGetBaseByName](#) ( OBJHANDLE *hPlanet*, char \* *name* )

Returns the handle of a surface base on a given planet or moon.

## Parameters

<i>hPlanet</i>	handle of planet or moon on which the base is located
<i>name</i>	base name (not case-sensitive)

## Returns

Base object handle, or NULL if base was not found.

## See also

[oapiGetBaseByIndex](#), [oapiGetBasePlanet](#)

16.43.2.3 OAPIFUNC DWORD [oapiGetBaseCount](#) ( OBJHANDLE *hPlanet* )

Returns the number of surface bases defined for a given planet.

## Parameters

<i>hPlanet</i>	handle of a planet or moon
----------------	----------------------------

## Returns

Number of surface bases ( $\geq 0$ ).

16.43.2.4 OAPIFUNC CELBODY\* [oapiGetCelbodyInterface](#) ( OBJHANDLE *hBody* )

Returns a [CELBODY](#) interface instance for a celestial body, if available.

## Parameters

<i>hBody</i>	handle of a celestial body
--------------	----------------------------

## Returns

Pointer to the [CELBODY](#) class instance for the body, or NULL if the body is not controlled by an external module.

## Note

*hBody* must be a valid handle for a celestial body (star, planet, moon, etc.), e.g. as obtained from [oapiGetCelbodyByName](#). Passing a handle of any other type will result in undefined behaviour.

Only celestial bodies controlled by external plugin modules have access to a [CELBODY](#) instance. Celestial bodies that are updated internally by Orbiter (e.g. using 2-body orbital elements, or dynamic updates) return NULL here.

### 16.43.2.5 OAPIFUNC VESSEL\* oapiGetFocusInterface ( )

Returns the [VESSEL](#) class instance for the current focus object.

#### Returns

Pointer to an instance of the [VESSEL](#) class or a derived class, providing an interface for access to the current focus object.

### 16.43.2.6 OAPIFUNC OBJHANDLE oapiGetFocusObject ( )

Returns the handle for the current focus object.

#### Returns

Focus object handle

#### Note

The focus object is the user-controlled vessel which receives keyboard and joystick input.

This function returns a valid vessel handle during a simulation session (between [oapi::Module::clbkSimulationStart\(\)](#) and [oapi::Module::clbkSimulationEnd\(\)](#))

#### See also

[oapiSetFocusObject](#)

### 16.43.2.7 OAPIFUNC OBJHANDLE oapiGetGbodyByIndex ( int *index* )

Returns the handle of a celestial body (sun, planet or moon) identified by its list index.

#### Parameters

<i>index</i>	object index (0 <= index < <a href="#">oapiGetGbodyCount()</a> )
--------------	--

#### Returns

Object handle, or NUL if index out of range.

#### See also

[oapiGetGbodyCount](#), [oapiGetGbodyByName](#)

### 16.43.2.8 OAPIFUNC OBJHANDLE oapiGetGbodyByName ( char \* *name* )

Returns the handle of a celestial body (sun, planet or moon) identified by its name.

#### Parameters

<i>name</i>	celestial object name (not case-sensitive)
-------------	--

#### Returns

Object handle, or NULL if the object could not be found.

#### Note

Celestial bodies in orbiter are objects that act as sources for gravitational fields.

#### See also

[oapiGetGbodyByIndex](#)

**16.43.2.9 OAPIFUNC DWORD oapiGetGbodyCount( )**

Returns the number of celestial bodies (sun, planets and moons) currently present in the simulation.

**Returns**

Number of objects.

**16.43.2.10 OAPIFUNC OBJHANDLE oapiGetObjectByIndex ( int *index* )**

Returns a handle for an indexed simulation object.

**Parameters**

<i>index</i>	object index (0 <= index < <a href="#">oapiGetObjectCount()</a> )
--------------	---

**Returns**

object handle

**Note**

Objects can be created and deleted during a simulation session. Therefore the list index of a given object and the range of valid list indices can change.

A typical use for accessing objects by index is in a loop running over all present objects:

```
1 for (int i = 0; i < oapiGetObjectCount(); i++) {  
2     OBJHANDLE hObj = oapiGetObjectByIndex (i);  
3     // do something with hObj  
4 }
```

**See also**

[oapiGetObjectByName](#), [oapiGetObjectType](#)

**16.43.2.11 OAPIFUNC OBJHANDLE oapiGetObjectByName ( char \* *name* )**

Returns a handle for a named simulation object.

**Parameters**

<i>name</i>	object name
-------------	-------------

**Returns**

object handle

**Note**

Objects can be vessels, planets, moons or suns.

A return value of NULL indicates that the object was not found.

The name is not case-sensitive ("Jupiter" will also match "jupiter" or "JUPITER").

Surface base handles cannot be retrieved with this method, because a planet handle is required in addition to the base name to uniquely identify the base. Use [oapiGetBaseByName\(\)](#) or [oapiGetBaseByIndex\(\)](#) instead.

**See also**

[oapiGetObjectByIndex](#), [oapiGetVesselByName](#), [oapiGetGbodyByName](#), [oapiGetBaseByName](#), [oapiGetObjectType](#)

### 16.43.2.12 OAPIFUNC DWORD oapiGetObjectCount ( )

Returns the number of objects currently present in the simulation.

#### Returns

object count

#### See also

[oapiGetObjectByIndex](#), [oapiGetObjectType](#)

### 16.43.2.13 OAPIFUNC void oapiGetObjectName ( OBJHANDLE *hObj*, char \* *name*, int *n* )

Returns the name of an object.

#### Parameters

<i>hObj</i>	object handle
<i>name</i>	pointer to character array to receive object name
<i>n</i>	length of character array

#### Note

*name* must be allocated to at least size *n* by the calling function.

If the string buffer is not long enough to hold the object name, the name is truncated.

### 16.43.2.14 OAPIFUNC const void\* oapiGetObjectParam ( OBJHANDLE *hObj*, DWORD *paramtype* )

Returns an object-specific configuration parameter.

#### Parameters

<i>hObj</i>	object handle
<i>paramtype</i>	parameter identifier (see <a href="#">Object parameter flags</a> )

#### Returns

pointer to parameter value

#### Note

This function returns the current value of a configuration parameter for a given object (e.g. planet).

The type of the return value depends on the parameter. The generic void pointer must be cast into the appropriate parameter type. Example:

```
1 bool *bClouds = (bool*)oapiGetObjectParam (hObj, OBJPRM_PLANET_HASCLOUDS);
```

#### See also

[Object parameter flags](#)

### 16.43.2.15 OAPIFUNC int oapiGetObjectType ( OBJHANDLE *hObj* )

Returns the type of an object identified by its handle.

## Parameters

<i>hObj</i>	object handle
-------------	---------------

## Returns

Integer code identifying the vessel type.

## Note

The following type identifiers are currently supported:

OBJTP_INVALID	invalid object handle
OBJTP_GENERIC	generic object (not currently used)
OBJTP_CBODY	generic celestial body (not currently used)
OBJTP_STAR	star
OBJTP_PLANET	planet (used for all celestial bodies that are not stars, including moons, comets, etc.)
OBJTP_VESSEL	vessel (spacecraft, space stations, etc.)
OBJTP_SURFBASE	surface base (spaceport)

This function searches through Orbiter's object list to determine if the provided object handle is valid. It scales with O(n) in the presence of n objects.

## See also

[oapiGetObjectParam](#), [oapiGetObjectCount](#)

16.43.2.16 OAPIFUNC OBJHANDLE oapiGetVesselByIndex ( int *index* )

Returns the handle of a vessel identified by its reference index.

## Parameters

<i>index</i>	object index (0 <= index < <a href="#">oapiGetVesselCount()</a> )
--------------	---

## Returns

Vessel object handle, or NULL if index out of range.

## Note

The index of a vessel can change during the simulation if vessels are created or destroyed. A typical use for [oapiGetVesselByIndex\(\)](#) would be to implement a loop over all vessels:

```
1 for (i = 0; i < oapiGetVesselCount(); i++) {
2     OBJHANDLE hVessel = oapiGetVesselByIndex (i);
3     // do something with hVessel
4 }
```

## See also

[oapiGetVesselByName](#), [oapiGetVesselCount](#)

16.43.2.17 OAPIFUNC OBJHANDLE oapiGetVesselByName ( char \* *name* )

Returns the handle of a vessel identified by its name.

## Parameters

<i>name</i>	vessel name (not case-sensitive)
-------------	----------------------------------

## Returns

Vessel object handle, or NULL if the vessel could not be found.

## See also

[oapiGetVesselByIndex](#)

## 16.43.2.18 OAPIFUNC DWORD oapiGetVesselCount ( )

Returns the number of vessels currently present in the simulation.

## Returns

Vessel count.

## See also

[oapiGetVesselByIndex](#)

16.43.2.19 OAPIFUNC VESSEL\* oapiGetVesselInterface ( OBJHANDLE *hVessel* )

Returns a [VESSEL](#) class instance for a vessel.

## Parameters

<i>hVessel</i>	vessel handle
----------------	---------------

## Returns

Pointer to an instance of the [VESSEL](#) class or a derived class, providing an interface for access to the specified vessel.

16.43.2.20 OAPIFUNC bool oapisVessel ( OBJHANDLE *hVessel* )

Checks if the specified handle is a valid vessel handle.

## Parameters

<i>hVessel</i>	handle to be tested
----------------	---------------------

## Returns

*true* if *hVessel* is a valid vessel handle, *false* otherwise.

## Note

This function can be used to test if a previously obtained vessel handle is still valid. A handle becomes invalid if the associated vessel is deleted.

An alternative to using [oapisVessel\(\)](#) is monitoring vessel deletions by implementing the [oapi::Module::clbkDeleteVessel\(\)](#) callback function of the module instance.

## See also

[oapiGetObjectType](#)

16.43.2.21 OAPIFUNC OBJHANDLE oapiSetFocusObject ( OBJHANDLE *hVessel* )

Switches the input focus to a different vessel object.

**Parameters**

<i>hVessel</i>	handle of vessel to receive input focus
----------------	---

**Returns**

Handle of vessel losing focus, or NULL if focus did not change.

**Note**

*hVessel* must refer to a vessel object. Trying to set the focus to a different object type will fail.

**See also**

[oapiGetFocusObject](#)

## 16.44 Vessel creation and destruction

### Functions

- OAPIFUNC `OBJHANDLE oapiCreateVessel` (const char \*name, const char \*classname, const `VESSELSSTATUS` &status)
 

*Creates a new vessel.*
- OAPIFUNC `OBJHANDLE oapiCreateVesselEx` (const char \*name, const char \*classname, const void \*status)
 

*Creates a new vessel via a VESSELSTATUSx (x >= 2) interface.*
- OAPIFUNC bool `oapiDeleteVessel` (`OBJHANDLE hVessel`, `OBJHANDLE hAlternativeCameraTarget=0`)
 

*Deletes an existing vessel.*

### 16.44.1 Detailed Description

### 16.44.2 Function Documentation

#### 16.44.2.1 OAPIFUNC `OBJHANDLE oapiCreateVessel` ( const char \* name, const char \* classname, const `VESSELSTATUS` & status )

Creates a new vessel.

#### Parameters

<code>name</code>	vessel name
<code>classname</code>	vessel class name
<code>status</code>	initial vessel status

#### Returns

Handle of the new vessel.

#### Note

A configuration file for the specified vessel class must exist in the Config or Config/Vessels subdirectory. `oapiCreateVesselEx` is an extended version of this function operating on a more versatile status structure.

#### See also

`oapiCreateVesselEx`, `VESSELSTATUS`

#### 16.44.2.2 OAPIFUNC `OBJHANDLE oapiCreateVesselEx` ( const char \* name, const char \* classname, const void \* status )

Creates a new vessel via a VESSELSTATUSx (x >= 2) interface.

#### Parameters

<code>name</code>	vessel name
<code>classname</code>	vessel class name
<code>status</code>	pointer to a VESSELSTATUSx structure

#### Returns

Handle of the new vessel.

**Note**

A configuration file for the specified vessel class must exist in the Config or the Config\Vessels folder, or a subfolder. If the config file is located in a subfolder, the relative path must be included in the *classname* parameter.

*status* must point to a VESSELSTATUSx structure. Currently only **VESSELSTATUS2** is supported, but future Orbiter versions may add new interfaces.

During the vessel creation process Orbiter will call the module's **VESSEL2::clbkSetStateEx** callback function if it exists.

**See also**

[oapiCreateVessel](#), **VESSEL2::clbkSetStateEx**, **VESSELSTATUS2**

**16.44.2.3 OAPIFUNC bool oapiDeleteVessel ( **OBJHANDLE hVessel**, **OBJHANDLE hAlternativeCameraTarget = 0** )**

Deletes an existing vessel.

**Parameters**

<i>hVessel</i>	vessel handle
<i>hAlternativeCameraTarget</i>	optional new camera target

**Returns**

*true* if vessel could be deleted.

**Note**

If the current focus vessel is deleted, Orbiter will switch focus to the closest focus-enabled vessel. If the last focus-enabled vessel is deleted, Orbiter returns to the launchpad.

If the current camera target is deleted, a new camera target can be provided in *hAlternativeCameraTarget*. If not specified, the focus object is used as default camera target.

The actual vessel destruction does not occur until the end of the current frame. Self-destruct calls are therefore permitted.

A vessel will undock all its docking ports before being destructed.

**See also**

[oapiCreateVessel](#), [oapiCreateVesselEx](#)

## 16.45 Body functions

### Functions

- OAPIFUNC double [oapiGetSize \(OBJHANDLE hObj\)](#)  
*Returns the size (mean radius) of an object.*
- OAPIFUNC double [oapiGetMass \(OBJHANDLE hObj\)](#)  
*Returns the mass of an object. For vessels, this is the total mass, including current fuel mass.*
- OAPIFUNC void [oapiGetGlobalPos \(OBJHANDLE hObj, VECTOR3 \\*pos\)](#)  
*Returns the position of an object in the global reference frame.*
- OAPIFUNC void [oapiGetGlobalVel \(OBJHANDLE hObj, VECTOR3 \\*vel\)](#)  
*Returns the velocity of an object in the global reference frame.*
- OAPIFUNC void [oapiGetRelativePos \(OBJHANDLE hObj, OBJHANDLE hRef, VECTOR3 \\*pos\)](#)  
*Returns the distance vector from hRef to hObj in the ecliptic reference frame.*
- OAPIFUNC void [oapiGetRelativeVel \(OBJHANDLE hObj, OBJHANDLE hRef, VECTOR3 \\*vel\)](#)  
*Returns the velocity difference vector of hObj relative to hRef in the ecliptic reference frame.*

### 16.45.1 Detailed Description

### 16.45.2 Function Documentation

#### 16.45.2.1 OAPIFUNC void [oapiGetGlobalPos \( OBJHANDLE hObj, VECTOR3 \\* pos \)](#)

Returns the position of an object in the global reference frame.

##### Parameters

<i>hObj</i>	object handle
<i>pos</i>	pointer to vector receiving coordinates

##### Note

The global reference frame is the heliocentric ecliptic system at ecliptic and equinox of J2000.  
 Units are meters.

##### See also

[oapiGetBarycentre](#), [oapiGetGlobalVel](#)

#### 16.45.2.2 OAPIFUNC void [oapiGetGlobalVel \( OBJHANDLE hObj, VECTOR3 \\* vel \)](#)

Returns the velocity of an object in the global reference frame.

##### Parameters

<i>hObj</i>	object handle
<i>vel</i>	pointer to vector receiving velocity data

##### Note

The global reference frame is the heliocentric ecliptic system at ecliptic and equinox of J2000.  
 Units are meters/second.

##### See also

[oapiGetBarycentre](#), [oapiGetGlobalPos](#)

#### 16.45.2.3 OAPIFUNC double [oapiGetMass \( OBJHANDLE hObj \)](#)

Returns the mass of an object. For vessels, this is the total mass, including current fuel mass.

## Parameters

<i>hObj</i>	object handle
-------------	---------------

## Returns

object mass [kg]

## See also

[oapiGetMaxFuelMass](#), [oapiGetEmptyMass](#)

**16.45.2.4 OAPIFUNC void oapiGetRelativePos ( OBJHANDLE *hObj*, OBJHANDLE *hRef*, VECTOR3 \* *pos* )**

Returns the distance vector from *hRef* to *hObj* in the ecliptic reference frame.

## Parameters

<i>hObj</i>	object handle
<i>hRef</i>	reference object handle
<i>pos</i>	pointer to vector receiving distance data

## Note

Results are w.r.t. ecliptic frame at equinox and ecliptic of J2000.0.

## See also

[oapiGetBarycentre](#), [oapiGetRelativeVel](#)

**16.45.2.5 OAPIFUNC void oapiGetRelativeVel ( OBJHANDLE *hObj*, OBJHANDLE *hRef*, VECTOR3 \* *vel* )**

Returns the velocity difference vector of *hObj* relative to *hRef* in the ecliptic reference frame.

## Parameters

<i>hObj</i>	object handle
<i>hRef</i>	reference object handle
<i>vel</i>	pointer to vector receiving velocity difference data

## Note

Results are w.r.t. ecliptic frame at equinox and ecliptic of J2000.0.

## See also

[oapiGetBarycentre](#), [oapiGetRelativePos](#)

**16.45.2.6 OAPIFUNC double oapiGetSize ( OBJHANDLE *hObj* )**

Returns the size (mean radius) of an object.

## Parameters

<i>hObj</i>	object handle
-------------	---------------

**Returns**

Object size (mean radius) in meter.

## 16.46 Vessel functions

### Enumerations

- enum `AltitudeMode` { `ALTMODE_MEANRAD`, `ALTMODE_GROUND` }

*Altitude mode used by altitude get functions.*

### Functions

- OAPIFUNC double `oapiGetEmptyMass` (`OBJHANDLE` `hVessel`)  
*Returns empty mass of a vessel, excluding fuel.*
- OAPIFUNC void `oapiSetEmptyMass` (`OBJHANDLE` `hVessel`, double `mass`)  
*Set the empty mass of a vessel (excluding fuel)*
- OAPIFUNC double `oapiGetFuelMass` (`OBJHANDLE` `hVessel`)  
*Returns current fuel mass of the first propellant resource of a vessel.*
- OAPIFUNC double `oapiGetMaxFuelMass` (`OBJHANDLE` `hVessel`)  
*Returns maximum fuel capacity of the first propellant resource of a vessel.*
- OAPIFUNC `PROPELLANT_HANDLE` `oapiGetPropellantHandle` (`OBJHANDLE` `hVessel`, `DWORD` `idx`)  
*Returns an identifier of a vessel's propellant resource.*
- OAPIFUNC double `oapiGetPropellantMass` (`PROPELLANT_HANDLE` `ph`)  
*Returns the current fuel mass [kg] of a propellant resource.*
- OAPIFUNC double `oapiGetPropellantMaxMass` (`PROPELLANT_HANDLE` `ph`)  
*Returns the maximum capacity [kg] of a propellant resource.*
- OAPIFUNC `DOCKHANDLE` `oapiGetDockHandle` (`OBJHANDLE` `hVessel`, `UINT` `n`)  
*Returns a handle to a vessel docking port.*
- OAPIFUNC `OBJHANDLE` `oapiGetDockStatus` (`DOCKHANDLE` `dock`)  
*Returns the handle of a vessel docked at a port.*
- OAPIFUNC void `oapiGetFocusGlobalPos` (`VECTOR3` \*`pos`)  
*Returns the position of the current focus object in the global reference frame.*
- OAPIFUNC void `oapiGetFocusGlobalVel` (`VECTOR3` \*`vel`)  
*Returns the velocity of the current focus object in the global reference frame.*
- OAPIFUNC void `oapiGetFocusRelativePos` (`OBJHANDLE` `hRef`, `VECTOR3` \*`pos`)  
*Returns the distance vector from `hRef` to the current focus object.*
- OAPIFUNC void `oapiGetFocusRelativeVel` (`OBJHANDLE` `hRef`, `VECTOR3` \*`vel`)  
*Returns the velocity difference vector of the current focus object relative to `hRef`.*
- OAPIFUNC `BOOL` `oapiGetAltitude` (`OBJHANDLE` `hVessel`, double \*`alt`)  
*Returns the altitude of a vessel over a planet mean radius.*
- OAPIFUNC `BOOL` `oapiGetAltitude` (`OBJHANDLE` `hVessel`, `AltitudeMode` `mode`, double \*`alt`)  
*Returns the altitude of a vessel over a planetary surface.*
- OAPIFUNC `BOOL` `oapiGetPitch` (`OBJHANDLE` `hVessel`, double \*`pitch`)  
*Returns a vessel's pitch angle w.r.t. the local horizon.*
- OAPIFUNC `BOOL` `oapiGetBank` (`OBJHANDLE` `hVessel`, double \*`bank`)  
*Returns a vessel's bank angle w.r.t. the local horizon.*
- OAPIFUNC `BOOL` `oapiGetHeading` (`OBJHANDLE` `hVessel`, double \*`heading`)  
*Returns a vessel's heading (against geometric north) calculated for the local horizon plane.*
- OAPIFUNC `BOOL` `oapiGetFocusAltitude` (double \*`alt`)  
*Returns the altitude of the current focus vessel over a planetary surface.*
- OAPIFUNC `BOOL` `oapiGetFocusPitch` (double \*`pitch`)  
*Returns the pitch angle of the current focus vessel w.r.t. the local horizon.*
- OAPIFUNC `BOOL` `oapiGetFocusBank` (double \*`bank`)  
*Returns the bank angle of the current focus vessel w.r.t. the local horizon.*

- OAPIFUNC BOOL `oapiGetFocusHeading` (double \*heading)  
*Returns the heading (against geometric north) of the current focus vessel calculated for the local horizon plane.*
- OAPIFUNC BOOL `oapiGetGroundspeed` (OBJHANDLE hVessel, double \*groundspeed)  
*Returns a vessel's ground speed w.r.t. the closest planet or moon.*
- OAPIFUNC bool `oapiGetGroundspeedVector` (OBJHANDLE hVessel, REFFRAME frame, VECTOR3 \*vel)  
*Returns a vessel's groundspeed vector w.r.t. the closest planet or moon in the requested frame of reference.*
- OAPIFUNC BOOL `oapiGetAirspeed` (OBJHANDLE hVessel, double \*airspeed)  
*Returns a vessel's true airspeed w.r.t. the closest planet or moon.*
- OAPIFUNC bool `oapiGetAirspeedVector` (OBJHANDLE hVessel, REFFRAME frame, VECTOR3 \*v)  
*Returns a vessel's true airspeed vector w.r.t. the closest planet or moon in the requested frame of reference.*
- OAPIFUNC BOOL `oapiGetEquPos` (OBJHANDLE hVessel, double \*longitude, double \*latitude, double \*radius)  
*Returns a vessel's spherical equatorial coordinates (longitude, latitude and radius) with respect to the closest planet or moon.*
- OAPIFUNC BOOL `oapiGetFocusEquPos` (double \*longitude, double \*latitude, double \*radius)  
*Returns the current focus vessel's spherical equatorial coordinates (longitude, latitude and radius) with respect to the closest planet or moon.*
- OAPIFUNC void `oapiGetAtm` (OBJHANDLE hVessel, ATMPARAM \*prm, OBJHANDLE \*hAtmRef=0)  
*Returns the atmospheric parameters at the current vessel position.*
- OAPIFUNC void `oapiGetEngineStatus` (OBJHANDLE hVessel, ENGINESTATUS \*es)  
*Retrieve the status of main, retro and hover thrusters for a vessel.*
- OAPIFUNC void `oapiGetFocusEngineStatus` (ENGINESTATUS \*es)  
*Retrieve the engine status for the focus vessel.*
- OAPIFUNC void `oapiSetEngineLevel` (OBJHANDLE hVessel, ENGINETYPE engine, double level)  
*Engage the specified engines.*
- OAPIFUNC int `oapiGetAttitudeMode` (OBJHANDLE hVessel)  
*Returns a vessel's current attitude thruster mode.*
- OAPIFUNC int `oapiToggleAttitudeMode` (OBJHANDLE hVessel)  
*Flip a vessel's attitude thruster mode between rotational and linear.*
- OAPIFUNC bool `oapiSetAttitudeMode` (OBJHANDLE hVessel, int mode)  
*Set a vessel's attitude thruster mode.*
- OAPIFUNC int `oapiGetFocusAttitudeMode` ()  
*Returns the current focus vessel's attitude thruster mode (rotational or linear)*
- OAPIFUNC int `oapiToggleFocusAttitudeMode` ()  
*Flip the current focus vessel's attitude thruster mode between rotational and linear.*
- OAPIFUNC bool `oapiSetFocusAttitudeMode` (int mode)  
*Set the current focus vessel's attitude thruster mode.*

#### 16.46.1 Detailed Description

#### 16.46.2 Enumeration Type Documentation

##### 16.46.2.1 enum AltitudeMode

Altitude mode used by altitude get functions.

##### Enumerator

**ALTMODE\_MEANRAD** altitude over mean radius

**ALTMODE\_GROUND** altitude over ground

## 16.46.3 Function Documentation

16.46.3.1 OAPIFUNC BOOL oapiGetAirspeed ( **OBJHANDLE** *hVessel*, **double** \* *airspeed* )

Returns a vessel's true airspeed w.r.t. the closest planet or moon.

## Parameters

<i>hVessel</i>	vessel handle, or NULL for focus vessel
<i>airspeed</i>	pointer to variable receiving airspeed value [m/s]

## Returns

Error flag (*false* on error)

## Note

This function works even for planets or moons without atmosphere. In that case it returns the ground speed.

## See also

[oapiGetAirspeedVector](#), [oapiGetGroundspeed](#), [oapiGetGroundspeedVector](#), [VESSEL::GetAirspeed](#)

16.46.3.2 OAPIFUNC bool oapiGetAirspeedVector ( **OBJHANDLE hVessel**, **REFFRAME frame**, **VECTOR3 \* v** )

Returns a vessel's true airspeed vector w.r.t. the closest planet or moon in the requested frame of reference.

## Parameters

in	<i>hVessel</i>	vessel handle, or NULL for focus vessel
in	<i>frame</i>	frame of reference flag
out	<i>v</i>	pointer to variable receiving airspeed vector [m/s in x,y,z]

## Returns

Error flag (*false* indicates error)

## Note

This method returns the true airspeed vector in the requested frame of reference. The airspeed vector is defined as the vessel's velocity vector with respect to the surrounding freestream air flow.

If the vessel is not within an a planetary atmosphere, the returned vector is equal to the groundspeed vector. Valid entries for *frame* are

- FRAME\_GLOBAL: Returns velocity vector in the global frame of reference
- FRAME\_LOCAL: Returns velocity vector in the vessel's local frame of reference
- FRAME\_REFLOCAL: Returns velocity vector in the celestial reference body's local frame of reference
- FRAME\_HORIZON: Returns velocity vector in the local horizon frame (x = longitudinal component, y = vertical component, z = latitudinal component)

## See also

[oapiGetAirspeed](#), [oapiGetGroundspeedVector](#), [oapiGetGroundspeed](#), [VESSEL::GetAirspeedVector](#)

16.46.3.3 OAPIFUNC BOOL oapiGetAltitude ( **OBJHANDLE hVessel**, **double \* alt** )

Returns the altitude of a vessel over a planet mean radius.

## Parameters

<i>hVessel</i>	vessel handle
<i>alt</i>	pointer to variable receiving altitude value

#### Returns

Error flag (*false* on failure)

#### Note

Unit is meter [m]

Returns altitude above closest planet.

Altitude is measured above mean planet radius (as defined by SIZE parameter in planet's cfg file)

The handle passed to the function must refer to a vessel.

#### See also

[oapiGetAltitude\(OBJHANDLE,AltitudeMode,double\\*\)](#), [VESSEL::GetAltitude](#)

### 16.46.3.4 OAPIFUNC BOOL oapiGetAltitude ( **OBJHANDLE hVessel**, **AltitudeMode mode**, **double \* alt** )

Returns the altitude of a vessel over a planetary surface.

#### Parameters

<i>hVessel</i>	vessel handle
<i>mode</i>	altitude mode
<i>alt</i>	pointer to variable receiving altitude value

#### Returns

Error flag (*false* on failure)

#### Note

Unit is meter [m]

Returns altitude above closest planet.

If mode==ALTMODE\_MEANRAD, the function returns the altitude above/below the planet mean radius and is equivalent to [oapiGetAltitude\(OBJHANDLE,double\\*\)](#). If mode==ALTMODE\_GROUND, the altitude above the local ground elevation is returned.

The handle passed to the function must refer to a vessel.

#### See also

[oapiGetAltitude\(OBJHANDLE,double\\*\)](#), [VESSEL::GetAltitude](#)

### 16.46.3.5 OAPIFUNC void oapiGetAtm ( **OBJHANDLE hVessel**, **ATMPARAM \* prm**, **OBJHANDLE \* hAtmRef = 0** )

Returns the atmospheric parameters at the current vessel position.

#### Parameters

in	<i>hVessel</i>	vessel handle
out	<i>prm</i>	pointer to <a href="#">ATMPARAM</a> structure receiving atmospheric parameters.

out	<i>hAtmRef</i>	pointer to handle receiving the atmosphere reference body.
-----	----------------	--

**Note**

If *hVessel* == NULL, the current focus vessel is used for the calculation.

If *hAtmRef* != NULL, it receives the handle of the celestial body contributing the atmospheric parameters.

If the vessel is not within range of any planet atmosphere model, all fields of the prm structure are set to 0. If applicable, \**hAtmRef* is set to NULL.

Currently, atmospheric values only depend on altitude, and don't take into account local weather variations.

**16.46.3.6 OAPIFUNC int oapiGetAttitudeMode ( OBJHANDLE *hVessel* )**

Returns a vessel's current attitude thruster mode.

**Parameters**

<i>hVessel</i>	vessel handle
----------------	---------------

**Returns**

Current attitude mode (0=disabled or not available, 1=rotational, 2=linear)

**Note**

The handle must refer to a vessel. This function does not support other object types.

**See also**

[oapiToggleAttitudeMode](#), [oapiSetAttitudeMode](#)

**16.46.3.7 OAPIFUNC BOOL oapiGetBank ( OBJHANDLE *hVessel*, double \* *bank* )**

Returns a vessel's bank angle w.r.t. the local horizon.

**Parameters**

<i>hVessel</i>	vessel handle
<i>bank</i>	pointer to variable receiving bank value

**Returns**

Error flag (*false* on failure)

**Note**

Unit is radian [rad]

Returns bank angle w.r.t. closest planet

The local horizon is the plane whose normal is defined by the distance vector from the planet centre to the vessel.

The handle passed to the function must refer to a vessel.

**See also**

[oapiGetHeading](#), [oapiGetPitch](#), [oapiGetAltitude](#)

**16.46.3.8 OAPIFUNC DOCKHANDLE oapiGetDockHandle ( OBJHANDLE *hVessel*, UINT *n* )**

Returns a handle to a vessel docking port.

## Parameters

<i>hVessel</i>	vessel handle
<i>n</i>	docking port index ( $\geq 0$ )

## Returns

docking port handle, or NULL if index is out of range

## See also

[VESSEL::GetDockHandle](#)

16.46.3.9 OAPIFUNC **OBJHANDLE** oapiGetDockStatus ( **DOCKHANDLE** *dock* )

Returns the handle of a vessel docked at a port.

## Parameters

<i>dock</i>	docking port handle
-------------	---------------------

## Returns

Handle of docked vessel, or NULL if no vessel is docked at the port.

## See also

[oapiGetDockHandle](#), [VESSEL::GetDockStatus](#)

16.46.3.10 OAPIFUNC **double** oapiGetEmptyMass ( **OBJHANDLE** *hVessel* )

Returns empty mass of a vessel, excluding fuel.

## Parameters

<i>hVessel</i>	vessel handle
----------------	---------------

## Returns

empty vessel mass [kg]

## Note

*hVessel* must be a vessel handle. Other object types are invalid.

Do not rely on a constant empty mass. Structural changes (e.g. discarding a rocket stage) will affect the empty mass.

For multistage configurations, the fuel mass of all currently inactive stages contributes to the empty mass. Only the fuel mass of active stages is excluded.

16.46.3.11 OAPIFUNC **void** oapiGetEngineStatus ( **OBJHANDLE** *hVessel*, **ENGINESTATUS** \* *es* )

Retrieve the status of main, retro and hover thrusters for a vessel.

## Parameters

<i>hVessel</i>	vessel handle
<i>es</i>	pointer to an <a href="#">ENGINESTATUS</a> structure which will receive the engine level parameters

**Note**

The main/retro engine level has a range of [-1,+1]. A positive value indicates engaged main/disengaged retro thrusters, a negative value indicates engaged retro/disengaged main thrusters. Main and retro thrusters cannot be engaged simultaneously. For vessels without retro thrusters the valid range is [0,+1]. The valid range for hover thrusters is [0,+1].

[ENGINESTATUS](#) has the following components:

```
1 typedef struct {
2     double main;      // -1 (full retro) .. +1 (full main)
3     double hover;    // 0 .. +1 (full hover)
4     int attmode;    // 0=rotation, 1=translation
5 } ENGINESTATUS;
```

#### 16.46.3.12 OAPIFUNC BOOL oapiGetEquPos ( OBJHANDLE *hVessel*, double \* *longitude*, double \* *latitude*, double \* *radius* )

Returns a vessel's spherical equatorial coordinates (longitude, latitude and radius) with respect to the closest planet or moon.

**Parameters**

<i>hVessel</i>	vessel handle
<i>longitude</i>	pointer to variable receiving longitude value [rad]
<i>latitude</i>	pointer to variable receiving latitude value [rad]
<i>radius</i>	pointer to variable receiving radius value [m]

**Returns**

Error flag (*false* on failure)

**Note**

The handle passed to the function must refer to a vessel.

#### 16.46.3.13 OAPIFUNC BOOL oapiGetFocusAltitude ( double \* *alt* )

Returns the altitude of the current focus vessel over a planetary surface.

**Parameters**

<i>alt</i>	pointer to variable receiving altitude value [m]
------------	--

**Returns**

Error flag (*false* on failure )

#### 16.46.3.14 OAPIFUNC int oapiGetFocusAttitudeMode ( )

Returns the current focus vessel's attitude thruster mode (rotational or linear)

**Returns**

Current attitude mode (0=disabled or not available, 1=rotational, 2=linear)

#### 16.46.3.15 OAPIFUNC BOOL oapiGetFocusBank ( double \* *bank* )

Returns the bank angle of the current focus vessel w.r.t. the local horizon.

## Parameters

<i>bank</i>	pointer to variable receiving bank angle [rad]
-------------	--

## Returns

Error flag (*false* on failure)

## See also

[oapiGetFocusHeading](#), [oapiGetFocusPitch](#), [oapiGetFocusAltitude](#)

16.46.3.16 OAPIFUNC void oapiGetFocusEngineStatus ( **ENGINESTATUS** \* *es* )

Retrieve the engine status for the focus vessel.

## Parameters

<i>es</i>	pointer to an <b>ENGINESTATUS</b> structure which will receive the engine level parameters.
-----------	---

## See also

[oapiGetEngineStatus](#)

16.46.3.17 OAPIFUNC BOOL oapiGetFocusEquPos ( **double** \* *longitude*, **double** \* *latitude*, **double** \* *radius* )

Returns the current focus vessel's spherical equatorial coordinates (longitude, latitude and radius) with respect to the closest planet or moon.

## Parameters

<i>longitude</i>	pointer to variable receiving longitude value [rad]
<i>latitude</i>	pointer to variable receiving latitude value [rad]
<i>radius</i>	pointer to variable receiving radius value [m]

## Returns

Error flag (*false* on failure)

16.46.3.18 OAPIFUNC void oapiGetFocusGlobalPos ( **VECTOR3** \* *pos* )

Returns the position of the current focus object in the global reference frame.

## Parameters

<i>pos</i>	pointer to vector receiving coordinates
------------	---

## Note

The global reference frame is the heliocentric ecliptic system at ecliptic and equinox of J2000.0. Units are meters.

## See also

[oapiGetFocusGlobalVel](#)

16.46.3.19 OAPIFUNC void oapiGetFocusGlobalVel ( **VECTOR3** \* *vel* )

Returns the velocity of the current focus object in the global reference frame.

## Parameters

<i>vel</i>	pointer to vector receiving velocity data
------------	---

## Note

The global reference frame is the heliocentric ecliptic system at ecliptic and equinox of J2000.  
Units are meters/second.

## See also

[oapiGetFocusGlobalPos](#)

16.46.3.20 OAPIFUNC BOOL oapiGetFocusHeading ( *double \* heading* )

Returns the heading (against geometric north) of the current focus vessel calculated for the local horizon plane.

## Parameters

<i>heading</i>	pointer to variable receiving heading value [rad]
----------------	---

## Returns

Error flag (*false* on failure)

## See also

[oapiGetFocusBank](#), [oapiGetFocusPitch](#), [oapiGetFocusAltitude](#)

16.46.3.21 OAPIFUNC BOOL oapiGetFocusPitch ( *double \* pitch* )

Returns the pitch angle of the current focus vessel w.r.t. the local horizon.

## Parameters

<i>pitch</i>	pointer to variable receiving pitch value
--------------	---

## Returns

Error flag (*false* on failure)

## See also

[oapiGetFocusBank](#), [oapiGetFocusHeading](#), [oapiGetFocusAltitude](#)

16.46.3.22 OAPIFUNC void oapiGetFocusRelativePos ( *OBJHANDLE hRef*, *VECTOR3 \* pos* )

Returns the distance vector from *hRef* to the current focus object.

## Parameters

<i>hRef</i>	reference object handle
<i>pos</i>	pointer to vector receiving distance data

## Note

Results are w.r.t. ecliptic frame at equinox and ecliptic of J2000.0.

## See also

[oapiGetFocusRelativeVel](#)

16.46.3.23 OAPIFUNC void oapiGetFocusRelativeVel ( **OBJHANDLE** *hRef*, **VECTOR3** \* *vel* )

Returns the velocity difference vector of the current focus object relative to *hRef*.

## Parameters

<i>hRef</i>	reference object handle
<i>vel</i>	pointer to vector receiving velocity difference data

## Note

Results are w.r.t. ecliptic frame at equinox and ecliptic of J2000.0.

## See also

[oapiGetFocusRelativePos](#)

16.46.3.24 OAPIFUNC double oapiGetFuelMass ( **OBJHANDLE hVessel** )

Returns current fuel mass of the first propellant resource of a vessel.

## Parameters

<i>hVessel</i>	vessel handle
----------------	---------------

## Returns

Current fuel mass [kg]

## Note

This function is equivalent to

```
1 oapiGetPropellantMass (oapiGetPropellantHandle (hVessel, 0))
```

*hVessel* must be a vessel handle. Other object types are invalid.

For multistage configurations, this returns the current fuel mass of active stages only.

## See also

[oapiGetMaxFuelMass](#), [oapiGetEmptyMass](#)

16.46.3.25 OAPIFUNC BOOL oapiGetGroundspeed ( **OBJHANDLE hVessel**, **double \* groundspeed** )

Returns a vessel's ground speed w.r.t. the closest planet or moon.

## Parameters

<i>hVessel</i>	vessel handle, or NULL for focus vessel
<i>groundspeed</i>	pointer to variable receiving ground speed value [m/s]

## Returns

Error flag (*false* on error)

## See also

[oapiGetGroundspeedVector](#), [oapiGetAirspeed](#), [oapiGetAirspeedVector](#)

16.46.3.26 OAPIFUNC bool oapiGetGroundspeedVector ( **OBJHANDLE hVessel**, **REFFRAME frame**, **VECTOR3 \* vel** )

Returns a vessel's groundspeed vector w.r.t. the closest planet or moon in the requested frame of reference.

## Parameters

in	<i>hVessel</i>	vessel handle, or NULL for focus vessel
in	<i>frame</i>	frame of reference flag
out	<i>vel</i>	pointer to variable receiving ground speed vector [m/s in x,y,z]

## Returns

Error flag (*false* indicates error)

## Note

This method returns the ground speed vector in the requested frame of reference. The ground speed vector is defined as the vessel's velocity vector with respect to a point at the vessel position fixed in the planet's rotating frame of reference.

Valid entries for *frame* are

- FRAME\_GLOBAL: Returns velocity vector in the global frame of reference
- FRAME\_LOCAL: Returns velocity vector in the vessel's local frame of reference
- FRAME\_REFLOCAL: Returns velocity vector in the celestial reference body's local frame of reference
- FRAME\_HORIZON: Returns velocity vector in the local horizon frame (x = longitudinal component, y = vertical component, z = latitudinal component)

## See also

[oapiGetGroundspeed](#), [oapiGetAirspeedVector](#), [oapiGetAirspeed](#), [VESSEL::GetGroundspeedVector](#)

16.46.3.27 OAPIFUNC BOOL oapiGetHeading ( **OBJHANDLE** *hVessel*, **double** \* *heading* )

Returns a vessel's heading (against geometric north) calculated for the local horizon plane.

## Parameters

<i>hVessel</i>	vessel handle
<i>heading</i>	pointer to variable receiving heading value [rad]

## Returns

Error flag (*false* on failure)

## Note

Unit is radian [rad] 0=north, PI/2=east, etc.

The handle passed to the function must refer to a vessel.

## See also

[oapiGetBank](#), [oapiGetPitch](#), [oapiGetAltitude](#)

16.46.3.28 OAPIFUNC double oapiGetMaxFuelMass ( **OBJHANDLE** *hVessel* )

Returns maximum fuel capacity of the first propellant resource of a vessel.

## Parameters

<i>hVessel</i>	vessel handle
----------------	---------------

## Returns

Maximum fuel mass [kg]

## Note

This function is equivalent to

```
1 oapiGetPropellantMaxMass (oapiGetPropellantHandle (hVessel, 0))
```

*hVessel* must be a vessel handle. Other object types are invalid.

For multistage configurations, this returns the sum of the max fuel mass of active stages only.

#### 16.46.3.29 OAPIFUNC BOOL oapiGetPitch ( **OBJHANDLE** *hVessel*, **double** \* *pitch* )

Returns a vessel's pitch angle w.r.t. the local horizon.

## Parameters

<i>hVessel</i>	vessel handle
<i>pitch</i>	pointer to variable receiving pitch value

## Returns

Error flag (*false* on failure)

## Note

Unit is radian [rad]

Returns pitch angle w.r.t. closest planet

The local horizon is the plane whose normal is defined by the distance vector from the planet centre to the vessel.

The handle passed to the function must refer to a vessel.

## See also

[oapiGetHeading](#), [oapiGetBank](#), [oapiGetAltitude](#)

#### 16.46.3.30 OAPIFUNC PROPELLANT\_HANDLE oapiGetPropellantHandle ( **OBJHANDLE** *hVessel*, **DWORD** *idx* )

Returns an identifier of a vessel's propellant resource.

## Parameters

<i>hVessel</i>	vessel handle
<i>idx</i>	propellant resource index ( $\geq 0$ )

## Returns

propellant resource id, or NULL if *idx*  $\geq$  # propellant resources

#### 16.46.3.31 OAPIFUNC double oapiGetPropellantMass ( **PROPELLANT\_HANDLE** *ph* )

Returns the current fuel mass [kg] of a propellant resource.

## Parameters

<i>ph</i>	propellant resource identifier
-----------	--------------------------------

## Returns

current fuel mass [kg] of the resource.

## See also

[oapiGetPropellantMaxMass](#), [oapiGetPropellantHandle](#)

16.46.3.32 OAPIFUNC double oapiGetPropellantMaxMass ( PROPELLANT\_HANDLE *ph* )

Returns the maximum capacity [kg] of a propellant resource.

## Parameters

<i>ph</i>	propellant resource identifier
-----------	--------------------------------

## Returns

maximum fuel capacity [kg] of the resource.

## See also

[oapiGetPropellantHandle](#), [VESSEL::GetPropellantMaxMass](#)

16.46.3.33 OAPIFUNC bool oapiSetAttitudeMode ( OBJHANDLE *hVessel*, int *mode* )

Set a vessel's attitude thruster mode.

## Parameters

<i>hVessel</i>	vessel handle
<i>mode</i>	attitude mode (0=disable, 1=rotational, 2=linear)

## Returns

Error flag; *false* indicates failure (requested mode not available)

## Note

The handle must refer to a vessel. This function does not support other object types.

## See also

[oapiToggleAttitudeMode](#), [oapiGetAttitudeMode](#)

16.46.3.34 OAPIFUNC void oapiSetEmptyMass ( OBJHANDLE *hVessel*, double *mass* )

Set the empty mass of a vessel (excluding fuel)

## Parameters

<i>hVessel</i>	vessel handle
<i>mass</i>	empty mass [kg]

## Note

Use this function to register structural mass changes, for example as a result of jettisoning a fuel tank, etc.

16.46.3.35 OAPIFUNC void oapiSetEngineLevel ( **OBJHANDLE** *hVessel*, **ENGINETYPE** *engine*, double *level* )

Engage the specified engines.

## Parameters

<i>hVessel</i>	vessel handle
<i>engine</i>	identifies the engine to be set
<i>level</i>	engine thrust level [0,1]

## Note

Not all vessels support all types of engines.

Setting main thrusters > 0 implies setting retro thrusters to 0 and vice versa.

Setting main thrusters to -level is equivalent to setting retro thrusters to +level and vice versa.

16.46.3.36 OAPIFUNC bool oapiSetFocusAttitudeMode ( int *mode* )

Set the current focus vessel's attitude thruster mode.

## Parameters

<i>mode</i>	attitude mode (0=disable, 1=rotational, 2=linear)
-------------	---

## Returns

Error flag; *false* indicates error (requested mode not available)

## See also

[oapiGetFocusAttitudeMode](#), [oapiToggleFocusAttitudeMode](#)

16.46.3.37 OAPIFUNC int oapiToggleAttitudeMode ( **OBJHANDLE** *hVessel* )

Flip a vessel's attitude thruster mode between rotational and linear.

## Parameters

<i>hVessel</i>	vessel handle
----------------	---------------

## Returns

The new attitude mode (1=rotational, 2=linear, 0=unchanged disabled)

## Note

The handle must refer to a vessel. This function does not support other object types.

This function flips between linear and rotational, but has no effect if attitude thrusters were disabled.

## See also

[oapiSetAttitudeMode](#), [oapiGetAttitudeMode](#)

## 16.46.3.38 OAPIFUNC int oapiToggleFocusAttitudeMode ( )

Flip the current focus vessel's attitude thruster mode between rotational and linear.

**Returns**

The new attitude mode (1=rotational, 2=linear, 0=unchanged disabled)

**Note**

This function flips between linear and rotational, but has no effect if attitude thrusters were disabled.

**See also**

[oapiSetFocusAttitudeMode](#), [oapiGetFocusAttitudeMode](#)

## 16.47 Coordinate transformations

### Functions

- OAPIFUNC void [oapiGetRotationMatrix \(OBJHANDLE hObj, MATRIX3 \\*mat\)](#)  
*Returns the current rotation matrix of an object.*
- OAPIFUNC void [oapiGlobalToLocal \(OBJHANDLE hObj, const VECTOR3 \\*glob, VECTOR3 \\*loc\)](#)  
*Maps a point from the global frame to a local object frame.*
- OAPIFUNC void [oapiLocalToGlobal \(OBJHANDLE hObj, const VECTOR3 \\*loc, VECTOR3 \\*glob\)](#)  
*Maps a point from a local object frame to the global frame.*
- OAPIFUNC void [oapiEquToLocal \(OBJHANDLE hObj, double Ing, double lat, double rad, VECTOR3 \\*loc\)](#)  
*Returns the cartesian position in the local object frame of a point given in equatorial coordinates.*
- OAPIFUNC void [oapiLocalToEqu \(OBJHANDLE hObj, const VECTOR3 &loc, double \\*Ing, double \\*lat, double \\*rad\)](#)  
*Returns the equatorial coordinates of a point given in the local frame of an object.*
- OAPIFUNC void [oapiEquToGlobal \(OBJHANDLE hObj, double Ing, double lat, double rad, VECTOR3 \\*glob\)](#)  
*Returns the global cartesian position of a point given in equatorial coordinates of an object.*
- OAPIFUNC void [oapiGlobalToEqu \(OBJHANDLE hObj, const VECTOR3 &glob, double \\*Ing, double \\*lat, double \\*rad\)](#)  
*Returns the equatorial coordinates with respect to an object of a point given in the global reference frame.*
- OAPIFUNC double [oapiOrthodome \(double Ing1, double lat1, double Ing2, double lat2\)](#)  
*Returns the angular distance of two points on a sphere.*

### 16.47.1 Detailed Description

### 16.47.2 Function Documentation

#### 16.47.2.1 OAPIFUNC void oapiEquToGlobal ( OBJHANDLE *hObj*, double *Ing*, double *lat*, double *rad*, VECTOR3 \* *glob* )

Returns the global cartesian position of a point given in equatorial coordinates of an object.

#### Parameters

in	<i>hObj</i>	object handle
in	<i>Ing</i>	longitude of point [rad]
in	<i>lat</i>	latitude of point [rad]
in	<i>rad</i>	distance from local object origin [m]
out	<i>glob</i>	point in cartesian coordinates of the global reference frame [m]

#### See also

[oapiGlobalToEqu](#), [oapiEquToLocal](#), [oapiLocalToEqu](#)

#### 16.47.2.2 OAPIFUNC void oapiEquToLocal ( OBJHANDLE *hObj*, double *Ing*, double *lat*, double *rad*, VECTOR3 \* *loc* )

Returns the cartesian position in the local object frame of a point given in equatorial coordinates.

#### Parameters

in	<i>hObj</i>	object handle
in	<i>Ing</i>	longitude of point [rad]
in	<i>lat</i>	latitude of point [rad]

in	<i>rad</i>	distance from local object origin [m]
out	<i>loc</i>	point in cartesian coordinates of the local object frame [m]

## See also

[oapiLocalToEqu](#), [oapiEquToGlobal](#), [oapiGlobalToEqu](#)

16.47.2.3 OAPIFUNC void oapiGetRotationMatrix ( **OBJHANDLE** *hObj*, **MATRIX3** \* *mat* )

Returns the current rotation matrix of an object.

## Parameters

in	<i>hObj</i>	object handle
out	<i>mat</i>	rotation matrix

## Note

The returned rotation matrix can be used to transform orientations from the local frame of an object to Orbiter's global reference frame (ecliptic and equinox of J2000) and vice versa.

The rotation, defined by matrix R, together with a translation vector t, provides the transformation of a point p between local and global coordinates:

$$\vec{p}_{\text{global}} = R\vec{p}_{\text{local}} + \vec{t}$$

and

$$\vec{p}_{\text{local}} = R^T(\vec{p}_{\text{global}} - \vec{t})$$

## See also

[VESSEL::GetRotationMatrix](#),  
[mul\(const MATRIX3&,const VECTOR3&\)](#),  
[tmul\(const MATRIX3&,const VECTOR3&\)](#)

16.47.2.4 OAPIFUNC void oapiGlobalToEqu ( **OBJHANDLE** *hObj*, **const VECTOR3** & *glob*, **double** \* *lng*, **double** \* *lat*, **double** \* *rad* )

Returns the equatorial coordinates with respect to an object of a point given in the global reference frame.

## Parameters

in	<i>hObj</i>	object handle
in	<i>glob</i>	point in global coordinates
out	<i>lng</i>	pointer to variable receiving the longitude value [rad]
out	<i>lat</i>	pointer to variable receiving the latitude value [rad]
out	<i>rad</i>	pointer to variable receiving the radial distance value [m]

## See also

[oapiEquToLocal](#), [oapiLocalToEqu](#), [oapiEquToGlobal](#)

16.47.2.5 OAPIFUNC void oapiGlobalToLocal ( **OBJHANDLE** *hObj*, **const VECTOR3** \* *glob*, **VECTOR3** \* *loc* )

Maps a point from the global frame to a local object frame.

## Parameters

in	<i>hObj</i>	object handle
in	<i>glob</i>	point in global coordinates
out	<i>loc</i>	point mapped into local coordinates

## Note

This function maps global point *glob* into the local reference frame of body *hObj*. The transformation is given by

$$\vec{p}_{\text{loc}} = \mathbf{R}_{\text{hObj}}^T (\vec{p}_{\text{glob}} - \vec{p}_{\text{hObj}})$$

where  $\mathbf{R}_{\text{hObj}}$ ,  $\vec{p}_{\text{hObj}}$  are the body's rotation matrix and global position, respectively.

## See also

[oapiLocalToGlobal](#), [oapiGetRotationMatrix](#)

**16.47.2.6 OAPIFUNC void oapiLocalToEqu ( OBJHANDLE *hObj*, const VECTOR3 & *loc*, double \* *lng*, double \* *lat*, double \* *rad* )**

Returns the equatorial coordinates of a point given in the local frame of an object.

## Parameters

in	<i>hObj</i>	object handle
in	<i>loc</i>	point in cartesian coordinates of the local object frame [m]
out	<i>lng</i>	pointer to variable receiving the longitude value [rad]
out	<i>lat</i>	pointer to variable receiving the latitude value [rad]
out	<i>rad</i>	pointer to variable receiving the radial distance value [m]

## See also

[oapiEquToLocal](#), [oapiEquToGlobal](#), [oapiGlobalToEqu](#)

**16.47.2.7 OAPIFUNC void oapiLocalToGlobal ( OBJHANDLE *hObj*, const VECTOR3 \* *loc*, VECTOR3 \* *glob* )**

Maps a point from a local object frame to the global frame.

## Parameters

in	<i>hObj</i>	object handle
in	<i>loc</i>	point in local coordinates of the object frame
out	<i>glob</i>	point mapped into global coordinates

## Note

This function maps point *loc* given in local coordinates of *hObj* into the global reference frame (barycentric ecliptic and equinox of J2000). The transformation is given by

$$\vec{p}_{\text{glob}} = \mathbf{R}_{\text{hObj}} \vec{p}_{\text{loc}} + \vec{p}_{\text{hObj}}$$

where  $\mathbf{R}_{\text{hObj}}$ ,  $\vec{p}_{\text{hObj}}$  are the body's rotation matrix and global position, respectively.

## See also

[oapiGlobalToLocal](#), [oapiGetRotationMatrix](#)

**16.47.2.8 OAPIFUNC double oapiOrthodome ( double *lng1*, double *lat1*, double *lng2*, double *lat2* )**

Returns the angular distance of two points on a sphere.

**Parameters**

<i>lng1</i>	longitude value of point 1 [rad]
<i>lat1</i>	latitude value of point 1 [rad]
<i>lng2</i>	longitude value of point 2 [rad]
<i>lat2</i>	latitude value of point 2 [rad]

**Note**

Given two points on the surface of a sphere, this function returns the orthodome (shortest) angular distance between them.

The shortest surface path between the points is an arc on a great circle containing the two points, and its length is given by  $d = a R$ , where  $a$  is the angular distance returned by `oapiOrthodome`, and  $R$  is the radius of the sphere.

## 16.48 Camera functions

### Functions

- OAPIFUNC bool [oapiCameraInternal](#) ()
 

*Returns flag to indicate internal/external camera mode.*
- OAPIFUNC int [oapiCameraMode](#) ()
 

*Returns the current camera view mode.*
- OAPIFUNC int [oapiCockpitMode](#) ()
 

*Returns the current cockpit display mode.*
- OAPIFUNC [OBJHANDLE](#) [oapiCameraTarget](#) ()
 

*Returns a handle to the current camera target.*
- OAPIFUNC int [oapiVCPPosition](#) ()
 

*Returns the current virtual cockpit position.*
- OAPIFUNC [OBJHANDLE](#) [oapiCameraProxyGbody](#) ()
 

*Returns celestial body whose surface is closest to the camera.*
- OAPIFUNC void [oapiCameraGlobalPos](#) ([VECTOR3](#) \*gpos)
 

*Returns current camera position in global coordinates.*
- OAPIFUNC void [oapiCameraGlobalDir](#) ([VECTOR3](#) \*gdir)
 

*Returns current camera direction in global coordinates.*
- OAPIFUNC void [oapiCameraRotationMatrix](#) ([MATRIX3](#) \*rmat)
 

*Returns the distance between the camera and its target [m].*
- OAPIFUNC double [oapiCameraTargetDist](#) ()
 

*Returns the current camera azimuth angle with respect to the target.*
- OAPIFUNC double [oapiCameraPolar](#) ()
 

*Returns the current camera polar angle with respect to the target.*
- OAPIFUNC double [oapiCameraAperture](#) ()
 

*Returns the current camera aperture (the field of view) in rad.*
- OAPIFUNC void [oapiCameraSetAperture](#) (double aperture)
 

*Change the camera aperture (field of view).*
- OAPIFUNC void [oapiCameraScaleDist](#) (double dscale)
 

*Moves the camera closer to the target or further away.*
- OAPIFUNC void [oapiCameraRotAzimuth](#) (double dazimuth)
 

*Rotate the camera around the target (azimuth angle).*
- OAPIFUNC void [oapiCameraRotPolar](#) (double dpolar)
 

*Rotate the camera around the target (polar angle).*
- OAPIFUNC void [oapiCameraSetCockpitDir](#) (double polar, double azimuth, bool transition=false)
 

*Set the camera direction in cockpit mode.*
- OAPIFUNC void [oapiCameraAttach](#) ([OBJHANDLE](#) hObj, int mode)
 

*Attach the camera to a new target, or switch between internal and external camera mode.*
- OAPIFUNC bool [oapiSetCameraMode](#) (const CameraMode &mode)
 

*Set the camera to the mode specified by the CameraMode object.*
- OAPIFUNC bool [oapiMoveGroundCamera](#) (double forward, double right=0, double up=0)
 

*Move the ground observer camera.*

## 16.48.1 Detailed Description

## 16.48.2 Function Documentation

## 16.48.2.1 OAPIFUNC double oapiCameraAperture ( )

Returns the current camera aperture (the field of view) in rad.

## Returns

camera aperture [rad]

## Note

Orbiter defines the the aperture as 1/2 of the vertical field of view, between the viewport centre and the top edge of the viewport.

16.48.2.2 OAPIFUNC void oapiCameraAttach ( OBJHANDLE *hObj*, int *mode* )

Attach the camera to a new target, or switch between internal and external camera mode.

## Parameters

<i>hObj</i>	handle of the new camera target
<i>mode</i>	camera mode (0=internal, 1=external, 2=don't change)

## Note

If the new target is not a vessel, the camera mode is always set to external, regardless of the value of mode.

## See also

[oapiCameraMode](#), [oapiCameraTarget](#)

## 16.48.2.3 OAPIFUNC double oapiCameraAzimuth ( )

Returns the current camera azimuth angle with respect to the target.

## Returns

Camera azimuth angle [rad]. Value 0 indicates that the camera is behind the target.

## Note

This function is useful only in external camera mode. In internal mode, it will always return 0.

16.48.2.4 OAPIFUNC void oapiCameraGlobalDir ( VECTOR3 \* *gdir* )

Returns current camera direction in global coordinates.

## Parameters

<i>gdir</i>	pointer to vector to receive global camera direction
-------------	--

## See also

[oapiCameraGlobalPos](#)

16.48.2.5 OAPIFUNC void oapiCameraGlobalPos ( VECTOR3 \* *gpos* )

Returns current camera position in global coordinates.

**Parameters**

<i>gpos</i>	pointer to vector to receive global camera coordinates
-------------	--

**Note**

The global coordinate system is the heliocentric ecliptic frame at epoch J2000.0.

**See also**

[oapiCameraGlobalDir](#)

**16.48.2.6 OAPIFUNC bool oapiCameraInternal ( )**

Returns flag to indicate internal/external camera mode.

**Returns**

*true* indicates an internal camera mode, i.e. the camera is located inside a vessel cockpit. In this case, the camera target is always the current focus object. *false* indicates an external camera mode, i.e. the camera points toward an object from outside. The camera target may be a vessel, planet, spaceport, etc.

**See also**

[oapiCameraMode](#), [oapiCockpitMode](#)

**16.48.2.7 OAPIFUNC int oapiCameraMode ( )**

Returns the current camera view mode.

**Returns**

Camera mode:

- **CAM\_COCKPIT** cockpit (internal) mode
- **CAM\_TARGETRELATIVE** tracking mode (relative direction)
- **CAM\_ABSDIRECTION** tracking mode (absolute direction)
- **CAM\_GLOBALFRAME** tracking mode (global frame)
- **CAM\_TARGETTOOBJECT** tracking mode (target to object)
- **CAM\_TARGETFROMOBJECT** tracking mode (object to target)
- **CAM\_GROUNDOSERVER** ground observer mode

**See also**

[oapiCameraInternal](#), [VESSEL::GetCameraOffset](#), [VESSEL::GetCameraDefaultDirection](#)

**16.48.2.8 OAPIFUNC double oapiCameraPolar ( )**

Returns the current camera polar angle with respect to the target.

**Returns**

Camera polar angle [rad]. Value 0 indicates that the camera is at the same elevation as the target.

**Note**

This function is useful only in external camera mode. In internal mode, it will always return 0.

**16.48.2.9 OAPIFUNC void oapiCameraRotAzimuth ( double *dazimuth* )**

Rotate the camera around the target (azimuth angle).

## Parameters

<i>dazimuth</i>	change in azimuth angle [rad]
-----------------	-------------------------------

## Note

This function is ignored if the camera is in internal mode.

16.48.2.10 OAPIFUNC void oapiCameraRotPolar ( double *dpolar* )

Rotate the camera around the target (polar angle).

## Parameters

<i>dpolar</i>	change in polar angle [rad]
---------------	-----------------------------

## Note

This function is ignored if the camera is in internal mode.

16.48.2.11 OAPIFUNC void oapiCameraScaleDist ( double *dscale* )

Moves the camera closer to the target or further away.

## Parameters

<i>dscale</i>	distance scaling factor
---------------	-------------------------

## Note

Setting *dscale* < 1 will move the camera closer to its target. *dscale* > 1 will move it further away.

This function is ignored if the camera is in internal mode.

16.48.2.12 OAPIFUNC void oapiCameraSetAperture ( double *aperture* )

Change the camera aperture (field of view).

## Parameters

<i>aperture</i>	new aperture [rad]
-----------------	--------------------

## Note

Orbiter restricts the aperture to the range from RAD\*0.1 to RAD\*80 (i. e. field of view between 0.2 and 160 deg. Very wide angles (> 90 deg) and very narrow angles (< 5 deg) should only be used to implement specific optical devices, e.g. telescopes or wide-angle cameras, not for standard observer views.

The Orbiter user interface does not accept apertures > 45 deg or < 5 deg. As soon as the user manipulates the aperture manually, it will be clamped back to the range from 5 to 45 deg.

16.48.2.13 OAPIFUNC void oapiCameraSetCockpitDir ( double *polar*, double *azimuth*, bool *transition = false* )

Set the camera direction in cockpit mode.

## Parameters

<i>polar</i>	polar angle [rad]
--------------	-------------------

<i>azimuth</i>	azimuth angle [rad]
<i>transition</i>	transition flag (see notes)

**Note**

This function is ignored if the camera is not currently in cockpit mode.

The polar and azimuth angles are relative to the default view direction (see [VESSEL::SetCameraDefaultDirection\(\)](#))

The requested direction should be within the current rotation ranges (see [VESSEL::SetCameraRotationRange\(\)](#)), otherwise the result is undefined.

If transition==false, the new direction is set instantaneously; otherwise the camera swings from the current to the new direction (not yet implemented).

**16.48.2.14 OAPIFUNC OBJHANDLE oapiCameraTarget( )**

Returns a handle to the current camera target.

**Returns**

Handle to the current camera target (i.e. the object the camera is pointing at in external mode, or the handle of the vessel in cockpit mode)

**Note**

The camera target is not necessarily a vessel, and if it is a vessel, it is not necessarily the focus object (the vessel receiving user input).

**See also**

[oapiCameraAttach](#)

**16.48.2.15 OAPIFUNC double oapiCameraTargetDist( )**

Returns the distance between the camera and its target [m].

**Returns**

Distance between camera and camera target [m].

**16.48.2.16 OAPIFUNC int oapiCockpitMode( )**

Returns the current cockpit display mode.

**Returns**

Cockpit mode:

- COCKPIT\_GENERIC (generic cockpit mode: left+right [MFD](#) and [HUD](#))
- COCKPIT\_PANELS (2D panel mode)
- COCKPIT\_VIRTUAL (virtual cockpit mode)

**Note**

This function also works if the camera is not currently in cockpit mode.

**See also**

[oapiCameralInternal](#), [VESSEL::GetCameraOffset](#), [VESSEL::GetCameraDefaultDirection](#)

**16.48.2.17 OAPIFUNC bool oapiMoveGroundCamera( double *forward*, double *right* = 0, double *up* = 0 )**

Move the ground observer camera.

**Parameters**

<i>forward</i>	distance in camera-forward direction (< 0 for backward) [m]
<i>right</i>	distance in camera-right direction (< 0 for left) [m]
<i>up</i>	distance in planet-up direction (< 0 for down) [m]

**Returns**

true on success, false if

- camera not in ground observer mode

**16.48.2.18 OAPIFUNC bool oapiSetCameraMode ( const CameraMode & *mode* )**

Set the camera to the mode specified by the CameraMode object.

**Parameters**

<i>mode</i>	CameraMode subclass object to set the parameters for cockpit, track or ground observer mode
-------------	---

**Returns**

Currently always returns true.

**16.48.2.19 OAPIFUNC int oapiVCPPosition ( )**

Returns the current virtual cockpit position.

**Returns**

VC position ( $\geq 0$ , or -1 if camera is not in VC mode)

## 16.49 Functions for planetary bodies

### Functions

- OAPIFUNC double `oapiGetPlanetPeriod (OBJHANDLE hPlanet)`  
*Returns the rotation period (the length of a sidereal day) of a planet.*
- OAPIFUNC double `oapiGetPlanetObliquity (OBJHANDLE hPlanet)`  
*Returns the obliquity of the planet's rotation axis (the angle between the rotation axis and the ecliptic zenith).*
- OAPIFUNC double `oapiGetPlanetTheta (OBJHANDLE hPlanet)`  
*Returns the longitude of the ascending node.*
- OAPIFUNC void `oapiGetPlanetObliquityMatrix (OBJHANDLE hPlanet, MATRIX3 *mat)`  
*Returns a rotation matrix which performs the transformation from the planet's tilted coordinates into global coordinates.*
- OAPIFUNC double `oapiGetPlanetCurrentRotation (OBJHANDLE hPlanet)`  
*Returns the current rotation angle of the planet around its axis.*
- OAPIFUNC bool `oapiPlanethasAtmosphere (OBJHANDLE hPlanet)`  
*Test for existence of planetary atmosphere.*
- OAPIFUNC void `oapiGetPlanetAtmParams (OBJHANDLE hPlanet, double rad, ATMPARAM *prm)`  
*Returns atmospheric parameters as a function of distance from the planet centre.*
- OAPIFUNC void `oapiGetPlanetAtmParams (OBJHANDLE hPlanet, double alt, double lng, double lat, ATMPARAM *prm)`  
*Returns atmospheric parameters of a planet as a function of altitude and geographic position.*
- OAPIFUNC const `ATMCONST * oapiGetPlanetAtmConstants (OBJHANDLE hPlanet)`  
*Returns atmospheric constants for a planet.*
- OAPIFUNC `VECTOR3 oapiGetGroundVector (OBJHANDLE hPlanet, double lng, double lat, int frame=2)`  
*Returns the velocity vector of a surface point.*
- OAPIFUNC `VECTOR3 oapiGetWindVector (OBJHANDLE hPlanet, double lng, double lat, double alt, int frame=0, double *windspeed=NULL)`  
*Returns the wind velocity at a given position in a planet's atmosphere.*
- OAPIFUNC `DWORD oapiGetPlanetJCoeffCount (OBJHANDLE hPlanet)`  
*Returns the number of perturbation coefficients defined for a planet.*
- OAPIFUNC double `oapiGetPlanetJCoeff (OBJHANDLE hPlanet, DWORD n)`  
*Returns a perturbation coefficient for the calculation of a planet's gravitational potential.*

### 16.49.1 Detailed Description

All OBJHANDLE function parameters used in this section must refer to planetary bodies (planets, moons, asteroids, etc.) unless stated otherwise. Invalid handles may lead to crashes.

Currently, the orientation of planetary rotation axes is assumed time-invariant. Precession, nutation and similar effects are not currently simulated.

### 16.49.2 Function Documentation

#### 16.49.2.1 OAPIFUNC `VECTOR3 oapiGetGroundVector ( OBJHANDLE hPlanet, double lng, double lat, int frame = 2 )`

Returns the velocity vector of a surface point.

##### Parameters

<code>hPlanet</code>	planet handle
----------------------	---------------

<i>lng</i>	longitude [rad]
<i>lat</i>	latitude [rad]
<i>frame</i>	reference frame flag (see notes)

**Returns**

surface velocity [m]

**Note**

The *frame* flag can be used to specify the reference frame to which the returned vector refers. The following values are supported:

- 0: surface-relative (relative to local horizon)
- 1: planet-local (relative to local planet frame)
- 2: planet-local non-rotating
- 3: global (maps to global frame and adds planet velocity)

*frame* = 0 and *frame* = 1 are provided for completeness only. They return (0,0,0) by definition.

*frame* = 2 returns the following vector for a planet with mean radius  $R$  and rotation period  $T$ :

$$\vec{v} = \frac{2\pi R}{T} \cos(\text{lat}) \begin{bmatrix} -\sin(\text{lng}) \\ 0 \\ \cos(\text{lng}) \end{bmatrix}$$

*frame* = 3 maps the vector given above into the global frame and adds the planet velocity.

**16.49.2.2 OAPIFUNC const ATMCONST\* oapiGetPlanetAtmConstants ( OBJHANDLE *hPlanet* )**

Returns atmospheric constants for a planet.

**Parameters**

<i>hPlanet</i>	planet handle
----------------	---------------

**Returns**

pointer to **ATMCONST** structure containing atmospheric coefficients for the planet (see notes)

**Note**

**ATMCONST** has the following components:

```

1 typedef struct {
2     double p0;           // pressure at mean radius ('sea level') [Pa]
3     double rho0;         // density at mean radius [kg/m3]
4     double R;            // specific gas constant [J/(K kg)]
5     double gamma;        // ratio of specific heats, c_p/c_v
6     double C;            // exponent for pressure equation (temporary)
7     double O2pp;         // partial pressure of oxygen
8     double altlimit;    // atmosphere altitude limit [m]
9     double radlimit;    // radius limit (altlimit + mean radius)
10    double horizonalt; // horizon rendering altitude
11    VECTOR3 color0;    // sky colour at sea level during daytime
12 } ATMCONST;

```

If the specified planet does not have an atmosphere, return value is NULL.

**See also**

[oapiPlanetHasAtmosphere](#), [oapiGetPlanetAtmParams](#)

**16.49.2.3 OAPIFUNC void oapiGetPlanetAtmParams ( OBJHANDLE *hPlanet*, double *rad*, ATMPARAM \* *prm* )**

Returns atmospheric parameters as a function of distance from the planet centre.

**Parameters**

<i>hPlanet</i>	planet handle
<i>rad</i>	radius from planet centre [m]
<i>prm</i>	pointer to <a href="#">ATMPARAM</a> structure receiving parameters

**Note**

If the planet has no atmosphere, or if the defined radius is beyond the defined upper atmosphere limit, all parameters are set to 0.

If the atmosphere model is position- as well as altitude-dependent, this function assumes longitude=0 and latitude=0.

[ATMPARAM](#) has the following components:

```
1 typedef struct {
2     double T;           // temperature [K]
3     double p;           // pressure [Pa]
4     double rho;         // density [kg/m^3]
5 } ATMPARAM;
```

**See also**

[oapiGetPlanetAtmParams\(OBJHANDLE,double,double,ATMPARAM\\*\)](#), [oapiPlanetHasAtmosphere](#), [oapiGetPlanetAtmConstants](#)

#### 16.49.2.4 OAPIFUNC void oapiGetPlanetAtmParams ( **OBJHANDLE** *hPlanet*, double *alt*, double *lng*, double *lat*, **ATMPARAM** \* *prm* )

Returns atmospheric parameters of a planet as a function of altitude and geographic position.

**Parameters**

<i>hPlanet</i>	planet handle
<i>alt</i>	altitude above planet mean radius [m]
<i>lng</i>	longitude [rad]
<i>lat</i>	latitude [rad]
<i>prm</i>	pointer to <a href="#">ATMPARAM</a> structure receiving parameters

**See also**

[oapiGetPlanetAtmParams\(OBJHANDLE,double,double,ATMPARAM\\*\)](#), [oapiPlanetHasAtmosphere](#), [oapiGetPlanetAtmConstants](#)

#### 16.49.2.5 OAPIFUNC double oapiGetPlanetCurrentRotation ( **OBJHANDLE** *hPlanet* )

Returns the current rotation angle of the planet around its axis.

**Parameters**

<i>hPlanet</i>	planet handle
----------------	---------------

**Returns**

Rotation angle [rad]

**Note**

The complete rotation matrix from planet local to global (ecliptic) coordinates is given by

$$R = R_a \begin{bmatrix} \cos \omega & 0 & -\sin \omega \\ 0 & 1 & 0 \\ \sin \omega & 0 & \cos \omega \end{bmatrix}$$

where  $R_a$  is the obliquity matrix as returned by [oapiGetPlanetObliquityMatrix\(\)](#), and  $\omega$  is the rotation angle returned by [oapiGetPlanetCurrentRotation\(\)](#).

16.49.2.6 OAPIFUNC double oapiGetPlanetJCoeff ( **OBJHANDLE** *hPlanet*, **DWORD** *n* )

Returns a perturbation coefficient for the calculation of a planet's gravitational potential.

## Parameters

<i>hPlanet</i>	planet handle
<i>n</i>	coefficient index

## Returns

Perturbation coefficient  $J_{n+2}$

## Note

Valid indices  $n$  are 0 to [oapiGetPlanetJCoeffCount\(\)](#)-1

Orbiter calculates the planet's gravitational potential  $U$  for a given distance  $r$  and latitude  $\phi$  by

$$U(r, \phi) = \frac{GM}{r} \left[ 1 - \sum_{n=2}^N J_n \left( \frac{R}{r} \right)^n P_n(\sin \phi) \right]$$

where  $R$  is the planet's equatorial radius,  $M$  is its mass,  $G$  is the gravitational constant, and  $P_n$  is the Legendre polynomial of order  $n$ .

Orbiter currently considers perturbations to be only a function of latitude (polar), not of longitude.

The first coefficient,  $n = 0$ , returns J2, which accounts for the ellipsoid shape of a planet (flattening). Higher perturbation terms are usually small compared to J2 (and not known for most planets).

## See also

[oapiGetPlanetJCoeffCount](#)

16.49.2.7 OAPIFUNC DWORD oapiGetPlanetJCoeffCount ( **OBJHANDLE hPlanet** )

Returns the number of perturbation coefficients defined for a planet.

Returns the number of perturbation coefficients defined for a planet to describe the latitude-dependent perturbation of its gravitational potential. A return value of 0 indicates that the planet is considered to have a spherically symmetric gravity field.

## Parameters

<i>hPlanet</i>	planet handle
----------------	---------------

## Returns

Number of perturbation coefficients.

## Note

Even if a planet defines perturbation coefficients, its gravity perturbation may be ignored, if the user disabled nonspherical gravity sources, or if orbit stabilisation is active at a given time step. Use the [VESSEL::NonsphericalGravityEnabled\(\)](#) function to check if a vessel uses the perturbation terms in the update of its state vectors.

Depending on the distance to the planet, Orbiter may use fewer perturbation terms than defined, if their contribution is negligible:

If  $J_n \left( \frac{R}{r} \right)^n < \epsilon, n \geq 2$ , ignore all terms  $\geq n$ ,

where  $R$  is the planet radius,  $r$  is the distance from the planet, and  $J_n$  is the  $n$ -th perturbation term defined for the planet.

Orbiter uses  $\epsilon = 10^{-10}$

16.49.2.8 OAPIFUNC double oapiGetPlanetObliquity ( **OBJHANDLE hPlanet** )

Returns the obliquity of the planet's rotation axis (the angle between the rotation axis and the ecliptic zenith).

## Parameters

<i>hPlanet</i>	planet handle
----------------	---------------

## Returns

obliquity [rad]

## Note

In Orbiter, the ecliptic zenith (at epoch J2000) is the positive y-axis of the global frame of reference.

## See also

[oapiGetPlanetPeriod](#), [oapiGetPlanetTheta](#)

16.49.2.9 OAPIFUNC void oapiGetPlanetObliquityMatrix ( **OBJHANDLE** *hPlanet*, **MATRIX3** \* *mat* )

Returns a rotation matrix which performs the transformation from the planet's tilted coordinates into global coordinates.

## Parameters

<i>hPlanet</i>	planet handle
<i>mat</i>	pointer to a matrix receiving the rotation data

## Note

The returned matrix is given by

$$R_a = \begin{bmatrix} \cos \theta & 0 & -\sin \theta \\ 0 & 1 & 0 \\ \sin \theta & 0 & \cos \theta \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos \varphi & -\sin \varphi \\ 0 & \sin \varphi & \cos \varphi \end{bmatrix}$$

where  $\theta$  is the longitude of the ascending node of the equator, as returned by [oapiGetPlanetTheta\(\)](#), and  $\varphi$  is the obliquity as returned by [oapiGetPlanetObliquity\(\)](#).  $R_a$  does not include the current rotation of the planet around its axis.  $R_a$  is therefore time-independent.

## See also

[oapiGetPlanetPeriod](#)

16.49.2.10 OAPIFUNC double oapiGetPlanetPeriod ( **OBJHANDLE** *hPlanet* )

Returns the rotation period (the length of a sidereal day) of a planet.

## Parameters

<i>hPlanet</i>	planet handle
----------------	---------------

## Returns

planet rotation period [seconds]

## See also

[oapiGetPlanetObliquity](#), [oapiGetPlanetTheta](#)

16.49.2.11 OAPIFUNC double oapiGetPlanetTheta ( **OBJHANDLE** *hPlanet* )

Returns the longitude of the ascending node.

Returns the longitude of the ascending node of the equatorial plane (denoted by  $q$ ), that is, the angle between the vernal equinox and the ascending node of the equator w.r.t. the ecliptic.

## Parameters

<i>hPlanet</i>	planet handle
----------------	---------------

## Returns

longitude of ascending node of the equator [rad]

## Note

For Earth, this function will return 0. (The ascending node of Earth's equatorial plane is the definition of the vernal equinox).

## See also

[oapiGetPlanetPeriod](#), [oapiGetPlanetObliquity](#)

**16.49.2.12 OAPIFUNC VECTOR3 oapiGetWindVector ( OBJHANDLE *hPlanet*, double *lng*, double *lat*, double *alt*, int *frame* = 0, double \* *windspeed* = NULL )**

Returns the wind velocity at a given position in a planet's atmosphere.

## Parameters

<i>hPlanet</i>	planet handle
<i>lng</i>	longitude [rad]
<i>lat</i>	latitude [rad]
<i>altitude</i>	above mean planet radius [m]
<i>frame</i>	reference frame flag (see notes)
<i>windspeed</i>	If defined, receives the wind speed magnitude in the local horizon frame, independent of the frame selected

## Returns

wind velocity vector relative to surface [m]

## Note

The *frame* flag can be used to specify the reference frame to which the returned vector refers. The following values are supported:

- 0: surface-relative (relative to local horizon)
- 1: planet-local (relative to local planet frame)
- 2: planet-local non-rotating (as 1, but adds the surface velocity, see [oapiGetGroundVector](#))
- 3: global (maps to global frame and adds planet velocity)

## Warning

Local wind velocities are not currently implemented. The surface-relative wind velocity is always (0,0,0). To ensure forward compatibility, plugins should not rely on this limitation, but use this function instead.

**16.49.2.13 OAPIFUNC bool oapiPlanetHasAtmosphere ( OBJHANDLE *hPlanet* )**

Test for existence of planetary atmosphere.

**Parameters**

<i>hPlanet</i>	planet handle
----------------	---------------

**Returns**

*true* if an atmosphere has been defined for the planet, *false* otherwise.

**See also**

[oapiGetPlanetAtmParams](#)

## 16.50 Elevation data-related functions

### Functions

- OAPIFUNC **ELEVHANDLE** oapiElevationManager (OBJHANDLE *hPlanet*)
 

*Returns a handle for elevation queries for a specified planet.*
- OAPIFUNC double oapiSurfaceElevation (OBJHANDLE *hPlanet*, double *lng*, double *lat*)
 

*Returns the elevation of a point on a planet surface.*

### 16.50.1 Detailed Description

### 16.50.2 Function Documentation

#### 16.50.2.1 OAPIFUNC ELEVHANDLE oapiElevationManager ( OBJHANDLE *hPlanet* )

Returns a handle for elevation queries for a specified planet.

##### Parameters

<i>hPlanet</i>	planet object handle
----------------	----------------------

##### Returns

elevation query handle (or 0 if planet doesn't support elevation data)

#### 16.50.2.2 OAPIFUNC double oapiSurfaceElevation ( OBJHANDLE *hPlanet*, double *lng*, double *lat* )

Returns the elevation of a point on a planet surface.

##### Parameters

<i>hPlanet</i>	planet object handle
<i>lng</i>	longitude [rad]
<i>lat</i>	latitude [rad]

##### Returns

Surface elevation above planet mean radius

##### Note

The OBJHANDLE passed to this function must be a handle for a planetary body  
 The return value may be negative if the specified point is below the mean planet radius.  
 If no elevation data are available for the specified body, the function returns 0.

## 16.51 Surface base interface

### Functions

- OAPIFUNC **OBJHANDLE** oapiGetBasePlanet (**OBJHANDLE** hBase)  
*Returns a handle for the planet/moon the given base is located on.*
- OAPIFUNC void oapiGetBaseEquPos (**OBJHANDLE** hBase, double \*lNg, double \*lat, double \*rad=0)  
*Returns the equatorial coordinates (longitude, latitude and radius) of the location of a surface base.*
- OAPIFUNC DWORD oapiGetBasePadCount (**OBJHANDLE** hBase)  
*Returns the number of VTOL landing pads owned by the base.*
- OAPIFUNC bool oapiGetBasePadEquPos (**OBJHANDLE** hBase, DWORD pad, double \*lNg, double \*lat, double \*rad=0)  
*Returns the equatorial coordinates (longitude, latitude and radius) of the location of a VTOL landing pad.*
- OAPIFUNC bool oapiGetBasePadStatus (**OBJHANDLE** hBase, DWORD pad, int \*status)  
*Returns the status of a VTOL landing pad (free, occupied or cleared).*
- OAPIFUNC **NAVHANDLE** oapiGetBasePadNav (**OBJHANDLE** hBase, DWORD pad)  
*Returns a handle to the ILS transmitter of a VTOL landing pad, if available.*

### 16.51.1 Detailed Description

### 16.51.2 Function Documentation

#### 16.51.2.1 OAPIFUNC void oapiGetBaseEquPos ( **OBJHANDLE** hBase, double \* lNg, double \* lat, double \* rad = 0 )

Returns the equatorial coordinates (longitude, latitude and radius) of the location of a surface base.

##### Parameters

<i>hBase</i>	surface base handle
<i>lNg</i>	pointer to variable to receive longitude value [rad]
<i>lat</i>	pointer to variable to receive latitude value [rad]
<i>rad</i>	pointer to variable to receive radius value [m]

##### Note

hBase must be a valid base handle (e.g. from [oapiGetBaseByName\(\)](#))

The radius pointer can be omitted if not required.

Currently, rad will always return the planet mean radius.

#### 16.51.2.2 OAPIFUNC DWORD oapiGetBasePadCount ( **OBJHANDLE** hBase )

Returns the number of VTOL landing pads owned by the base.

##### Parameters

<i>hBase</i>	surface base handle
--------------	---------------------

##### Returns

Number of landing pads

##### Note

hBase must be a valid base handle (e.g. from [oapiGetBaseByName\(\)](#))

This function only counts VTOL pads, not runways.

16.51.2.3 OAPIFUNC bool oapiGetBasePadEquPos ( **OBJHANDLE** *hBase*, **DWORD** *pad*, **double** \* *lng*, **double** \* *lat*, **double** \* *rad* = 0 )

Returns the equatorial coordinates (longitude, latitude and radius) of the location of a VTOL landing pad.

## Parameters

<i>hBase</i>	surface base handle
<i>pad</i>	pad index
<i>lng</i>	pointer to variable to receive longitude value [rad]
<i>lat</i>	pointer to variable to receive latitude value [rad]
<i>rad</i>	pointer to variable to receive radius value [m]

## Returns

*false* indicates failure (pad index out of range). In that case, the return values are undefined.

## Note

*hBase* must be a valid base handle (e.g. from [oapiGetBaseByName\(\)](#))

$0 \leq \text{pad} < \text{oapiGetBasePadCount()}$  is required.

The radius pointer can be omitted if not required.

16.51.2.4 OAPIFUNC NAVHANDLE [oapiGetBasePadNav](#) ( **OBJHANDLE hBase, DWORD pad** )

Returns a handle to the ILS transmitter of a VTOL landing pad, if available.

## Parameters

<i>hBase</i>	surface base handle
<i>pad</i>	pad index

## Returns

Handle of a ILS transmitter, or NULL if the pad index is out of range or the pad has no ILS.

## Note

*hBase* must be a valid base handle (e.g. from [oapiGetBaseByName\(\)](#))

$0 \leq \text{pad} < \text{oapiGetBasePadCount()}$  is required.

16.51.2.5 OAPIFUNC bool [oapiGetBasePadStatus](#) ( **OBJHANDLE hBase, DWORD pad, int \* status** )

Returns the status of a VTOL landing pad (free, occupied or cleared).

## Parameters

<i>hBase</i>	surface base handle
<i>pad</i>	pad index
<i>status</i>	pointer to variable to receive pad status

## Returns

*false* indicates failure (pad index out of range)

## Note

*hBase* must be a valid base handle (e.g. from [oapiGetBaseByName\(\)](#))

$0 \leq \text{pad} < \text{oapiGetBasePadCount()}$  is required.

*status* can be one of the following:

0 = pad is free

1 = pad is occupied

2 = pad is cleared for an incoming vessel

16.51.2.6 OAPIFUNC OBJHANDLE [oapiGetBasePlanet](#) ( **OBJHANDLE hBase** )

Returns a handle for the planet/moon the given base is located on.

**Parameters**

<i>hBase</i>	base handle
--------------	-------------

**Returns**

Planet handle, or NULL if the base was not recognised.

**See also**

[oapiGetBaseByIndex](#), [oapiGetBaseByName](#)

## 16.52 Time functions

### Functions

- OAPIFUNC double [oapiGetSimTime \(\)](#)  
*Retrieve simulation time (in seconds) since simulation start.*
- OAPIFUNC double [oapiGetSimStep \(\)](#)  
*Retrieve length of last simulation time step (from previous to current frame) in seconds.*
- OAPIFUNC double [oapiGetSysTime \(\)](#)  
*Retrieve system (real) time since simulation start.*
- OAPIFUNC double [oapiGetSysStep \(\)](#)  
*Retrieve length of last system time step in seconds.*
- OAPIFUNC double [oapiGetSimMJD \(\)](#)  
*Retrieve absolute time measure (Modified Julian Date) for current simulation state.*
- OAPIFUNC double [oapiGetSysMJD \(\)](#)  
*Retrieve the current computer system time in Modified Julian Date (MJD) format.*
- OAPIFUNC bool [oapiSetSimMJD \(double mjd, int pmode=0\)](#)  
*Set the current simulation time. The simulation session performs a jump to the new time.*
- OAPIFUNC double [oapiTime2MJD \(double simt\)](#)  
*Convert a simulation up time value into a Modified Julian Date.*
- OAPIFUNC double [oapiGetTimeAcceleration \(\)](#)  
*Returns simulation time acceleration factor.*
- OAPIFUNC void [oapiSetTimeAcceleration \(double warp\)](#)  
*Set the simulation time acceleration factor.*
- OAPIFUNC double [oapiGetFrameRate \(\)](#)  
*Returns current simulation frame rate (frames/sec).*
- OAPIFUNC bool [oapiGetPause \(\)](#)  
*Returns the current simulation pause state.*
- OAPIFUNC void [oapiSetPause \(bool pause\)](#)  
*Sets the simulation pause state.*

### 16.52.1 Detailed Description

#### 16.52.2 Function Documentation

##### 16.52.2.1 OAPIFUNC double [oapiGetFrameRate \( \)](#)

Returns current simulation frame rate (frames/sec).

#### Returns

Current frame rate (fps)

##### 16.52.2.2 OAPIFUNC bool [oapiGetPause \( \)](#)

Returns the current simulation pause state.

#### Returns

*true* if simulation is currently paused, *false* if it is running.

#### See also

[oapiSetPause](#)

### 16.52.2.3 OAPIFUNC double oapiGetSimMJD ( )

Retrieve absolute time measure (Modified Julian Date) for current simulation state.

#### Returns

Current Modified Julian Date (days)

#### Note

Orbiter defines the Modified Julian Date (MJD) as  $JD - 240\ 0000.5$ , where JD is the Julian Date. JD is the interval of time in mean solar days elapsed since 4713 BC January 1 at Greenwich mean noon.

#### See also

[oapiSetSimMJD](#), [oapiGetSimTime](#)

### 16.52.2.4 OAPIFUNC double oapiGetSimStep ( )

Retrieve length of last simulation time step (from previous to current frame) in seconds.

#### Returns

Simulation time step (seconds)

#### Note

This parameter is useful for numerical (finite difference) calculation of time derivatives.

### 16.52.2.5 OAPIFUNC double oapiGetSimTime ( )

Retrieve simulation time (in seconds) since simulation start.

#### Returns

Simulation up time (seconds)

#### Note

Since the simulation up time depends on the simulation start time, this parameter is useful mainly for time differences. To get an absolute time parameter, use [oapiGetSimMJD\(\)](#).

### 16.52.2.6 OAPIFUNC double oapiGetSysMJD ( )

Retrieve the current computer system time in Modified Julian Date (MJD) format.

#### Returns

Computer system time in MJD format

#### Note

The returned value is the UTC time obtained from the computer system clock, plus  $dt=66.184$  seconds to map from UTC to TDB (Barycentric Dynamical Time) used internally by Orbiter. The  $dt$  offset was not added in previous Orbiter releases.

#### See also

[oapiGetSysTime](#)

**16.52.2.7 OAPIFUNC double oapiGetSysStep ( )**

Retrieve length of last system time step in seconds.

**Returns**

System time step (seconds)

**Note**

Unlike [oapiGetSimStep\(\)](#), this function does not include the time compression factor. It is useful to control actions which do not depend on the simulation time acceleration.

**16.52.2.8 OAPIFUNC double oapiGetSysTime ( )**

Retrieve system (real) time since simulation start.

**Returns**

Real-time simulation up time (seconds)

**Note**

This function measures the real time elapsed since the simulation was started. Unlike [oapiGetSimTime\(\)](#), it doesn't take into account time acceleration.

**See also**

[oapiGetSysMJD](#)

**16.52.2.9 OAPIFUNC double oapiGetTimeAcceleration ( )**

Returns simulation time acceleration factor.

**Returns**

time acceleration factor

**Note**

This function will not return 0 when the simulation is paused. Instead it will return the acceleration factor at which the simulation will resume when unpause. Use [oapiGetPause](#) to obtain the pause/resume state.

**See also**

[oapiSetTimeAcceleration](#)

**16.52.2.10 OAPIFUNC void oapiSetPause ( bool pause )**

Sets the simulation pause state.

**Parameters**

<i>pause</i>	<i>true</i> to pause the simulation, <i>false</i> to resume.
--------------	--

#### See also

[oapiGetPause](#)

#### 16.52.2.11 OAPIFUNC bool oapiSetSimMJD ( double *mjd*, int *pmode* = 0 )

Set the current simulation time. The simulation session performs a jump to the new time.

#### Parameters

<i>mjd</i>	new simulation time
<i>pmode</i>	vessel propagation modes (see notes)

#### Returns

Currently this function always returns *true*.

#### Note

The new time can be set before or after the current simulation time.

Deterministic objects (planets controlled by Keplerian elements or perturbation code) are propagated directly. Vessels are propagated according to *pmode*, which can be a combination of

Orbital vessels	
PROP_ORBITAL_ELEMENTS	Move the vessel along its current orbital trajectory, assuming that no forces other than the central body's gravitational force are acting on the vessel.
PROP_ORBITAL_FIXEDSTATE	Keep the vessel's relative position and velocity with respect to the central body fixed in a non-rotating frame.
PROP_ORBITAL_FIXEDSURF	Keep the vessel's position velocity and attitude fixed relative to the planet surface.
Suborbital vessels	
PROP_SORBITAL_ELEMENTS	PROP_ORBITAL_ELEMENTS
PROP_SORBITAL_FIXEDSTATE	PROP_ORBITAL_FIXEDSTATE
PROP_SORBITAL_FIXEDSURF	PROP_ORBITAL_FIXEDSURF
PROP_SORBITAL_DESTROY	Destroy any suborbital vessels (i.e. assume that the vessels impacted on the ground during time propagation).

*pmode* can be a bitwise combination of one of the orbital and one of the suborbital modes. Default is propagation along osculating elements for both.

#### See also

[oapiGetSimMJD](#)

#### 16.52.2.12 OAPIFUNC void oapiSetTimeAcceleration ( double *warp* )

Set the simulation time acceleration factor.

#### Parameters

<i>warp</i>	new time acceleration factor
-------------	------------------------------

**Note**

Warp factors will be clamped to the valid range [1,100000]. If the new warp factor is different from the previous one, all DLLs (including the one that called [oapiSetTimeAcceleration\(\)](#)) will be sent a [opcTimeAccChanged\(\)](#) message.

**See also**

[oapiGetTimeAcceleration](#)

**16.52.2.13 OAPIFUNC double oapiTime2MJD ( double *simt* )**

Convert a simulation up time value into a Modified Julian Date.

**Parameters**

<i>simt</i>	simulation time (seconds)
-------------	---------------------------

**Returns**

Modified Julian Date (MJD) corresponding to *simt*.

## 16.53 Navigation radio transmitter functions

### Functions

- OAPIFUNC void [oapiGetNavPos \(NAVHANDLE hNav, VECTOR3 \\*gpos\)](#)  
*Returns the current position of a NAV transmitter (in global coordinates, i.e. heliocentric ecliptic).*
- OAPIFUNC DWORD [oapiGetNavChannel \(NAVHANDLE hNav\)](#)  
*Returns the channel number of a NAV transmitter.*
- OAPIFUNC float [oapiGetNavFreq \(NAVHANDLE hNav\)](#)  
*Returns the frequency of a NAV transmitter.*
- OAPIFUNC double [oapiGetNavSignal \(NAVHANDLE hNav, const VECTOR3 &gpos\)](#)  
*Returns the signal strength of a transmitter at a given position.*
- OAPIFUNC float [oapiGetNavRange \(NAVHANDLE hNav\)](#)  
*Returns the range of a NAV transmitter.*
- OAPIFUNC DWORD [oapiGetNavType \(NAVHANDLE hNav\)](#)  
*Returns the type id of a NAV transmitter.*
- OAPIFUNC int [oapiGetNavData \(NAVHANDLE hNav, NAVDATA \\*data\)](#)  
*Returns information about a NAV transmitter.*
- OAPIFUNC int [oapiGetNavDescr \(NAVHANDLE hNav, char \\*descr, int maxlen\)](#)  
*Returns a descriptive string for a NAV transmitter.*
- OAPIFUNC bool [oapiNavInRange \(NAVHANDLE hNav, const VECTOR3 &gpos\)](#)  
*Determines whether a given global coordinate is within the range of a NAV transmitter.*

### 16.53.1 Detailed Description

### 16.53.2 Function Documentation

#### 16.53.2.1 OAPIFUNC DWORD oapiGetNavChannel ( NAVHANDLE hNav )

Returns the channel number of a NAV transmitter.

##### Parameters

<i>hNav</i>	NAV transmitter handle
-------------	------------------------

##### Returns

channel number

##### Note

Channel numbers range from 0 to 639.

To convert a channel number ch into a frequency, use  $f = (108.0 + 0.05 ch)$  MHz

##### See also

[oapiGetNavData](#), [oapiGetNavFreq](#), [oapiGetNavRange](#), [oapiGetNavPos](#), [oapiGetNavType](#)

#### 16.53.2.2 OAPIFUNC int oapiGetNavData ( NAVHANDLE hNav, NAVDATA \* data )

Returns information about a NAV transmitter.

## Parameters

in	<i>hNav</i>	NAV transmitter handle
out	<i>data</i>	pointer to <a href="#">NAVDATA</a> structure receiving transmitter data

## Returns

Error flag. Currently always returns 0.

## Note

On call, *data* must point to a [NAVDATA](#) variable.

## See also

[NAVDATA](#), [oapiGetNavType](#)

16.53.2.3 OAPIFUNC int oapiGetNavDescr ( NAVHANDLE *hNav*, char \* *descr*, int *maxlen* )

Returns a descriptive string for a NAV transmitter.

## Parameters

<i>hNav</i>	NAV transmitter handle
<i>descr</i>	pointer to string receiving description
<i>maxlen</i>	string buffer length

## Returns

Number of characters returned (excluding terminating NULL character). If maxlen was not sufficient to store the complete description, the return value is negative.

## Note

This function fills string *descr* with a description of the NAV radio transmitter of lenght  $\leq maxlen$ . If the buffer length is greater than required for the description, a NULL character is appended.

The description format for the different transmitter types is as follows:

VOR	"VOR <id>"	where <id> is a 3-4 letter sequence
VTOL	"VTOL Pad-<#> <base>"	where <#> is the pad number, and <base> is the base name
ILS	"ILS Rwy <#> <base>"	where <#> is the runway id, and <base> is the base name
IDS	"IDS D-<#> <vessel>"	where <#> is the dock number, and <vessel> is the vessel name
XPDR	"XPDR <vessel>"	where <vessel> is the vessel name

16.53.2.4 OAPIFUNC float oapiGetNavFreq ( NAVHANDLE *hNav* )

Returns the frequency of a NAV transmitter.

## Parameters

<i>hNav</i>	NAV transmitter handle
-------------	------------------------

## Returns

Transmitter frequency [MHz]

## Note

In Orbiter, NAV transmitter frequencies range from 108.0 to 139.95 MHz and are incremented in 0.05 MHz steps.

## See also

[oapiGetNavData](#), [oapiGetNavChannel](#), [oapiGetNavRange](#), [oapiGetNavPos](#), [oapiGetNavType](#)

16.53.2.5 OAPIFUNC void oapiGetNavPos ( NAVHANDLE *hNav*, VECTOR3 \* *gpos* )

Returns the current position of a NAV transmitter (in global coordinates, i.e. heliocentric ecliptic).

## Parameters

<i>hNav</i>	NAV transmitter handle
<i>gpos</i>	pointer to variable to receive global position

## See also

[oapiGetNavRange](#), [oapiGetNavType](#), [oapiNavInRange](#)

16.53.2.6 OAPIFUNC float oapiGetNavRange ( NAVHANDLE *hNav* )

Returns the range of a NAV transmitter.

## Parameters

<i>hNav</i>	NAV transmitter handle
-------------	------------------------

## Returns

Transmitter range [m]

## Note

A NAV receiver will only receive a signal when within the range of a transmitter.

Variable receiver sensitivity is not currently implemented.

Shadowing of a transmitter by obstacles between transmitter and receiver is not currently implemented.

Because the range of the transmitter depends on receiver gain as well as transmitter power, the range is not strictly a property of the transmitter. It is preferred to calculate the range for a given receiver gain by using the [oapiGetNavData](#) or [oapiGetNavSignal](#) functions.

## See also

[oapiGetNavData](#), [oapiGetNavSignal](#), [oapiGetNavPos](#), [oapiGetNavType](#), [oapiNavInRange](#)

16.53.2.7 OAPIFUNC double oapiGetNavSignal ( NAVHANDLE *hNav*, const VECTOR3 & *gpos* )

Returns the signal strength of a transmitter at a given position.

## Parameters

<i>hNav</i>	transmitter handle
<i>gpos</i>	global position

## Returns

Signal strength in arbitrary units

## Note

The transmitter signal strength drops off with the square of distance to the transmitter. The units are chosen so that a 'default' receiver will be able to detect signals above a strength of 1.

## See also

[oapiGetNavData](#), [oapiGetNavRange](#)

16.53.2.8 OAPIFUNC DWORD oapiGetNavType ( NAVHANDLE *hNav* )

Returns the type id of a NAV transmitter.

## Parameters

<i>hNav</i>	NAV transmitter handle
-------------	------------------------

## Returns

transmitter type identifier

## Note

The following transmitter types are currently supported:

- TRANSMITTER\_VOR (omnidirectional beacon)
- TRANSMITTER\_VTOL (launchpad homing beacon)
- TRANSMITTER\_IALS (instrument landing system)
- TRANSMITTER\_IDS (instrument docking system)
- TRANSMITTER\_XPDR (transponder)

## See also

[oapiGetNavData](#), [oapiGetNavDescr](#)

16.53.2.9 OAPIFUNC bool oapiNavInRange ( NAVHANDLE *hNav*, const VECTOR3 & *gpos* )

Determines whether a given global coordinate is within the range of a NAV transmitter.

## Parameters

<i>hNav</i>	NAV transmitter handle
<i>gpos</i>	Global coordinates [m,m,m] of a point (cartesian heliocentric ecliptic)

## Returns

*true* if the point is within range of the transmitter.

## 16.54 Script interpreter functions

### Functions

- OAPIFUNC **INTERPRETERHANDLE** [oapiCreateInterpreter \(\)](#)  
*Returns a handle to a new interpreter instance.*
- OAPIFUNC int [oapiDellInterpreter \(INTERPRETERHANDLE hInterp\)](#)  
*Delete an interpreter instance.*
- OAPIFUNC bool [oapiExecScriptCmd \(INTERPRETERHANDLE hInterp, const char \\*cmd\)](#)  
*Executes a script command in an interpreter instance.*
- OAPIFUNC bool [oapiAsyncScriptCmd \(INTERPRETERHANDLE hInterp, const char \\*cmd\)](#)  
*Passes a command to an interpreter instance for execution.*
- OAPIFUNC **lua\_State** \* [oapiGetLua \(INTERPRETERHANDLE hInterp\)](#)

### 16.54.1 Detailed Description

### 16.54.2 Function Documentation

#### 16.54.2.1 OAPIFUNC bool [oapiAsyncScriptCmd \( INTERPRETERHANDLE hInterp, const char \\* cmd \)](#)

Passes a command to an interpreter instance for execution.

##### Parameters

<i>hInterp</i>	interpreter handle
<i>cmd</i>	Lua command to be executed

##### Returns

*false* on error (interpreter library not found, or command error)

##### Note

This function returns immediately. The command is executed during the next postStep cycle. If more asynchronous commands are issued before execution starts, they are appended to the execution list. If the interpreter receives a synchronous request ([oapiExecScriptCmd](#)) before the asynchronous commands are executed, the synchronous command is executed immediately, while the asynchronous requests continue waiting.

##### See also

[oapiExecScriptCmd](#), [oapiCreateInterpreter](#), [oapiDellInterpreter](#)

#### 16.54.2.2 OAPIFUNC **INTERPRETERHANDLE** [oapiCreateInterpreter \( \)](#)

Returns a handle to a new interpreter instance.

##### Note

The interpreter can subsequently be used to execute commands and scripts.

##### See also

[oapiDellInterpreter](#), [oapiExecScriptCmd](#)

#### 16.54.2.3 OAPIFUNC int [oapiDellInterpreter \( INTERPRETERHANDLE hInterp \)](#)

Delete an interpreter instance.

**Parameters**

<i>hInterp</i>	interpreter handle
----------------	--------------------

**Note**

After the interpreter instance has been deleted, the handle becomes invalid and must not be used any more. If the interpreter was executing a background script, the execution is terminated when the interpreter is deleted.

**See also**

[oapiCreateInterpreter](#), [oapiExecScriptCmd](#)

**16.54.2.4 OAPIFUNC bool oapiExecScriptCmd ( INTERPRETERHANDLE *hInterp*, const char \* *cmd* )**

Executes a script command in an interpreter instance.

**Parameters**

<i>hInterp</i>	interpreter handle
<i>cmd</i>	Lua command to be executed

**Returns**

*false* on error (interpreter library not found, or command error)

**Note**

This function returns as soon as the command has been executed.

**See also**

[oapiAsyncScriptCmd](#), [oapiCreateInterpreter](#), [oapiDellInterpreter](#)

## 16.55 Visual and mesh functions

### Typedefs

- **typedef void(\* LoadMeshClbkFunc) (MESHHANDLE hMesh, bool firstload)**  
*Callback function used by [oapiLoadMeshGlobal\(const char\\*,LoadMeshClbkFunc\)](#)*

### Functions

- **OAPIFUNC VISHANDLE \* oapiObjectVisualPtr (OBJHANDLE hObject)**  
*Returns a pointer storing the objects visual handle.*
- **OAPIFUNC MESHHANDLE oapiLoadMesh (const char \*fname)**  
*Loads a mesh from file and returns a handle to it.*
- **OAPIFUNC const MESHHANDLE oapiLoadMeshGlobal (const char \*fname)**  
*Retrieves a mesh handle from the global mesh manager.*
- **OAPIFUNC const MESHHANDLE oapiLoadMeshGlobal (const char \*fname, LoadMeshClbkFunc fClbk)**  
*Retrieves a mesh handle from the global mesh manager.*
- **OAPIFUNC MESHHANDLE oapiCreateMesh (DWORD ngrp, MESHGROUP \*grp)**  
*Creates a new mesh from a list of mesh group definitions.*
- **OAPIFUNC void oapiDeleteMesh (MESHHANDLE hMesh)**  
*Removes a mesh from memory.*
- **OAPIFUNC DWORD oapiGetMeshFlags (MESHHANDLE hMesh)**  
*Returns the bit flags for the mesh.*
- **OAPIFUNC DWORD oapiMeshGroupCount (MESHHANDLE hMesh)**  
*Returns the number of mesh groups defined in a mesh.*
- **OAPIFUNC MESHGROUP \* oapiMeshGroup (MESHHANDLE hMesh, DWORD idx)**  
*Returns a pointer to the group specification of a mesh group.*
- **OAPIFUNC MESHGROUP \* oapiMeshGroup (DEVMESHHANDLE hMesh, DWORD idx)**
- **OAPIFUNC MESHGROUPEX \* oapiMeshGroupEx (MESHHANDLE hMesh, DWORD idx)**
- **OAPIFUNC DWORD oapiAddMeshGroup (MESHHANDLE hMesh, MESHGROUP \*grp)**
- **OAPIFUNC bool oapiAddMeshGroupBlock (MESHHANDLE hMesh, DWORD grpidx, const NTVERTEX \*vtx, DWORD nvtx, const WORD \*idx, DWORD nidx)**
- **OAPIFUNC int oapiGetMeshGroup (DEVMESHHANDLE hMesh, DWORD grpidx, GROUPREQUESTSPEC \*grs)**  
*Retrieve mesh group data.*
- **OAPIFUNC int oapiEditMeshGroup (MESHHANDLE hMesh, DWORD grpidx, GROUPEDITSPEC \*ges)**  
*Modify mesh group data.*
- **OAPIFUNC int oapiEditMeshGroup (DEVMESHHANDLE hMesh, DWORD grpidx, GROUPEDITSPEC \*ges)**
- **OAPIFUNC DWORD oapiMeshTextureCount (MESHHANDLE hMesh)**  
*Returns the number of textures associated with a mesh.*
- **OAPIFUNC SURFHANDLE oapiGetTextureHandle (MESHHANDLE hMesh, DWORD texidx)**  
*Retrieve a surface handle for a mesh texture.*
- **OAPIFUNC SURFHANDLE oapiLoadTexture (const char \*fname, bool dynamic=false)**  
*Load a texture from a file.*
- **OAPIFUNC void oapiReleaseTexture (SURFHANDLE hTex)**  
*Release a texture.*
- **OAPIFUNC bool oapiSetTexture (MESHHANDLE hMesh, DWORD texidx, SURFHANDLE tex)**  
*Replace a mesh texture.*
- **OAPIFUNC bool oapiSetTexture (DEVMESHHANDLE hMesh, DWORD texidx, SURFHANDLE tex)**
- **OAPIFUNC DWORD oapiMeshMaterialCount (MESHHANDLE hMesh)**  
*Returns the number of materials defined in the mesh.*

- OAPIFUNC **MATERIAL** \* [oapiMeshMaterial](#) (**MESHHANDLE** hMesh, **DWORD** idx)  
*Returns a pointer to a material specification in the material list of the mesh.*
- OAPIFUNC **int** [oapiMeshMaterial](#) (**DEVMESHHANDLE** hMesh, **DWORD** idx, **MATERIAL** \*mat)  
*Retrieve properties of a device mesh material.*
- OAPIFUNC **DWORD** [oapiAddMaterial](#) (**MESHHANDLE** hMesh, **MATERIAL** \*mat)  
*Add a material definition to a mesh.*
- OAPIFUNC **bool** [oapiDeleteMaterial](#) (**MESHHANDLE** hMesh, **DWORD** idx)  
*Delete a material definition from the mesh.*
- OAPIFUNC **int** [oapiSetMaterial](#) (**DEVMESHHANDLE** hMesh, **DWORD** matidx, **const MATERIAL** \*mat)  
*Reset the properties of a mesh material.*
- OAPIFUNC **bool** [oapiSetMeshProperty](#) (**MESHHANDLE** hMesh, **DWORD** property, **DWORD** value)  
*Set custom properties for a mesh.*
- OAPIFUNC **bool** [oapiSetMeshProperty](#) (**DEVMESHHANDLE** hMesh, **DWORD** property, **DWORD** value)  
*Set custom properties for a device-specific mesh.*
- OAPIFUNC **void** [oapiParticleSetLevelRef](#) (**PSTREAM\_HANDLE** ph, **double** \*lvl)  
*Reset the reference pointer used by the particle stream to calculate the intensity (opacity) of the generated particles.*

### 16.55.1 Detailed Description

### 16.55.2 Typedef Documentation

#### 16.55.2.1 **typedef void(\* LoadMeshClbkFunc) (MESHHANDLE hMesh, bool firstload)**

Callback function used by [oapiLoadMeshGlobal](#)(**const char\***,[LoadMeshClbkFunc](#))

##### Parameters

<i>hMesh</i>	mesh handle
<i>firstload</i>	flag indicating if the mesh has been loaded for the first time

##### Note

If *firstload*==false, the mesh had already been loaded previously. In this case, the mesh is not re-loaded, and the returned handle points to the previously loaded mesh.

### 16.55.3 Function Documentation

#### 16.55.3.1 OAPIFUNC **DWORD** [oapiAddMaterial](#) ( **MESHHANDLE** hMesh, **MATERIAL** \* mat )

Add a material definition to a mesh.

##### Parameters

<i>hMesh</i>	mesh handle
<i>mat</i>	pointer to material definition

##### Returns

Material index in the mesh.

##### Note

The material is appended to the mesh material list.

##### See also

[oapiMeshMaterial](#), [oapiDeleteMaterial](#), [oapiMeshMaterialCount](#)

**16.55.3.2 OAPIFUNC MESHHANDLE oapiCreateMesh ( DWORD *ngrp*, MESHGROUP \* *grp* )**

Creates a new mesh from a list of mesh group definitions.

## Parameters

<i>ngrp</i>	number of groups in the list
<i>grp</i>	list of mesh groups

## Returns

Handle for the newly created mesh.

## Note

Orbiter performs a deep copy of the group definitions passed to the functions. Therefore it is admissible to pass the groups as variables with local scope. If the mesh groups were dynamically allocated, they should be deallocated by the caller after use.

16.55.3.3 OAPIFUNC bool oapiDeleteMaterial ( **MESHHANDLE** *hMesh*, **DWORD** *idx* )

Delete a material definition from the mesh.

## Parameters

<i>hMesh</i>	mesh handle
<i>idx</i>	material index ( $\geq 0$ )

## Returns

*false* indicates failure (index out of range)

## Note

This function adjusts all mesh group material indices to account for the modified material table. Any groups that referenced the deleted material are reset to material 0 (default material).

## See also

[oapiMeshMaterial](#), [oapiAddMaterial](#), [oapiMeshMaterialCount](#)

16.55.3.4 OAPIFUNC void oapiDeleteMesh ( **MESHHANDLE** *hMesh* )

Removes a mesh from memory.

## Parameters

<i>hMesh</i>	mesh handle
--------------	-------------

16.55.3.5 OAPIFUNC int oapiEditMeshGroup ( **MESHHANDLE** *hMesh*, **DWORD** *grpidx*, **GROUPEDITSPEC** \* *ges* )

Modify mesh group data.

## Parameters

<i>hMesh</i>	mesh handle
<i>grpidx</i>	mesh group index ( $\geq 0$ )
<i>ges</i>	replacement/modification data for the group

## Returns

0 on success, or error code

**Note**

This function allows to modify a mesh group, by replacing vertex data, or group flags.

It should not be used to apply a linear transformation to the entire group (use [VESSEL::MeshgroupTransform](#) instead), because such transformations are usually implemented by defining a transformation matrix instead of editing the vertex positions directly.

This version operates on device-independent meshes, e.g. mesh templates.

`oapiEditMeshGroup` should be used in preference to [oapiMeshGroup](#), because it is more likely to be supported by external graphics engines.

**See also**

`oapiEditMeshGroup(DEVMESSHHANDLE,DWORD,GROUPEDITSPEC*)`

**16.55.3.6 OAPIFUNC DWORD oapiGetMeshFlags ( MESSHHANDLE *hMesh* )**

Returns the bit flags for the mesh.

**Returns**

mesh flags

bit	effect
0	set: mesh cast shadow on planetary surfaces
1	set: use global shadow setting (bit 0) for all groups; unset: use individual group flags

**16.55.3.7 OAPIFUNC int oapiGetMeshGroup ( DEVMESSHHANDLE *hMesh*, DWORD *grpidx*, GROUPREQUESTSPEC \* *grs* )**

Retrieve mesh group data.

**Parameters**

in	<i>hMesh</i>	mesh handle
in	<i>grpidx</i>	mesh group index ( $\geq 0$ )
in, out	<i>grs</i>	data buffers and buffer sizes

**Returns**

Error code:

- 0: success
- -1: no graphics client attached
- -2: graphics client hasn't implemented this function
- 1: grpidx is out of bounds
- 2: some indices in VtxPerm or IdxPerm were out of bounds (but data are still returned for the rest)

**Note**

The vertex buffer (*grs.Vtx*), index buffer (*grs.Idx*) and vertex permutation buffer (*grs.VtxPerm*) must be allocated by the caller to sufficient size, or set to NULL to indicate that they are not required.

If vertex data should be returned, *nVtx* should be set to the maximum number of vertices to return, and *Vtx* must be allocated to at least this size. If the group contains fewer vertices, the *Vtx* buffer is only partially filled, and *nVtx* is set to the actual number of returned vertices. If the group contains more vertices, and *VtxPerm* is NULL, only the first *nVtx* vertices are returned.

If an arbitrary subset of vertices should be returned, assign the *VtxPerm* buffer to at least size *nVtx*, and fill it with the indices of the vertices you want returned. The order of vertices returned in *Vtx* will correspond to *VtxPerm*. If *VtxPerm* contains any indices outside the valid range, the corresponding entries in *Vtx* will be filled with {0} vertices, and the function will return 2.

If no vertex data are requested, set Vtx to NULL and/or nVtx to 0.

Similar for triangle index data: If index data should be returned, set nIdx > 0 and allocate Idx to at least size nIdx.

If you want indices returned from the beginning, set IdxPerm to NULL. Otherwise, allocate IdxPerm and fill it with the requested triangle indices.

The MtrlIdx and TexIdx entries are always returned.

`oapiGetMeshGroup` can be an expensive operation. It involves data copying, and Graphics clients may have to retrieve data from video memory. Avoid continuous `oapiGetMeshGroup/oapiEditMesh` cycles and instead keep the data stored in your own buffers once retrieved.

#### 16.55.3.8 OAPIFUNC SURFHANDLE `oapiGetTextureHandle ( MESHHANDLE hMesh, DWORD texidx )`

Retrieve a surface handle for a mesh texture.

##### Parameters

<i>hMesh</i>	mesh handle
<i>texidx</i>	texture index (>=1)

##### Returns

surface handle

##### Note

This function can be used for dynamically updating textures during the simulation.

the texture index is given by the order in which the textures appear in the texture list at the end of the mesh file.

Important: Any textures which are to be dynamically modified should be listed with the "D" flag ("dynamic") in the mesh file. This causes Orbiter to decompress the texture when it is loaded. Blitting operations to compressed surfaces is very inefficient on most graphics hardware.

#### 16.55.3.9 OAPIFUNC MESHHANDLE `oapiLoadMesh ( const char * fname )`

Loads a mesh from file and returns a handle to it.

##### Parameters

<i>fname</i>	mesh file name
--------------	----------------

##### Returns

Handle to the loaded mesh. (NULL indicates load error)

##### Note

The file name should not contain a path or file extension. Orbiter appends extension .msh and searches in the default mesh directory.

Meshes should be deallocated with `oapiDeleteMesh` when no longer needed.

##### See also

[oapiDeleteMesh](#), [VESSEL::AddMesh](#)

#### 16.55.3.10 OAPIFUNC const MESHHANDLE `oapiLoadMeshGlobal ( const char * fname )`

Retrieves a mesh handle from the global mesh manager.

When called for the first time for any given file name, the mesh is loaded from file and stored as a system resource. Every further request for the same mesh directly returns a handle to the stored mesh without additional file I/O.

## Parameters

<i>fname</i>	mesh file name
--------------	----------------

## Returns

mesh handle

## Note

Once a mesh is globally loaded it remains in memory until the user closes the simulation window. This function can be used to pre-load meshes to avoid load delays during the simulation. For example, parent objects may pre-load meshes for any child objects they may create later.

Do NOT delete any meshes obtained by this function with [oapiDeleteMesh\(\)](#) Orbiter takes care of deleting globally managed meshes.

If you assign the mesh to a vessel with a subsequent [VESSEL::AddMesh\(\)](#) call, a copy of the global mesh is created every time the vessel creates its visual, and discarded as soon as the visual is deleted. The global mesh can therefore be regarded as a template from which individual vessel instances make copies whenever they need to initialise their visual representation. Handles for the individual mesh copies can be obtained within the [VESSEL2::clbkVisualCreated\(\)](#) callback function, using the [VESSEL::GetMesh\(\)](#) method. Vessels should only modify their individual meshes, never the global template, since the latter is shared across all vessel instances.

For external graphics clients, the Orbiter core forwards the mesh data to the client for conversion to a device-specific format. The mesh template referred to by the handle returned by [oapiLoadMeshGlobal](#) is then no longer used, so any changes made to it will be ignored.

16.55.3.11 OAPIFUNC const MESHHANDLE oapiLoadMeshGlobal ( const char \* *fname*, LoadMeshClbkFunc *fClbk* )

Retrieves a mesh handle from the global mesh manager.

## Parameters

<i>fname</i>	mesh file name
<i>fClbk</i>	Callback function for mesh modification

## Returns

mesh handle

## Note

This function is identical to [oapiLoadMeshGlobal\(const char\\*\)](#), except that it invokes the callback function immediately after loading the mesh. This is important in combination with external graphics clients, because Orbiter hands the loaded mesh on to the client for conversion to a device-specific format. The callback function is invoked before the mesh is passed to the graphics client. This allows to apply modifications (e.g. decryption) while the mesh is still in an editable format. Applying the modifications to the mesh handle returned by [oapiLoadMeshGlobal](#) would not work in this case, because the mesh has already been copied to the client.

16.55.3.12 OAPIFUNC SURFHANDLE oapiLoadTexture ( const char \* *fname*, bool *dynamic* = false )

Load a texture from a file.

## Parameters

<i>fname</i>	texture file name
--------------	-------------------

<i>dynamic</i>	allow dynamic modification
----------------	----------------------------

**Returns**

Surface handle for the loaded texture, or NULL if not found.

**Note**

Textures loaded by this function should be in DDS format and conform to the DirectX restrictions for texture surfaces, typically square bitmaps with dimensions of powers of 2 (128x128, 256x256, etc.).

File names can contain search paths. Orbiter searches for textures in the standard way, i.e. first searches the HitexDir directory (usually Textures2), then the TextureDir directory (usually Textures). All search paths are relative to the texture root directories. For example, [oapiLoadTexture\(\)](#) ("myvessel\mytex.dds") would first search for Textures2\myvessel\mytex.dds, then for Textures\myvessel\mytex.dds.

**16.55.3.13 OAPIFUNC MESHGROUP\* oapiMeshGroup ( MESHHANDLE *hMesh*, DWORD *idx* )**

Returns a pointer to the group specification of a mesh group.

**Parameters**

<i>hMesh</i>	mesh handle
<i>idx</i>	group index ( $\geq 0$ )

**Returns**

pointer to mesh group specification (or NULL if idx out of range)

**Note**

**MESHGROUP** is a structure that contains the components of the group, including vertex list, index list, texture and material index.

This method can be used to edit the a mesh group directly (for geometry animation, texture animation, etc.)

This function should only be applied to device-independent meshes, such as mesh templates.

For device-dependent mesh instances (such as returned by [VESSEL::GetDevMesh](#)) use [oapiEditMeshGroup](#) instead.

**See also**

[oapiEditMeshGroup](#)

**16.55.3.14 OAPIFUNC DWORD oapiMeshGroupCount ( MESHHANDLE *hMesh* )**

Returns the number of mesh groups defined in a mesh.

**Parameters**

<i>hMesh</i>	mesh handle
--------------	-------------

**Returns**

number of mesh groups defined in the mesh

**Note**

Each mesh is subdivided into mesh groups, defining a part of the 3-D object represented by the mesh.

A group consists of a list of vertex coordinates and vertex indices, representing its geometry, and optionally a material and a texture reference.

See 3DModel document for details of the mesh format.

**16.55.3.15 OAPIFUNC MATERIAL\* oapiMeshMaterial ( MESHHANDLE *hMesh*, DWORD *idx* )**

Returns a pointer to a material specification in the material list of the mesh.

## Parameters

<i>hMesh</i>	mesh handle
<i>idx</i>	material index ( $\geq 0$ )

## Returns

pointer to material specification (or NULL if *idx* out of range)

## Note

**MATERIAL** is a structure defined as follows:

```
1 typedef struct {      // material definition
2     COLOUR4 diffuse; // diffuse component
3     COLOUR4 ambient; // ambient component
4     COLOUR4 specular; // specular component
5     COLOUR4 emissive; // emissive component
6     float power;      // specular power
7 } MATERIAL;
```

where **COLOUR4** defines a 4-valued (RGBA) colour component (red, green, blue, opacity):

```
1 typedef struct { // vertex definition including normals and texture coordinates
2     float r; // red component
3     float g; // green component
4     float b; // blue component
5     float a; // opacity
6 } COLOUR4;
```

colour component entries are in the range 0..1. Values  $> 1$  may sometimes be used to obtain special effects. This function can be used to edit mesh materials directly.

This function should only be used for mesh templates, not for device-specific rendering meshes (except for Orbiter's built-in graphics engine). For device meshes, use **oapiSetMaterial** instead.

## See also

[oapiAddMaterial](#), [oapiDeleteMaterial](#), [oapiMeshMaterialCount](#)

16.55.3.16 OAPIFUNC int **oapiMeshMaterial** ( **DEVMESHHANDLE** *hMesh*, **DWORD** *idx*, **MATERIAL** \* *mat* )

Retrieve properties of a device mesh material.

## Parameters

<i>hMesh</i>	device mesh handle
<i>idx</i>	material index ( $\geq 0$ )
<i>mat</i>	pointer to <b>MATERIAL</b> structure to be filled by the method

## Returns

Error code (0 = success)

16.55.3.17 OAPIFUNC **DWORD** **oapiMeshMaterialCount** ( **MESHHANDLE** *hMesh* )

Returns the number of materials defined in the mesh.

## Parameters

<i>hMesh</i>	mesh handle
--------------	-------------

**Returns**

number of materials defined in the mesh

**Note**

A mesh can contain a number of material specifications, and individual mesh groups can be linked to a material via the MtrlIdx entry in the group specification.

A material defines the diffuse, ambient, specular and emissive colour components of a mesh group, and also its level of transparency.

See 3DModel document for details of the mesh format.

**16.55.3.18 OAPIFUNC DWORD oapiMeshTextureCount ( MESHHANDLE *hMesh* )**

Returns the number of textures associated with a mesh.

**Parameters**

<i>hMesh</i>	mesh handle
--------------	-------------

**Returns**

Number of textures

**See also**

[oapiGetTextureHandle](#), [oapiSetTexture](#)

**16.55.3.19 OAPIFUNC VISHANDLE\* oapiObjectVisualPtr ( OBJHANDLE *hObject* )**

Returns a pointer storing the objects visual handle.

**Parameters**

<i>hObject</i>	object handle
----------------	---------------

**Returns**

pointer to visual handle

**Note**

Returns a pointer that stores the object's visual handle whenever the object is within visual range of the camera. When the object is out of range, the pointer is set to NULL.

This function currently only works for vessel objects. All other object types return a pointer to NULL.

**16.55.3.20 OAPIFUNC void oapiParticleSetLevelRef ( PSTREAM\_HANDLE *ph*, double \* *lvl* )**

Reset the reference pointer used by the particle stream to calculate the intensity (opacity) of the generated particles.

**Parameters**

<i>ph</i>	particle stream handle
<i>lvl</i>	pointer to variable defining particle intensity

#### Note

The variable pointed to by *lvl* should be set to values between 0 (lowest intensity) and 1 (highest intensity). By default, exhaust streams are linked to the thrust level setting of the thruster they are associated with. Reentry streams are set to a fixed level of 1 by default. This function allows to customise the appearance of the particle streams directly by the module. Other parameters besides the intensity level, such as atmospheric density can also have an effect on the particle intensity.

#### 16.55.3.21 OAPIFUNC void oapiReleaseTexture ( SURFHANDLE *hTex* )

Release a texture.

#### Parameters

<i>hTex</i>	Texture surface handle.
-------------	-------------------------

#### Note

After the function returns, the surface handle is invalid and should no longer be used. Do not release textures that are referenced by a mesh. Mesh textures are released automatically.

#### 16.55.3.22 OAPIFUNC int oapiSetMaterial ( DEVMESSHHANDLE *hMesh*, DWORD *matidx*, const MATERIAL \* *mat* )

Reset the properties of a mesh material.

#### Parameters

<i>hMesh</i>	device mesh handle
<i>matidx</i>	material index ( $\geq 0$ )
<i>mat</i>	pointer to new material properties.

#### Returns

Error flag: 0=success, 1=no graphics engine attached, 2=graphics engine does not support operation, 3=invalid mesh handle, 4=material index out of range.

#### Note

This function can be used to reset the parameters of an existing mesh material. To add a new material, use [oapiAddMaterial](#) instead.

#### 16.55.3.23 OAPIFUNC bool oapiSetMeshProperty ( MESHHANDLE *hMesh*, DWORD *property*, DWORD *value* )

Set custom properties for a mesh.

#### Parameters

<i>hMesh</i>	mesh handle
<i>property</i>	property tag
<i>value</i>	new mesh property value

#### Returns

*true* if the property tag was recognised and the request could be executed, *false* otherwise.

**Note**

Currently only a single mesh property is recognised, but this may be extended in future versions:

- MESHPROPERTY\_MODULATEMATALPHA

if value==0 (default) disable material alpha information in textured mesh groups (only use texture alpha channel).

if value<>0 modulate (mix) material alpha values with texture alpha maps.

**See also**

[oapiSetMeshProperty\(DEVMESSHANDLE,DWORD,DWORD\)](#)

**16.55.3.24 OAPIFUNC bool oapiSetMeshProperty ( **DEVMESSHANDLE** *hMesh*, **DWORD** *property*, **DWORD** *value* )**

Set custom properties for a device-specific mesh.

**Parameters**

<i>hMesh</i>	device mesh handle
<i>property</i>	property tag
<i>value</i>	new mesh property value

**Returns**

*true* if the property tag was recognised and the request could be executed, *false* otherwise.

**Note**

Currently only a single mesh property is recognised, but this may be extended in future versions:

- MESHPROPERTY\_MODULATEMATALPHA

if value==0 (default) disable material alpha information in textured mesh groups (only use texture alpha channel).

if value<>0 modulate (mix) material alpha values with texture alpha maps.

**See also**

[oapiSetMeshProperty\(MESHHANDLE,DWORD,DWORD\)](#)

**16.55.3.25 OAPIFUNC bool oapiSetTexture ( **MESHHANDLE** *hMesh*, **DWORD** *texidx*, **SURFHANDLE** *tex* )**

Replace a mesh texture.

**Parameters**

<i>hMesh</i>	mesh handle
<i>texidx</i>	texture index ( $>=1$ )
<i>tex</i>	texture handle

**Returns**

*true* if texture was set successfully, *false* if texidx is out of range.

**Note**

This function replaces one of the mesh textures. All mesh groups referencing the corresponding texture index will show the new texture.

texidx must be in the range [1..n] where n is the length of the texture list in the mesh, i.e. textures can be replaced, but no new textures added.

To point an individual mesh group to a different texture, use [oapiMeshGroup\(\)](#) to retrieve a **MESHGROUP** pointer, and modify the TexIdx entry.

## 16.56 HUD, MFD and panel functions

### Functions

- OAPIFUNC bool `oapiSetHUDMode` (int mode)
 

*Set HUD (head up display) mode.*
- OAPIFUNC bool `oapiSetHUDMode` (int mode, const `HUDPARAM` \*prm)
 

*Set HUD (head up display) mode with mode-specific parameters.*
- OAPIFUNC int `oapiGetHUDMode` ()
 

*Query current HUD (head up display) mode.*
- OAPIFUNC int `oapiGetHUDMode` (`HUDPARAM` \*prm)
 

*Query current HUD mode and mode parameters.*
- OAPIFUNC void `oapiToggleHUColour` ()
 

*Switch the HUD display to a different colour.*
- OAPIFUNC double `oapiGetHUDIntensity` ()
 

*Return the current HUD brightness setting.*
- OAPIFUNC void `oapiSetHUDIntensity` (double val)
 

*Set the HUD brightness.*
- OAPIFUNC void `oapiIncHUDIntensity` ()
 

*Increase the brightness of the HUD display.*
- OAPIFUNC void `oapiDecHUDIntensity` ()
 

*Decrease the brightness of the HUD display.*
- OAPIFUNC void `oapiRenderHUD` (`MESHHANDLE` hMesh, `SURFHANDLE` \*hTex)
 

*Render custom HUD elements.*
- OAPIFUNC void `oapiOpenMFD` (int mode, int mfd)
 

*Set an `MFD` (multifunctional display) to a specific mode.*
- OAPIFUNC void `oapiToggleMFD_on` (int mfd)
 

*Switches an `MFD` on or off.*
- OAPIFUNC int `oapiGetMFDMode` (int mfd)
 

*Get the current mode of the specified `MFD`.*
- OAPIFUNC double `oapiSetMFDRefreshIntervalMultiplier` (int mfd, double multiplier=1.0)
 

*Modify the refresh interval of the specified `MFD` instrument.*
- OAPIFUNC int `oapiBroadcastMFDMessage` (int mode, int msg, void \*data)
- OAPIFUNC int `oapiSendMFDKey` (int mfd, DWORD key)
 

*Sends a keystroke to an `MFD`.*
- OAPIFUNC void `oapiRefreshMFDButtons` (int mfd, `OBJHANDLE` hVessel=0)
 

*Sends a `clbkMFDMode` call to the current focus vessel to allow it to dynamically update its button labels.*
- OAPIFUNC bool `oapiProcessMFDButton` (int mfd, int bt, int event)
 

*Requests a default action as a result of a `MFD` button event.*
- OAPIFUNC const char \* `oapiMFDButtonLabel` (int mfd, int bt)
 

*Retrieves a default label for an `MFD` button.*
- OAPIFUNC void `oapiRegisterMFD` (int mfd, const `MFDSPEC` &spec)
 

*Registers an `MFD` position for a custom panel.*
- OAPIFUNC void `oapiRegisterMFD` (int mfd, const `EXTMFDSPEC` \*spec)
 

*Registers an `MFD` position for a custom panel or virtual cockpit. This version has an extended parameter list.*
- OAPIFUNC void `oapiRegisterExternMFD` (`ExternMFD` \*emfd, const `MFDSPEC` &spec)
- OAPIFUNC bool `oapiUnregisterExternMFD` (`ExternMFD` \*emfd)
- OAPIFUNC void `oapiRegisterPanelBackground` (`HBITMAP` hBmp, DWORD flag=`PANEL_ATTACH_BOTTOM`←  
`OM`|`PANEL_MOVEOUT_BOTTOM`, DWORD ck=(DWORD)-1)
 

*Register the background bitmap for a custom panel.*
- OAPIFUNC void `oapiRegisterPanelArea` (int id, const `RECT` &pos, int draw\_event=`PANEL_REDRAW_NEVER`, int mouse\_event=`PANEL_MOUSE_IGNORE`, int bkmode=`PANEL_MAP_NONE`)

- Defines a rectangular area within a panel to receive mouse or redraw notifications.*
- OAPIFUNC void [oapiSetPanelNeighbours](#) (int left, int right, int top, int bottom)
 

*Defines the neighbour panels of the current panels. These are the panels the user can switch to via Ctrl-Arrow keys.*
  - OAPIFUNC bool [oapiBltPanelAreaBackground](#) (int area\_id, SURFHANDLE surf)
 

*Copies the stored background of a panel area into the provided surface.*
  - OAPIFUNC void [oapiSetDefNavDisplay](#) (int mode)
 

*Defines how the navigation mode buttons will be displayed in a default cockpit view.*
  - OAPIFUNC void [oapiSetDefRCSDisplay](#) (int mode)
 

*Enable or disable the display of the reaction control system indicators/controls in default cockpit view.*
  - OAPIFUNC int [oapiSwitchPanel](#) (int direction)
 

*Switch to a neighbour instrument panel in 2-D panel cockpit mode.*
  - OAPIFUNC int [oapiSetPanel](#) (int panel\_id)
 

*Switch to a different instrument panel in 2-D panel cockpit mode.*
  - OAPIFUNC double [oapiGetPanelScale](#) ()
 

*Returns the scaling factor for 2-D instrument panels.*
  - OAPIFUNC double [oapiGetPanel2DScale](#) ()
 

*Returns the current scaling factor for the active 2D instrument panel.*
  - OAPIFUNC void [oapiSetPanelBlink](#) (VECTOR3 v[4])

#### 16.56.1 Detailed Description

#### 16.56.2 Function Documentation

##### 16.56.2.1 OAPIFUNC bool [oapiBltPanelAreaBackground](#) ( int area\_id, SURFHANDLE surf )

Copies the stored background of a panel area into the provided surface.

This function should only be called from within the repaint callback function of an area registered with the `PANEL←L_MAP_BGONREQUEST` flag.

#### Parameters

<code>area_id</code>	area identifier
<code>surf</code>	surface handle

#### Note

Areas defined with the `PANEL_MAP_BGONREQUEST` receive a surface with undefined contents when their repaint callback is called. They can use [oapiBltPanelAreaBackground](#) to copy the area background into the surface.

For areas not registered with the `PANEL_MAP_BGONREQUEST`, this function will do nothing.

Using `PANEL_MAP_BGONREQUEST` is more efficient than `PANEL_MAP_BACKGROUND` if the area doesn't need to be repainted at each call of the callback function, because it delays blitting the background until the module requests the background. This is particularly significant for areas which are updated at each time step.

#### See also

[oapiRegisterPanelArea](#), [oapiRegisterPanelBackground](#)

##### 16.56.2.2 OAPIFUNC void [oapiDecHUDIntensity](#) ( )

Decrease the brightness of the HUD display.

**Note**

Calling this function will decrease the intensity (in virtual cockpit modes) or brightness (in other modes) of the HUD display down to a minimum value.

This function should be called repeatedly (e.g. while the user presses a key).

**See also**

[oapiSetHUDIntensity](#), [oapiIncHUDIntensity](#)

**16.56.2.3 OAPIFUNC double oapiGetHUDIntensity ( )**

Return the current HUD brightness setting.

**Returns**

Brightness value (0..1)

**16.56.2.4 OAPIFUNC int oapiGetHUDMode ( )**

Query current HUD (head up display) mode.

**Returns**

Current HUD mode

**See also**

[HUD Modes](#), [oapiGetHUDMode\(const HUDPARAM\\*\)](#), [oapiSetHUDMode](#)

**16.56.2.5 OAPIFUNC int oapiGetHUDMode ( **HUDPARAM** \* *prm* )**

Query current HUD mode and mode parameters.

**Parameters**

<i>prm</i>	pointer to HUD parameter structure to be filled.
------------	--

**Returns**

Current HUD mode

**See also**

[HUD Modes](#), [HUDPARAM](#), [oapiGetHUDMode\(\)](#)

**16.56.2.6 OAPIFUNC int oapiGetMFDMode ( **int** *mfd* )**

Get the current mode of the specified [MFD](#).

**Parameters**

<i>mfd</i>	MFD identifier (e.g. MFD_LEFT, MFD_RIGHT)
------------	---

**Returns**

[MFD Mode](#)

**See also**

[MFD Identifiers](#)

### 16.56.2.7 OAPIFUNC double oapiGetPanel2DScale( )

Returns the current scaling factor for the active 2D instrument panel.

#### Returns

Current panel scaling factor.

#### Note

The value returned by this function describes the scaling between the coordinates of the panel mesh and the screen pixels. They correspond to the values passed to [VESSEL3::SetPanelScaling](#).

A scaling value of 1 means every mesh unit corresponds to the size of a pixel. Smaller values indicate a scaled-down mesh, larger values a scaled-up mesh.

If the current camera view is not in Panel2D mode, the return value is 1.

The value returned by this function is only used by instrument panels which have been created with [VESSEL3::clbkLoadPanel2D](#). Legacy panels created with [VESSEL2::clbkLoadPanel](#) should use oapiGetPanelScale instead.

#### See also

[VESSEL3::SetPanelScaling](#), [VESSEL3::clbkLoadPanel2D](#)

### 16.56.2.8 OAPIFUNC double oapiGetPanelScale( )

Returns the scaling factor for 2-D instrument panels.

#### Returns

Panel scaling factor (>0)

#### Note

This function returns the panel scaling factor defined by the user in the Launchpad dialog.

The default scaling factor is 1. Values > 1 cause panels to be expanded, values < 1 cause panels to be shrunk.

The value returned by this function is only used by legacy panels defined in [VESSEL2::clbkLoadPanel](#). Panels created with [VESSEL3::clbkLoadPanel2D](#) should use oapiGetPanel2DScale instead.

#### See also

[oapigetPanel2DScale](#)

### 16.56.2.9 OAPIFUNC void oapiIncHUDIntensity( )

Increase the brightness of the HUD display.

#### Note

Calling this function will increase the intensity (in virtual cockpit modes) or brightness (in other modes) of the HUD display up to a maximum value.

This function should be called repeatedly (e.g. while the user presses a key).

#### See also

[oapiSetHUDIntensity](#), [oapiDecHUDIntensity](#)

### 16.56.2.10 OAPIFUNC const char\* oapiMFDButtonLabel( int mfd, int bt )

Retrieves a default label for an [MFD](#) button.

## Parameters

<i>mfd</i>	<a href="#">MFD</a> identifier (e.g. MFD_LEFT, MFD_RIGHT)
<i>bt</i>	button number ( $>=0$ )

## Returns

pointer to static string containing the label, or NULL if the button is not assigned.

## Note

Labels contain 1 to 3 characters.

This function can be used to paint the labels on the [MFD](#) buttons of a custom panel.

The labels correspond to the default button actions executed by VESSEL::ProcessMFDButton().

## See also

[MFD Identifiers](#)

16.56.2.11 OAPIFUNC void oapiOpenMFD ( int *mode*, int *mfd* )

Set an [MFD](#) (multifunctional display) to a specific mode.

## Parameters

<i>mode</i>	<a href="#">MFD</a> mode
<i>mfd</i>	<a href="#">MFD</a> identifier (e.g. MFD_LEFT, MFD_RIGHT)

## Note

*mode* MFD\_NONE will turn off the [MFD](#).

For the on-screen instruments, only MFD\_LEFT and MFD\_RIGHT are supported. Custom panels may support (up to 3) additional MFDs.

## See also

[MFD Identifiers](#), [MFD Modes](#)

16.56.2.12 OAPIFUNC bool oapiProcessMFDButton ( int *mfd*, int *bt*, int *event* )

Requests a default action as a result of a [MFD](#) button event.

## Parameters

<i>mfd</i>	<a href="#">MFD</a> identifier (e.g. MFD_LEFT, MFD_RIGHT)
<i>bt</i>	button number ( $>=0$ )
<i>event</i>	mouse event (a combination of <a href="#">PANEL_MOUSE_xxx</a> flags)

## Returns

Returns *true* if the button was processed, *false* if no action was assigned to the button.

## Note

Orbiter assigns default button actions for the various [MFD](#) modes. For example, in Orbit mode the action assigned to button 0 is Select reference. Calling oapiProcessMFDButton (for example as a reaction to a mouse button event) will execute this action.

16.56.2.13 OAPIFUNC void oapiRefreshMFDButtons ( int *mfd*, [OBJHANDLE](#) *hVessel* = 0 )

Sends a clbkMFDButtons call to the current focus vessel to allow it to dynamically update its button labels.

## Parameters

<i>mfd</i>	<a href="#">MFD</a> identifier (e.g. MFD_LEFT, MFD_RIGHT)
<i>hVessel</i>	recipient vessel handle

## Note

This message will only be sent to the current input focus vessel. If *hVessel* != 0, the function will not have any effect unless *hVessel* points to the focus vessel.

The recipient vessel will receive a [VESSEL2::clbkMFDMode](#) call, with the mode parameter set to MFD\_RE←FRESHBUTTONS.

This function can be used to force an [MFD](#) to refresh its button labels even if the mode has not changed. This is useful to update the labels for modes that dynamically update their labels.

You don't need to call [oapiRefreshMFDButtons](#) after an actual mode change, because a [clbkMFDMode](#) call will be sent automatically by Orbiter.

## See also

[MFD Identifiers](#)

16.56.2.14 OAPIFUNC void [oapiRegisterMFD](#) ( int *mfd*, const [MFDSPEC](#) & *spec* )

Registers an [MFD](#) position for a custom panel.

## Parameters

<i>mfd</i>	<a href="#">MFD</a> identifier (e.g. MFD_LEFT, MFD_RIGHT)
<i>spec</i>	<a href="#">MFD</a> parameters (see below)

## Note

Should be called in the body of [VESSEL2::clbkLoadPanel\(\)](#) for panels which define MFDs.

Defining more than 2 or 3 MFDs per panel can degrade performance.

[MFDSPEC](#) is a structure with the following interface:

```

1 typedef struct {
2     RECT pos;           // position of MFD in panel (pixel)
3     int nbt_left;       // number of buttons on left side of MFD display
4     int nbt_right;      // number of buttons on right side of MFD display
5     int bt_yofs;        // y-offset of top button from top display edge (pixel)
6     int bt_ydist;       // y-distance between buttons (pixel)
7 } MFDSPEC;

```

## See also

[MFD Identifiers](#)

16.56.2.15 OAPIFUNC void [oapiRegisterMFD](#) ( int *mfd*, const [EXTMFDSPEC](#) \* *spec* )

Registers an [MFD](#) position for a custom panel or virtual cockpit. This version has an extended parameter list.

## Parameters

<i>mfd</i>	<a href="#">MFD</a> identifier (e.g. MFD_LEFT, MFD_RIGHT)
<i>spec</i>	extended <a href="#">MFD</a> parameters (see below)

## Note

Should be called in the body of [VESSEL2::clbkLoadPanel\(\)](#) or [VESSEL2::clbkLoadVC\(\)](#) to define [MFD](#) instruments for 2-D instrument panels or 3-D virtual cockpits.

[EXTMFDSPEC](#) is a structure with the following interface:

```

1 typedef struct {
2     RECT pos;      // position of MFD in panel (pixel)
3     DWORD nmesh;   // mesh index (>=0)
4     DWORD ngroup;  // mesh group index (>=0)
5     DWORD flag;    // parameter flags (see below)
6     int nbt1;      // number of buttons in array 1 (e.g. left side of MFD display)
7     int nbt2;      // number of buttons in array 2 (e.g. right side of MFD display)
8     int bt_yofs;   // y-offset of top button from top display edge (pixel)
9     int bt_ydist;  // y-distance between buttons (pixel)
10 } MFDSPEC;

```

*flag* is a bitmask which can be set to a combination of the following options:

- MFD\_SHOWMODELABELS Show 3-letter abbreviations for [MFD](#) modes when displaying the mode selection page (default: only show carets ">"). This is useful if the buttons are not located next to the list display.

If this function is used during initialisation of a 2-D instrument panel, *pos* defines the rectangle of the [MFD](#) display in the panel bitmap (in pixels), while *nmesh* and *ngroup* are ignored.

If it is used during initialisation of a virtual cockpit, *nmesh* and *ngroup* define the mesh and group index of the mesh element which will receive the [MFD](#) display texture, while *pos* is ignored.

#### See also

[MFD Identifiers](#)

**16.56.2.16 OAPIFUNC void oapiRegisterPanelArea ( int *id*, const RECT & *pos*, int *draw\_event* = PANEL\_REDRAW\_NEVER, int *mouse\_event* = PANEL\_MOUSE\_IGNORE, int *bemode* = PANEL\_MAP\_NONE )**

Defines a rectangular area within a panel to receive mouse or redraw notifications.

#### Parameters

<i>id</i>	area identifier
<i>pos</i>	bounding box of the marked area
<i>draw_event</i>	defines redraw events
<i>mouse_event</i>	defines mouse events
<i>bemode</i>	redraw background mode

#### Note

Each panel area must be defined with an identifier aid which is unique within the panel. *draw\_event* can have the following values:

- PANEL\_REDRAW\_NEVER : do not generate redraw events.
- PANEL\_REDRAW\_ALWAYS : generate a redraw event at every time step.
- PANEL\_REDRAW\_MOUSE : mouse events trigger redraw events.

For possible values of *mouse\_event* see [Mouse event identifiers](#). PANEL\_MOUSE\_IGNORE prevents mouse events from being triggered.

By default, no mouse events are sent during a playback session. You can force Orbiter to trigger mouse events during a playback (e.g. to allow the user to operate [MFD](#) buttons) by using PANEL\_MOUSE\_ONREPLAY in combination with any of the other mouse event flags.

*bemode* defines the bitmap handed to the redraw callback:

- `PANEL_MAP_NONE`: provides an undefined bitmap. Should be used if the whole area is repainted.
- `PANEL_MAP_CURRENT`: provides a copy of the current area.
- `PANEL_MAP_BACKGROUND`: provides a copy of the panel background (as defined by [oapiRegisterPanelBackground\(\)](#)).
- `PANEL_MAP_BGONREQUEST`: like `PANEL_MAP_BACKGROUND`, this stores the area background, but the user must request it explicitly with a call to `oapiBltPanelAreaBackground`. This can improve performance if the area does not need to be updated at each call of the repaint callback function.

#### See also

[Mouse event identifiers](#), [Panel redraw events](#), [oapiRegisterPanelBackground](#)

**16.56.2.17 OAPIFUNC void oapiRegisterPanelBackground ( HBITMAP *hBmp*, DWORD *flag* =  
PANEL\_ATTACH\_BOTTOM|PANEL\_MOVEOUT\_BOTTOM, DWORD *ck* = (DWORD) -1 )**

Register the background bitmap for a custom panel.

#### Parameters

<i>hBmp</i>	bitmap handle
<i>flag</i>	property bit flags (see notes)
<i>ck</i>	transparency colour key

#### Note

This function will normally be called in the body of `ovcLoadPanel`.

Typically the bitmap will be stored as a resource in the DLL and obtained by a call to the Windows function `LoadBitmap(...)`.

*flag* defines panel properties and can be a combination of the following bitmasks:

- `PANEL_ATTACH_{ LEFT/RIGHT/TOP/BOTTOM }`
- `PANEL_MOVEOUT_{ LEFT/RIGHT/TOP/BOTTOM }`

where `PANEL_ATTACH_BOTTOM` means that the bottom edge of the panel cannot be scrolled above the bottom edge of the screen (other directions work equivalently) and `PANEL_MOVEOUT_BOTTOM` means that the panel can be scrolled downwards out of the screen (other directions work equivalently)

The colour key, if defined, specifies a colour which will appear transparent when displaying the panel. The key is in (hex) 0xRRGGBB format. If no key is specified, the panel will be opaque. It is best to use black (0x000000) or white (0xffffffff) as colour keys, since other values may cause problems in 16bit screen modes. Of course, care must be taken that the keyed colour does not appear anywhere in the opaque part of the panel.

#### See also

[oapiRegisterPanelArea](#)

**16.56.2.18 OAPIFUNC void oapiRenderHUD ( MESHHANDLE *hMesh*, SURFHANDLE \* *hTex* )**

Render custom HUD elements.

## Parameters

<i>hMesh</i>	HUD mesh handle
<i>hTex</i>	array of texture handles

## Note

This function should only be called from within [VESSEL3::clbkRenderHUD](#).

It can be used to render custom HUD elements in glass cockpit and 2-D panel mode.

The mesh handle must refer to a 2-D mesh (z-components of all vertices are zero). The x and y components are in units of screen pixels.

The mesh may have multiple groups, but generally a single group should be sufficient. The texture indices of each group refer to the textures in the *hTex* list (starting with 0). If only a single texture is used, the texture index in the mesh should be set to 0, and *hTex* should be a pointer to the surface handle.

Mesh animations can be applied by modifying vertex and/or texture coordinates at each frame.

16.56.2.19 OAPIFUNC int oapiSendMFDKey ( int *mfd*, DWORD *key* )

Sends a keystroke to an [MFD](#).

## Parameters

<i>mfd</i>	<a href="#">MFD</a> identifier (e.g. <code>MFD_LEFT</code> , <code>MFD_RIGHT</code> )
<i>key</i>	key code (see <a href="#">OAPI_KEY_xxx</a> Constants)

## Returns

nonzero if the [MFD](#) understood and processed the key.

## Note

This function can be used to interact with the [MFD](#) as if the user had pressed Shift-key, for example to select a different [MFD](#) mode, to select a target body, etc.

## See also

[MFD Identifiers](#)

16.56.2.20 OAPIFUNC void oapiSetDefNavDisplay ( int *mode* )

Defines how the navigation mode buttons will be displayed in a default cockpit view.

## Parameters

<i>mode</i>	display mode (0 .. 2)
-------------	-----------------------

## Note

This function should usually be called in the body of the overloaded [VESSEL2::clbkLoadGenericCockpit](#)().

It defines if the buttons for navigation modes (e.g. "Killrot" or "Prograde") are displayed in the generic (non-panel) cockpit camera mode, and if the buttons can be operated with the mouse.

The following values for mode are defined:

- 0 buttons are not shown
- 1 buttons are shown and can be operated with the mouse (default)
- 2 only buttons representing active modes are shown, and can not be operated with the mouse

**16.56.2.21 OAPIFUNC void oapiSetDefRCSDisplay ( int *mode* )**

Enable or disable the display of the reaction control system indicators/controls in default cockpit view.

## Parameters

<i>mode</i>	display mode (0 .. 1)
-------------	-----------------------

## Note

This function should usually be called in the body of the overloaded [VESSEL2::clbkLoadGenericCockpit\(\)](#). The RCS display consists of three buttons in the engine status display at the top left of the generic cockpit view. If displayed (mode=1), the buttons show the RCS mode (off/rotational/linear), and can be clicked with the mouse to switch modes.

The following values for mode are defined:

- 0 RCS buttons are not shown
- 1 RCS buttons are shown and can be operated with the mouse (default)

16.56.2.22 OAPIFUNC void oapiSetHUDIntensity ( double *val* )

Set the HUD brightness.

## Parameters

<i>val</i>	brightness setting (0..1)
------------	---------------------------

## See also

[oapiGetHUDIntensity](#), [oapiIncHUDIntensity](#), [oapiDecHUDIntensity](#)

16.56.2.23 OAPIFUNC bool oapiSetHUDMode ( int *mode* )

Set HUD (head up display) mode.

## Parameters

<i>mode</i>	new HUD mode
-------------	--------------

## Returns

*true* if mode has changed, *false* otherwise.

## Note

Mode `HUD_NONE` will turn off the HUD display.

See constants `HUD_xxx` for currently supported HUD modes.

## See also

[HUD Modes](#), [oapiGetHUDMode](#)

16.56.2.24 OAPIFUNC bool oapiSetHUDMode ( int *mode*, const `HUDPARAM` \* *prm* )

Set HUD (head up display) mode with mode-specific parameters.

## Parameters

<i>mode</i>	new HUD mode
<i>prm</i>	mode-specific parameters

#### Returns

*true* if mode has changed, *false* otherwise.

#### Note

Mode `HUD_NONE` will turn off the HUD display.

See constants `HUD_xxx` for currently supported HUD modes.

#### See also

[HUD Modes](#), [HUDPARAM](#), [oapiGetHUDMode](#), [oapiGetHUDMode\(const HUDPARAM\\*\)](#)

### 16.56.2.25 OAPIFUNC double oapiSetMFDRefreshIntervalMultiplier ( int *mfd*, double *multiplier* = 1.0 )

Modify the refresh interval of the specified [MFD](#) instrument.

#### Parameters

<i>mfd</i>	<a href="#">MFD</a> identifier (e.g. <code>MFD_LEFT</code> , <code>MFD_RIGHT</code> )
<i>multiplier</i>	refresh interval scale factor (1 = default)

#### Returns

Previous multiplier value

#### Note

The actual refresh rate is the product of the multiplier and the base refresh rate, which is globally user-selectable in the Launchpad dialog, and may be modified by specific [MFD](#) modes.

The multiplier is reset to 1 whenever the panel mode or virtual panel position is changed, so `oapiSetMFDRefreshIntervalMultiplier` should be called during [VESSEL2::clbkLoadVC](#), [VESSEL3::clbkLoadPanel2D](#) or [VESSEL2::clbkLoadGenericCockpit](#).

### 16.56.2.26 OAPIFUNC int oapiSetPanel ( int *panel\_id* )

Switch to a different instrument panel in 2-D panel cockpit mode.

#### Parameters

<i>panel_id</i>	panel identifier ( $\geq 0$ )
-----------------	-------------------------------

#### Returns

*panel\_id* if the panel was set successfully, or -1 if failed (camera not in 2-D panel cockpit mode, or requested panel does not exist for the current vessel)

#### Note

This function has no effect if the current view is not in 2-D panel cockpit mode.

#### See also

[oapiSwitchPanel](#)

### 16.56.2.27 OAPIFUNC void oapiSetPanelNeighbours ( int *left*, int *right*, int *top*, int *bottom* )

Defines the neighbour panels of the current panels. These are the panels the user can switch to via Ctrl-Arrow keys.

**Parameters**

<i>left</i>	panel id of left neighbour (or -1 if none)
<i>right</i>	panel id of right neighbour (or -1 if none)
<i>top</i>	panel id of top neighbour (or -1 if none)
<i>bottom</i>	panel id of bottom neighbour (or -1 if none)

**Note**

This function should be called during panel registration (in [VESSEL2::clbkLoadPanel\(\)](#)) to define the neighbours of the registered panel.

Every panel (except panel 0) must be listed as a neighbour by at least one other panel, otherwise it is inaccessible.

**16.56.2.28 OAPIFUNC int oapiSwitchPanel ( int *direction* )**

Switch to a neighbour instrument panel in 2-D panel cockpit mode.

**Parameters**

<i>direction</i>	neighbour direction (see notes)
------------------	---------------------------------

**Returns**

Identifier of the newly selected panel ( $\geq 0$ ) or -1 if the requested panel does not exist.

**Note**

*direction* can be one of the constants in [Panel neighbour identifiers](#).

The neighbourhood status between panels is established by the [oapiSetPanelNeighbours\(\)](#) function.

This function has no effect if the current view is not in 2-D panel cockpit mode.

**See also**

[oapiSetPanel](#)

**16.56.2.29 OAPIFUNC void oapiToggleHUDColour ( )**

Switch the HUD display to a different colour.

**Note**

Orbiter currently defines 3 HUD colours: green, red, white. Calls to [oapiToggleHUDColour](#) will cycle through these.

**See also**

[oapiIncHUDIntensity](#), [oapiDecHUDIntensity](#)

**16.56.2.30 OAPIFUNC void oapiToggleMFD\_on ( int *mfd* )**

Switches an [MFD](#) on or off.

**Parameters**

<i>mdf</i>	MFD identifier (e.g. MFD_LEFT, MFD_RIGHT)
------------	---

**Note**

Flips the on/off state of an [MFD](#). Typically used to respond to the user pressing the "power" button.

**See also**

[oapiOpenMFD](#)

## 16.57 Drawing support functions

### Enumerations

- enum **FontStyle** { **FONT\_NORMAL** = 0, **FONT\_BOLD** = 1, **FONT\_ITALIC** = 2, **FONT\_UNDERLINE** = 4 }

### Functions

- OAPIFUNC [oapi::Sketchpad](#) \* [oapiGetSketchpad](#) (SURFHANDLE surf)  
*Obtain a drawing context for a surface.*
- OAPIFUNC void [oapiReleaseSketchpad](#) ([oapi::Sketchpad](#) \*skp)  
*Release a drawing device context instance.*
- OAPIFUNC [oapi::Font](#) \* [oapiCreateFont](#) (int height, bool prop, char \*face, FontStyle style=FONT\_NORMAL)  
*Creates a font resource for drawing text into surfaces.*
- OAPIFUNC [oapi::Font](#) \* [oapiCreateFont](#) (int height, bool prop, const char \*face, FontStyle style, int orientation)  
*Creates a font resource for drawing text into surfaces.*
- OAPIFUNC void [oapiReleaseFont](#) ([oapi::Font](#) \*font)  
*Release a font resource.*
- OAPIFUNC [oapi::Pen](#) \* [oapiCreatePen](#) (int style, int width, DWORD col)  
*Creates a pen resource for drawing lines and shape outlines.*
- OAPIFUNC void [oapiReleasePen](#) ([oapi::Pen](#) \*pen)  
*Release a pen resource.*
- OAPIFUNC [oapi::Brush](#) \* [oapiCreateBrush](#) (DWORD col)  
*Creates a brush resource for filling shapes.*
- OAPIFUNC void [oapiReleaseBrush](#) ([oapi::Brush](#) \*brush)  
*Release a brush resource.*
- OAPIFUNC HDC [oapiGetDC](#) (SURFHANDLE surf)  
*Obtain a Windows device context handle (HDC) for a surface.*
- OAPIFUNC void [oapiReleaseDC](#) (SURFHANDLE surf, HDC hDC)  
*Release a GDI drawing device context handle.*

#### 16.57.1 Detailed Description

#### 16.57.2 Function Documentation

##### 16.57.2.1 OAPIFUNC [oapi::Brush](#)\* [oapiCreateBrush](#) ( DWORD col )

Creates a brush resource for filling shapes.

#### Parameters

col	shape fill colour (format: 0xBBGGRR)
-----	--------------------------------------

#### Note

After use, the brush should be deallocated with [oapiReleaseBrush](#).

#### See also

[oapiReleaseBrush](#)

##### 16.57.2.2 OAPIFUNC [oapi::Font](#)\* [oapiCreateFont](#) ( int height, bool prop, char \* face, FontStyle style = FONT\_NORMAL )

Creates a font resource for drawing text into surfaces.

**Parameters**

<i>height</i>	font height [pixel]
<i>prop</i>	flag for proportional/fixed pitch font
<i>face</i>	typeface name (see notes)
<i>style</i>	font decoration style (see notes)

**Returns**

pointer to font resource, or NULL if not supported.

**Note**

The following generic typeface names should be understood by all graphics systems:

- Fixed (fixed pitch font)
- Sans (sans-serif proportional font)
- Serif (serif proportional font) Other font names may not be recognised by all graphics clients. In that case, the default fixed or sans-serif font will be used, depending on the value of *prop*.

The decoration style flags allow bold, italic and underlining.

After use, the font should be deallocated with [oapiReleaseFont](#).

**See also**

[oapiReleaseFont](#)

**16.57.2.3 OAPIFUNC `oapi::Font* oapiCreateFont( int height, bool prop, const char * face, FontStyle style, int orientation )`**

Creates a font resource for drawing text into surfaces.

**Parameters**

<i>height</i>	font height [pixel]
<i>prop</i>	flag for proportional/fixed pitch font
<i>face</i>	typeface name (see notes)
<i>style</i>	font decoration style (see notes)
<i>orientation</i>	text orientation [1/10 deg]

**Returns**

pointer to font resource, or NULL if not supported.

**Note**

Identical to [oapiCreateFont\(int,bool,char\\*,FontStyle\)](#), but contains the additional orientation parameter.

**16.57.2.4 OAPIFUNC `oapi::Pen* oapiCreatePen( int style, int width, DWORD col )`**

Creates a pen resource for drawing lines and shape outlines.

**Parameters**

<i>style</i>	line style (0=invisible, 1=solid, 2=dashed)
--------------	---

<i>width</i>	line width [pixel]
<i>col</i>	line colour (format: 0xBBGGRR)

#### Note

After use, the pen should be deallocated with [oapiReleasePen](#).

#### See also

[oapiReleasePen](#)

#### 16.57.2.5 OAPIFUNC HDC oapiGetDC ( SURFHANDLE *surf* )

Obtain a Windows device context handle (HDC) for a surface.

#### Parameters

<i>surf</i>	surface handle
-------------	----------------

#### Returns

device context handle, or NULL if not supported.

#### Warning

This function uses a device-dependent drawing context handle and may not work with all graphics clients. It has been superseded by [oapiGetSketchpad](#).

#### Note

This function returns a valid device handle only when Orbiter is using its inline graphics client, or if an external client is attached that supports GDI drawing. In all other cases, the function returns NULL. Therefore, the caller should always check the returned value before using it.

If a nonzero HDC was returned, it should be released with [oapiReleaseDC](#) after drawing.

Most graphics clients must lock the surface data buffer (and copy it to main memory, if necessary) before GDI access can be provided. This means that read/write access to the surface (e.g. for blitting) may be disabled between [oapiGetDC](#) and [oapiReleaseDC](#), and should be avoided.

#### See also

[oapiReleaseDC](#), [oapiGetSketchpad](#)

#### 16.57.2.6 OAPIFUNC oapi::Sketchpad\* oapiGetSketchpad ( SURFHANDLE *surf* )

Obtain a drawing context for a surface.

#### Parameters

<i>surf</i>	surface handle
-------------	----------------

#### Returns

drawing context instance, or NULL if no graphics support

**Note**

This function returns a valid context instance only when Orbiter is attached to a graphics client which supports 2-D drawing into surfaces. The caller should check the return value for NULL.

If a nonzero Sketchpad instance was returned, it should be released with [oapiReleaseSketchpad](#) after drawing.

Most graphics clients must lock the surface data buffer (and copy it to main memory, if necessary) before drawing access can be provided. This means that read/write access to the surface (e.g. for blitting) may be disabled between oapiGetSketchpad and oapiReleaseSketchpad, and should be avoided.

**See also**

[oapiReleaseSketchpad](#)

**16.57.2.7 OAPIFUNC void oapiReleaseBrush ( *oapi::Brush* \* *brush* )**

Release a brush resource.

**Parameters**

<i>brush</i>	pointer to brush resource
--------------	---------------------------

**See also**

[oapiCreateBrush](#)

**16.57.2.8 OAPIFUNC void oapiReleaseDC ( *SURFHANDLE* *surf*, *HDC* *hDC* )**

Release a GDI drawing device context handle.

**Parameters**

<i>surf</i>	surface handle
<i>hDC</i>	device context handle

**Warning**

This function uses a device-dependent drawing context handle and may not work with all graphics clients. It has been superseded by oapiReleaseSketchpad.

**Note**

Use this function to release a device context previously acquired with [oapiGetDC](#).

Standard Windows device context rules apply. For example, any custom device objects loaded via `Select->Object` must be unloaded before calling oapiReleaseDC.

**See also**

[oapiGetDC](#), [oapiGetSketchpad](#), [oapiReleaseSketchpad](#)

**16.57.2.9 OAPIFUNC void oapiReleaseFont ( *oapi::Font* \* *font* )**

Release a font resource.

## Parameters

<i>font</i>	pointer to font resource
-------------	--------------------------

## See also

[oapiCreateFont](#)16.57.2.10 OAPIFUNC void oapiReleasePen ( *oapi::Pen \* pen* )

Release a pen resource.

## Parameters

<i>pen</i>	pointer to pen resource
------------	-------------------------

## See also

[oapiCreatePen](#)16.57.2.11 OAPIFUNC void oapiReleaseSketchpad ( *oapi::Sketchpad \* skp* )

Release a drawing device context instance.

## Parameters

<i>skp</i>	drawing context instance
------------	--------------------------

## Note

Use this function to release a device instance previously acquired with oapiGetSketchpad.

## See also

[oapiGetSketchpad](#)

## 16.58 Surface functions

### Functions

- OAPIFUNC **SURFHANDLE** oapiCreateSurface (int width, int height)  
*Create a surface of the specified dimensions.*
- OAPIFUNC **SURFHANDLE** oapiCreateSurfaceEx (int width, int height, DWORD attrib)  
*Create a surface of the specified dimensions and usage/access attributes.*
- OAPIFUNC **SURFHANDLE** oapiCreateSurface (HBITMAP hBmp, bool release\_bmp=true)  
*Create a surface from a bitmap. Bitmap surfaces are typically used for blitting operations during instrument panel redraws.*
- OAPIFUNC **SURFHANDLE** oapiCreateTextureSurface (int width, int height)  
*Create a surface that can be used as a texture for a 3-D object.*
- OAPIFUNC void oapiDestroySurface (**SURFHANDLE** surf)  
*Destroy a surface previously created with oapiCreateSurface.*
- OAPIFUNC void oapiClearSurface (**SURFHANDLE** surf, DWORD col=0)
- OAPIFUNC void oapiSetSurfaceColourKey (**SURFHANDLE** surf, DWORD ck)  
*Define a colour key for a surface to allow transparent blitting.*
- OAPIFUNC void oapiClearSurfaceColourKey (**SURFHANDLE** surf)  
*Clear a previously defined colour key.*
- OAPIFUNC void oapiBlt (**SURFHANDLE** tgt, **SURFHANDLE** src, int tgtx, int tgy, int srcx, int srcy, int w, int h, DWORD ck=SURF\_NO\_CK)  
*Copy a rectangular area from one surface to another.*
- OAPIFUNC void oapiBlt (**SURFHANDLE** tgt, **SURFHANDLE** src, RECT \*tgt, RECT \*src, DWORD ck=SURF\_NO\_CK, DWORD rotate=SURF\_NO\_ROTATION)  
*Copy a scaled rectangular area from one surface to another.*
- OAPIFUNC int oapiBeginBltGroup (**SURFHANDLE** tgt)  
*Begin a block of blitting operations to the same target surface.*
- OAPIFUNC int oapiEndBltGroup ()  
*End a block of blitting operations to the same target surface.*
- OAPIFUNC void oapiColourFill (**SURFHANDLE** tgt, DWORD fillcolor, int tgtx=0, int tgy=0, int w=0, int h=0)  
*Fill an area of the target surface with a uniform colour.*

### 16.58.1 Detailed Description

### 16.58.2 Function Documentation

#### 16.58.2.1 OAPIFUNC int oapiBeginBltGroup ( **SURFHANDLE** tgt )

Begin a block of blitting operations to the same target surface.

##### Parameters

<i>tgt</i>	Target surface for subsequent blitting calls.
------------	---

##### Returns

Error code:

- 0: success
- -1: no graphics client loaded
- -1: blitting target was set already
- -2: tgt was given as RENDERTGT\_NONE
- other error codes are client-specific

## Note

All blitting calls following this function must address the same target until the blitting block is ended with a call to `oapiEndBltGroup`.

This mechanism should always be used when multiple blitting operations go to the same target, because some graphics clients may be able to optimise the calls.

To refer to the main render surface, use `tgt=RENDERTGT_MAINWINDOW`.

Do not call a blitting function with a target other than `tgt` within a blitting group.

Within the blitting group, multiple source surfaces can be used, but if possible the blitting calls should be arranged so that blits from the same surface are grouped together, to allow additional optimisation.

## See also

[oapiEndBltGroup](#)

**16.58.2.2 OAPIFUNC void oapiBlt ( SURFHANDLE *tgt*, SURFHANDLE *src*, int *tgtx*, int *tgy*, int *srcx*, int *srcy*, int *w*, int *h*, DWORD *ck* = SURF\_NO\_CK )**

Copy a rectangular area from one surface to another.

## Parameters

<i>tgt</i>	target surface
<i>src</i>	source surface
<i>tgtx</i>	left edge of target rectangle [pixel]
<i>tgy</i>	top edge of target rectangle [pixel]
<i>srcx</i>	left edge of source rectangle [pixel]
<i>srcy</i>	top edge of source rectangle [pixel]
<i>w</i>	width of copied rectangle [pixel]
<i>h</i>	height of copied rectangle [pixel]
<i>ck</i>	transparency colour key (inline graphics only)

## Note

This function copies rectangular areas between two surfaces, or between two locations of the same surface. A typical use is the dynamic update of instrument panels, e.g. in the body of [VESSEL2::clbkPanelRedraw](#) Event.

This function must not be used while a device context is acquired for the target surface (i.e. between `oapiGetDC` and `oapiReleaseDC` calls). If a blitting operation is necessary between `oapiGetDC` and `oapiReleaseDC`, you must use the standard Windows BitBlt function. However this does not use hardware acceleration and should therefore be avoided.

Transparent blitting can be performed by specifying a colour key in `ck`. The transparent colour can either be passed explicitly in `ck`, or `ck` can be set to `SURF_PREDEF_CK` to use the key previously defined with `oapiSetSurfaceColourKey`.

Colour keys are only supported with Orbiter's inline graphics client. External clients ignore the `ck` parameter. The use of colour keys is therefore discouraged.

**16.58.2.3 OAPIFUNC void oapiBlt ( SURFHANDLE *tgt*, SURFHANDLE *src*, RECT \* *tgt*, RECT \* *src*, DWORD *ck* = SURF\_NO\_CK, DWORD *rotate* = SURF\_NO\_ROTATION )**

Copy a scaled rectangular area from one surface to another.

## Parameters

<i>tgt</i>	target surface
------------	----------------

<i>src</i>	source surface
<i>tgtr</i>	pointer to target rectangle [pixel]
<i>srcr</i>	pointer to source rectangle [pixel]
<i>ck</i>	transparency colour key (inline graphics only)
<i>rotate</i>	rotation flag (deprecated)

#### Note

This function copies a rectangular area from a source to a target surface.

If the sizes of the source and target rectangles differ, the copied area is stretched or shrunk to fit into the target rectangle.

This function must not be used while a device context is acquired for the target surface (i.e. between [oapiGetDC](#) and [oapiReleaseDC](#) calls).

Transparent blitting can be performed by specifying a colour key in *ck*. The transparent colour can either be passed explicitly in *ck*, or *ck* can be set to SURF\_PREDEF\_CK to use the key previously defined with [oapiSetSurfaceColourKey](#).

Colour keys are only supported with Orbiter's inline graphics client. External clients ignore the *ck* parameter. The use of colour keys is therefore discouraged.

The rotation flag is deprecated. It has no effect.

#### 16.58.2.4 OAPIFUNC void oapiClearSurfaceColourKey ( SURFHANDLE *surf* )

Clear a previously defined colour key.

#### Parameters

<i>surf</i>	surface handle
-------------	----------------

#### See also

[oapiSetSurfaceColourKey](#), [oapiBlit](#)

#### 16.58.2.5 OAPIFUNC void oapiColourFill ( SURFHANDLE *tgt*, DWORD *fillcolor*, int *tgtx* = 0, int *tgyt* = 0, int *w* = 0, int *h* = 0 )

Fill an area of the target surface with a uniform colour.

#### Parameters

<i>tgt</i>	target surface
<i>fillcolor</i>	fill colour
<i>tgtx</i>	coordinate of upper left corner of area to fill.
<i>tgyt</i>	coordinate of upper left corner of area to fill.
<i>w</i>	width of area to fill.
<i>h</i>	height of area to fill.

#### Note

The fill colour should be acquired with [oapiGetColour](#)), to ensure compatibility with 16-bit colour modes.

This function must not be used while a device context is acquired for the target surface (i.e. between [oapiGetDC](#) and [oapiReleaseDC](#) calls).

If *w* and *h* are zero (the default) the whole surface is filled. The *tgtx* and *tgyt* values are ignored in that case and can be omitted.

#### 16.58.2.6 OAPIFUNC SURFHANDLE oapiCreateSurface ( int *width*, int *height* )

Create a surface of the specified dimensions.

**Deprecated** This function has been superseded by [oapiCreateSurfaceEx](#)

## Parameters

<i>width</i>	width of surface bitmap (pixels)
<i>height</i>	height of surface bitmap (pixels)

## Returns

Handle to the new surface.

## Note

The bitmap contents are undefined after creation, so the surface must be repainted fully before mapping it to the screen.

The surface is created with the OAPISURFACE\_RENDERTARGET, OAPISURFACE\_GDI and OAPISURFACE\_SKETCHPAD attributes (see [Surface and texture attributes](#)). For more control over the surface attributes, e.g. if you want to use the surface as a texture, use `oapiCreateSurfaceEx` instead.

Surfaces should be destroyed by calling `oapiDestroySurface` when they are no longer needed.

## See also

[oapiCreateSurfaceEx](#), [oapiDestroySurface](#)

16.58.2.7 OAPIFUNC SURFHANDLE `oapiCreateSurface( HBITMAP hBmp, bool release_bmp = true )`

Create a surface from a bitmap. Bitmap surfaces are typically used for blitting operations during instrument panel redraws.

## Parameters

<i>hBmp</i>	bitmap handle
<i>release_bmp</i>	flag for bitmap release

## Returns

Handle to the new surface.

## Note

The easiest way to access bitmaps is by storing them as resources in the module, and loading them via a call to `LoadBitmap`.

Do not use this function with a bitmap generated by `CreateBitmap`. To create a surface of specified dimensions, use `oapiCreateSurface` (*width*, *height*) instead.

If *release\_bmp==true*, then `oapiCreateSurface()` will destroy the bitmap after creating a surface from it (i.e. the *hBmp* handle will be invalid after the function returns), otherwise the module is responsible for destroying the bitmap by a call to `DestroyObject` when it is no longer needed.

Surfaces should be destroyed by calling `oapiDestroySurface` when they are no longer needed.

## See also

[oapiDestroySurface](#)

16.58.2.8 OAPIFUNC SURFHANDLE `oapiCreateSurfaceEx( int width, int height, DWORD attrib )`

Create a surface of the specified dimensions and usage/access attributes.

## Parameters

<i>width</i>	width of surface bitmap (pixels)
<i>height</i>	height of surface bitmap (pixels)
<i>attrib</i>	surface creation attributes (see <a href="#">Surface and texture attributes</a> )

## Returns

Handle to the new surface.

## Note

The surface contents are undefined after creation, so the surface must be repainted fully before mapping it to the screen.

Surfaces should be destroyed by calling `oapiDestroySurface` when they are no longer needed.

If you create a texture surface (by including the `OAPISURFACE_TEXTURE` attribute), the width and height should be multiples of 2, and not greater than 2048 x 2048 pixels for best hardware compatibility.

## See also

[oapiDestroySurface](#)

16.58.2.9 OAPIFUNC SURFHANDLE `oapiCreateTextureSurface ( int width, int height )`

Create a surface that can be used as a texture for a 3-D object.

**Deprecated** This function has been superseded by `oapiCreateSurfaceEx`

## Parameters

<i>width</i>	width of surface bitmap (pixels)
<i>height</i>	height of surface bitmap (pixels)

## Returns

handle of new texture surface

## Note

Use this function instead of `oapiCreateSurface` if you want the surface to be used as a surface texture for a 3-D object, for example via a call to `oapiSetTexture`.

This is equivalent to calling `oapiCreateSurfaceEx` with the `OAPISURFACE_TEXTURE` attribute. For maximum compatibility, the surface should be square, and dimensions powers of 2, for example 64x64, 128x128, 256x256, etc. Note that older video cards may not support textures larger than 256x256.

Surfaces should be destroyed by calling `oapiDestroySurface` when they are no longer needed.

16.58.2.10 OAPIFUNC void `oapiDestroySurface ( SURFHANDLE surf )`

Destroy a surface previously created with `oapiCreateSurface`.

## Parameters

<i>surf</i>	surface handle
-------------	----------------

16.58.2.11 OAPIFUNC int `oapiEndBltGroup ( )`

End a block of blitting operations to the same target surface.

**Returns**

Error code:

- 0; success
- -1: no graphics client loaded
- -2: no blitting target was set
- other error codes are client-specific

**See also**

[oapiBeginBltGroup](#)

**16.58.2.12 OAPIFUNC void oapiSetSurfaceColourKey ( SURFHANDLE *surf*, DWORD *ck* )**

Define a colour key for a surface to allow transparent blitting.

**Parameters**

<i>surf</i>	surface handle
<i>ck</i>	colour key (0xRRGGBB)

**Note**

Defining a colour key and subsequently calling oapiBlt with the SURF\_PREDEF\_CK flag is slightly more efficient than passing the colour key explicitly to oapiBlt each time, if the same colour key is used repeatedly.

**See also**

[oapiClearSurfaceColourKey](#), [oapiBlt](#)

## 16.59 Custom MFD mode definition

### Functions

- OAPIFUNC int [oapiRegisterMFDMode](#) (MFDMODESPECEX &spec)  
*Register a custom MFD mode.*
- OAPIFUNC bool [oapiUnregisterMFDMode](#) (int mode)  
*Unregister a previously registered custom MFD mode.*
- OAPIFUNC void [oapiDisableMFDMode](#) (int mode)  
*Disable an MFD mode.*
- OAPIFUNC int [oapiGetMFDModeSpecEx](#) (char \*name, MFDMODESPECEX \*\*spec=0)  
*Returns the mode identifier and spec for an MFD mode defined by its name.*

### 16.59.1 Detailed Description

### 16.59.2 Function Documentation

#### 16.59.2.1 OAPIFUNC void [oapiDisableMFDMode](#) ( int mode )

Disable an MFD mode.

##### Parameters

<i>mode</i>	MFD mode to be disabled.
-------------	--------------------------

##### Note

The list of disabled MFDs is cleared whenever the focus switches to a new vessel. To disable MFD modes permanently for a particular vessel type, [oapiDisableMFDMode\(\)](#) should be called from within the `ovcFocusChanged()` callback function.

For built-in MFD modes, mode can be any of the MFD\_xxx constants. For MFD modes defined in plugin modules, the mode id must be obtained by a call to [oapiGetMFDModeSpec\(\)](#).

##### See also

[MFD Modes](#)

#### 16.59.2.2 OAPIFUNC int [oapiGetMFDModeSpecEx](#) ( char \* name, MFDMODESPECEX \*\* spec = 0 )

Returns the mode identifier and spec for an MFD mode defined by its name.

##### Parameters

<i>name</i>	MFD name (as defined in MFDMODESPECEX::name during <a href="#">oapiRegisterMFDMode()</a> )
<i>spec</i>	If defined, this will return a pointer to the MFDMODESPECEX structure for the mode.

##### Returns

MFD mode identifier.

##### Note

This function returns the same value as [oapiRegisterMFDMode\(\)](#) for the given mode.

If no matching mode is found, the return value is MFD\_NONE. In that case, the returned spec pointer is undefined.

The mode identifiers for custom MFD modes can not be assumed to persist across simulation runs, since they will change if the user loads or unloads MFD plugins.

This function can also be used for built-in MFD modes, which are defined as follows:

Name string	Mode identifier
Orbit	MFD_ORBIT
Surface	MFD_SURFACE
Map	MFD_MAP
HSI	MFD_HSI
VOR/VTOL	MFD_LANDING
Docking	MFD_DOCKING
Align Planes	MFD_OPLANEALIGN
Sync Orbit	MFD_OSYNC
Transfer	MFD_TRANSFER
COM/NAV	MFD_COMMS

#### 16.59.2.3 OAPIFUNC int oapiRegisterMFDMode ( MFDMODESPECEX & spec )

Register a custom [MFD](#) mode.

##### Parameters

spec	<a href="#">MFD</a> specs (see notes below)
------	---

##### Returns

[MFD](#) mode identifier

##### Note

This function registers a custom [MFD](#) mode with Orbiter. There are two types of custom MFDs: generic and vessel class-specific. Generic [MFD](#) modes are available to all vessel types, while specific modes are only available for a single vessel class. Generic modes should be registered in the [InitModule](#) callback function of a plugin module. Vessel class specific modes should be registered via [VESSEL4::RegisterMFDMode](#).

MFDMODESPECEX is a struct defining the parameters of the new mode:

```

1 typedef struct {
2     char *name;      // points to the name of the new mode
3     DWORD key;       // mode selection key
4     void *context;  // mode-specific context pointer
5     int (*msgproc) (UINT,UINT,WPARAM,LPARAM); // address of MFD message parser
6 } MFDMODESPEC;

```

See [orbitersdk\samples\CustomMFD](#) for a sample [MFD](#) mode implementation.

##### See also

[oapiUnregisterMFDMode](#), [VESSEL4::RegisterMFDMode](#)

#### 16.59.2.4 OAPIFUNC bool oapiUnregisterMFDMode ( int mode )

Unregister a previously registered custom [MFD](#) mode.

##### Parameters

mode	mode identifier, as returned by <a href="#">oapiRegisterMFDMode</a>
------	---

##### Returns

*true* on success (mode could be unregistered).

## 16.60 Virtual cockpit functions

### Functions

- OAPIFUNC void [oapiVCRegisterMFD](#) (int mfd, const VCMFDSPEC \*spec)  
*Define a render target for rendering an [MFD](#) display in a virtual cockpit.*
- OAPIFUNC void [oapiVCRegisterArea](#) (int id, const RECT &tgtrect, int draw\_event, int mouse\_event, int bkmode, [SURFHANDLE](#) tgt)  
*Define an active area in a virtual cockpit. Active areas can be repainted. This function is similar to [oapiRegisterPanelArea](#).*
- OAPIFUNC void [oapiVCRegisterArea](#) (int id, int draw\_event, int mouse\_event)  
*Define an active area in a virtual cockpit. This version is used when no dynamic texture update is required during redraw events.*
- OAPIFUNC void [oapiVCSetAreaClickmode\\_Spherical](#) (int id, const [VECTOR3](#) &cnt, double rad)  
*Associate a spherical region in the virtual cockpit with a registered area to receive mouse events.*
- OAPIFUNC void [oapiVCSetAreaClickmode\\_Quadrilateral](#) (int id, const [VECTOR3](#) &p1, const [VECTOR3](#) &p2, const [VECTOR3](#) &p3, const [VECTOR3](#) &p4)  
*Associate a quadrilateral region in the virtual cockpit with a registered area to receive mouse events.*
- OAPIFUNC void [oapiVCSetNeighbours](#) (int left, int right, int top, int bottom)  
*Defines the neighbouring virtual cockpit camera positions in relation to the current position. The user can switch to neighbour positions with Ctrl-Arrow keys.*
- OAPIFUNC void [oapiVCTriggerRedrawArea](#) (int vc\_id, int area\_id)  
*Triggers a redraw notification for a virtual cockpit area.*
- OAPIFUNC void [oapiVCRegisterHUD](#) (const VCHUDSPEC \*spec)  
*Define a render target for the head-up display (HUD) in a virtual cockpit.*

### 16.60.1 Detailed Description

### 16.60.2 Function Documentation

#### 16.60.2.1 OAPIFUNC void [oapiVCRegisterArea](#) ( int id, const RECT & tgtrect, int draw\_event, int mouse\_event, int bkmode, [SURFHANDLE](#) tgt )

Define an active area in a virtual cockpit. Active areas can be repainted. This function is similar to [oapiRegisterPanelArea](#).

#### Parameters

<i>id</i>	area identifier
<i>tgtrect</i>	bounding box of the active area in the target texture (pixels)
<i>draw_event</i>	redraw condition (see <a href="#">draw events</a> )
<i>mouse_event</i>	mouse event ( see <a href="#">mouse events</a> )
<i>bkmode</i>	background mode (see <a href="#">bkmodes</a> )
<i>tgt</i>	target texture to be updated

#### Note

The target texture can be retrieved from a mesh by using the [oapiGetTextureHandle\(\)](#) method. Dynamic textures must be marked with flag "D" in the mesh file.

Redraw events can be used not only to update mesh textures dynamically, but also to animate mesh groups, or edit mesh vertices or texture coordinates.

If no dynamic texture repaints are required during redraw events, use the alternative version of [oapiVCRegisterArea\(\)](#) instead.

To define a mouse-sensitive volume in the virtual cockpit, use one of the [oapiVCSetAreaClickmode\\_XXX](#) functions.

16.60.2.2 OAPIFUNC void oapiVCRegisterArea ( int *id*, int *draw\_event*, int *mouse\_event* )

Define an active area in a virtual cockpit. This version is used when no dynamic texture update is required during redraw events.

**Parameters**

<i>id</i>	area identifier
<i>draw_event</i>	redraw condition (see <a href="#">draw events</a> )
<i>mouse_event</i>	mouse event (see <a href="#">mouse events</a> )

**Note**

This function is equivalent to:

```
1 oapiVCRegisterArea (aid, _R(0,0,0,0), draw_event, mouse_event, PANEL_MAP_NONE, NULL);
```

**16.60.2.3 OAPIFUNC void oapiVCRegisterHUD ( const VCHUDSPEC \* spec )**

Define a render target for the head-up display (HUD) in a virtual cockpit.

**Parameters**

<i>spec</i>	hud specification (see notes)
-------------	-------------------------------

**Note**

This function should be placed in the body of the VESSEL2::ovcLoadVC() vessel module callback function. VCHUDSPEC is a structure defined as:

```
1 struct VCHUDSPEC {
2     DWORD nmesh;      // mesh index
3     DWORD ngroup;    // group index
4     VECTOR3 hudcnt; // HUD centre in vessel frame
5     double size;     // physical size of the HUD [m]
6 };
```

The mesh group specified by nmesh and ngroup should be a square panel in front of the camera position in the virtual cockpit. This group is rendered separately from the rest of the mesh and should therefore have FLAG 2 set in the mesh file. The group material and texture can be set to 0.

The HUD centre position and size are required to allow Orbiter to correctly scale the display.

Orbiter renders the HUD with completely transparent background. Rendering the glass pane, brackets, etc. is up to the vessel designer.

**16.60.2.4 OAPIFUNC void oapiVCRegisterMFD ( int mfd, const VCMFDSPEC \* spec )**

Define a render target for rendering an [MFD](#) display in a virtual cockpit.

**Parameters**

<i>mfd</i>	<a href="#">MFD</a> identifier (e.g. MFD_LEFT, MFD_RIGHT)
<i>spec</i>	render target specification (see notes)

**Note**

The render target specification is defined as a structure:

```
1 struct VCMFDSPEC { DWORD nmesh, ngroup };
```

where nmesh is the mesh index ( $>=0$ ), and ngroup is the group index ( $>=0$ ) defining the render target.

This function should be placed in the body of the ovcLoadVC vessel module callback function.

The addressed mesh group should define a simple square (4 vertices, 2 triangles). The group materials and textures can be set to 0.

**See also**

[MFD Identifiers](#)

16.60.2.5 OAPIFUNC void oapiVCSetAreaClickmode\_Quadrilateral ( int *id*, const VECTOR3 & *p1*, const VECTOR3 & *p2*, const VECTOR3 & *p3*, const VECTOR3 & *p4* )

Associate a quadrilateral region in the virtual cockpit with a registered area to receive mouse events.

## Parameters

<i>id</i>	area identifier (as specified during area registration)
<i>p1</i>	top left corner of region
<i>p2</i>	top right corner
<i>p3</i>	bottom left corner
<i>p4</i>	bottom right corner

## Note

This function will trigger mouse events when the user clicks within the projection of the quadrilateral region on the render window. The mouse event handler will receive the relative position within the area at which the mouse event occurred, where the top left corner has coordinates (0,0), and the bottom right corner has coordinates (1,1).

The area can define any flat quadrilateral in space. It is not limited to rectangles, but all 4 points should be in the same plane.

## See also

[VESSEL2::clbkVCMouseEvent](#)

16.60.2.6 OAPIFUNC void oapiVCSetAreaClickmode\_Spherical ( int *id*, const VECTOR3 & *cnt*, double *rad* )

Associate a spherical region in the virtual cockpit with a registered area to receive mouse events.

## Parameters

<i>id</i>	area identifier (as specified during area registration)
<i>cnt</i>	centre of active area in the local vessel frame
<i>rad</i>	radius of active area [m]

## Note

The area identifier must refer to an area which has previously been registered with a call to [oapiVCRegisterArea\(\)](#), with the required mouse event modes.

This function can be called repeatedly, to change the mouse-sensitive area.

## See also

[VESSEL2::clbkVCMouseEvent](#)

16.60.2.7 OAPIFUNC void oapiVCSetNeighbours ( int *left*, int *right*, int *top*, int *bottom* )

Defines the neighbouring virtual cockpit camera positions in relation to the current position. The user can switch to neighbour positions with Ctrl-Arrow keys.

## Parameters

<i>left</i>	panel id of left neighbour position (or -1 if none)
<i>right</i>	panel id of right neighbour position (or -1 if none)
<i>top</i>	panel id of top neighbour position (or -1 if none)
<i>bottom</i>	panel id of bottom neighbour position (or -1 if none)

**Note**

This function should be called during virtual cockpit registration (in [VESSEL2::clbkLoadVC\(\)](#)) to define the neighbouring cockpit camera positions, if any.

The left, right, top and bottom values specify the (zero-based) identifiers of the VC positions to switch to when the user presses Ctrl and an arrow button, or -1 if no position is available in this direction.

The neighbour relations should normally be reciprocal, i.e. if position 0 defines position 1 as its right neighbour, then position 1 should define position 0 as its left neighbour.

If only a single VC position (id 0) is defined, this function doesn't need to be called.

Orbiter calls [VESSEL2::clbkLoadVC\(\)](#) with the appropriate id whenever the user switches to a new position.

**16.60.2.8 OAPIFUNC void oapiVCTriggerRedrawArea ( int vc\_id, int area\_id )**

Triggers a redraw notification for a virtual cockpit area.

**Parameters**

<i>vc_id</i>	virtual cockpit identifier
<i>area_id</i>	area identifier (as specified during area registration)

**Note**

This function triggers a call to the [VESSEL2::ovcVCRedrawEvent\(\)](#) callback function in the vessel module.

The redraw notification is normally only sent if vc\_id is equal to the currently active virtual cockpit position ( $\geq 0$ ). To invoke the redraw notification independent of the currently active position, set vc\_id to -1.

## 16.61 Customisation - custom menu, dialogs

### Typedefs

- `typedef void(* CustomFunc) (void *context)`

### Functions

- `OAPIFUNC LAUNCHPADITEM_HANDLE oapiRegisterLaunchpadItem (LaunchpadItem *item, LAUNCHPADITEM_HANDLE parent=0)`

*Register a new item in the parameter list of the "Extra" tab of the Orbiter Launchpad dialog.*
- `OAPIFUNC bool oapiUnregisterLaunchpadItem (LaunchpadItem *item)`

*Unregister a previously registered entry in the "Extra" tab of the Orbiter Launchpad dialog.*
- `OAPIFUNC LAUNCHPADITEM_HANDLE oapiFindLaunchpadItem (const char *name=0, LAUNCHPADITEM_HANDLE parent=0)`

*Returns a handle for an existing entry in the Extra parameter list.*
- `OAPIFUNC DWORD oapiRegisterCustomCmd (char *label, char *desc, CustomFunc func, void *context)`

*Register a custom function. Custom functions can be accessed in Orbiter by pressing Ctrl-F4. A common use for custom functions is opening plugin dialog boxes.*
- `OAPIFUNC bool oapiUnregisterCustomCmd (int cmdId)`

*Unregister a previously defined custom function.*
- `OAPIFUNC HWND oapiOpenDialog (HINSTANCE hDLLInst, int resourceId, DLGPROC msgProc, void *context=0)`

*Open a dialog box defined as a Windows resource.*
- `OAPIFUNC HWND oapiOpenDialogEx (HINSTANCE hDLLInst, int resourceId, DLGPROC msgProc, DWORD flag=0, void *context=0)`

*Open a dialog box defined as a Windows resource. This version provides additional functionality compared to `oapiOpenDialog()`.*
- `OAPIFUNC HWND oapiFindDialog (HINSTANCE hDLLInst, int resourceId)`

*Returns the window handle of an open dialog box, or NULL if the specified dialog box is not open.*
- `OAPIFUNC void oapiCloseDialog (HWND hDlg)`

*Close a dialog box.*
- `OAPIFUNC void * oapiGetDialogContext (HWND hDlg)`

*Retrieves the context pointer of a dialog box which has been defined during the call to `oapiOpenDialog()`.*
- `OAPIFUNC bool oapiRegisterWindow (HINSTANCE hDLLInst, HWND hWnd, DWORD flag=0)`
- `OAPIFUNC bool oapiAddTitleButton (DWORD msgId, HBITMAP hBmp, DWORD flag)`

*Adds a custom button in the title bar of a dialog box.*
- `OAPIFUNC DWORD oapiGetTitleButtonState (HWND hDlg, DWORD msgId)`
- `OAPIFUNC bool oapiSetTitleButtonState (HWND hDlg, DWORD msgId, DWORD state)`
- `OAPIFUNC BOOL oapiDefDialogProc (HWND hDlg, UINT uMsg, WPARAM wParam, LPARAM lParam)`

*Default Orbiter dialog message handler.*
- `OAPIFUNC bool oapiOpenHelp (HELPCONTEXT *hcontext)`

*Opens the ingame help window on the specified help page.*
- `OAPIFUNC bool oapiOpenLaunchpadHelp (HELPCONTEXT *hcontext)`

*Opens a help window outside a simulation session, i.e. when the Launchpad dialog is displayed.*
- `OAPIFUNC DWORD oapiGetMainMenuVisibilityMode ()`

*Returns the display mode of the main menu bar.*
- `OAPIFUNC void oapiSetMainMenuVisibilityMode (DWORD mode)`

*Set the display mode for the main menu bar.*
- `OAPIFUNC DWORD oapiGetMainInfoVisibilityMode ()`

*Returns the display mode of the two info blocks at the top left and right screen corners.*
- `OAPIFUNC void oapiSetMainInfoVisibilityMode (DWORD mode)`

*Set the display mode for the two info blocks at the top left and right screen corners.*

## 16.61.1 Detailed Description

## 16.61.2 Function Documentation

16.61.2.1 OAPIFUNC bool oapiAddTitleButton ( *DWORD msgid*, *HBITMAP hBmp*, *DWORD flag* )

Adds a custom button in the title bar of a dialog box.

## Parameters

<i>msgid</i>	The message identifier generated by pressing the button
<i>hBmp</i>	bitmap containing the button images.
<i>flag</i>	additional parameters (see notes)

## Returns

*true* if the button could be created, *false* otherwise.

## Note

`oapiAddTitleButton` can only be called while processing the `WM_INITDIALOG` message in the dialog message procedure.

Up to 5 buttons can be created in the title bar, including the standard buttons defined in the call to `oapiOpenDialogEx`.

Whenever the users left-clicks on the button, a `WM_COMMAND` message is generated in the message procedure, where the low-word of the `WPARAM` parameter is set to *msgid*.

The button size defined in the bitmap should be 15x15 pixels large. Their look should conform to Orbiter's standard dialog buttons.

The following bit-flags in the *flag* parameter are currently supported: `DLG_CB_TWOSTATE`: The button has two states, and clicking on it will flip between the two states.

If the `DLG_CB_TWOSTATE` flag is set, the bitmap must be 15x30 pixels large, containing two images, where the upper image represents the initial state, and the lower image represents the "checked" state.

If the `DLG_CB_TWOSTATE` flag is set, the button state (0 or 1) is passed in the high-word of the `WPARAM` parameter whenever the dialog is notified of a button press.

16.61.2.2 OAPIFUNC void oapiCloseDialog ( *HWND hDlg* )

Close a dialog box.

## Parameters

<i>hDlg</i>	dialog window handle (as obtained by <code>oapiOpenDialog</code> )
-------------	--

## Note

This function should be called in response to an `IDCANCEL` message in the dialog message handler to close a dialog which was opened by `oapiOpenDialog()`.

16.61.2.3 OAPIFUNC BOOL oapiDefDialogProc ( *HWND hDlg*, *UINT uMsg*, *WPARAM wParam*, *LPARAM lParam* )

Default Orbiter dialog message handler.

This function should be called from the message handler of all dialogs created with `oapiOpenDialog` to perform default actions for any messages not processed in the handler.

## Parameters:

The parameters passed to the message handler.

**Returns**

The value returned by oapiDefDialogProc should be returned by the message handler.

**Typical usage:**

```

1 BOOL CALLBACK MsgProc (HWND hDlg, UINT uMsg, WPARAM wParam, LPARAM lParam)
2 {
3     switch (uMsg) {
4     case WM_COMMAND:
5         switch (LOWORD (wParam)) {
6             case IDCANCEL: // dialog closed by user
7                 CloseDlg (hDlg);
8                 return TRUE;
9             }
10            break;
11            // add more messages to be processed here
12        }
13    return oapiDefDialogProc (hDlg, uMsg, wParam, lParam);
14 }
```

**Note**

oapiDefDialogProc currently only processes the WM\_SETCURSOR message, and always returns *false*.

**See also**

[oapiCloseDialog](#), [oapiFindDialog](#), [oapiOpenDialog](#)

**16.61.2.4 OAPIFUNC HWND oapiFindDialog ( HINSTANCE *hDLLInst*, int *resourceId* )**

Returns the window handle of an open dialog box, or NULL if the specified dialog box is not open.

**Parameters**

<i>hDLLInst</i>	module instance handle (as obtained from <i>InitModule</i> )
<i>resourceId</i>	dialog resource identifier

**Returns**

Window handle of dialog box, or NULL if the dialog was not found.

**16.61.2.5 OAPIFUNC LAUNCHPADITEM\_HANDLE oapiFindLaunchpadItem ( const char \* *name* = 0, LAUNCHPADITEM\_HANDLE *parent* = 0 )**

Returns a handle for an existing entry in the Extra parameter list.

**Parameters**

<i>name</i>	the name of the item in the list (or 0 for first entry)
<i>parent</i>	the parent item below which to search (or 0 for root)

**Returns**

value Item handle if found, or 0 otherwise.

**Note**

This method allows to retrieve the handle of an already existing entry in the Extra list. It is useful for placing new items below a parent that wasn't defined by the module itself.

It can be used iteratively to search for lower-level entries.

If name is not set, the first child entry of parent is returned (or the first root entry, if parent==0).

You should only attach children to items that don't themselves define an activation method.

**See also**

[oapiRegisterLaunchpadItem](#), [oapiUnregisterLaunchpadItem](#)

16.61.2.6 OAPIFUNC void\* oapiGetDialogContext ( HWND *hDig* )

Retrieves the context pointer of a dialog box which has been defined during the call to [oapiOpenDialog\(\)](#).

## Parameters

<i>hDlg</i>	dialog window handle
-------------	----------------------

## Note

This function returns NULL if no context pointer was specified in [oapiOpenDialog\(\)](#).

## 16.61.2.7 OAPIFUNC DWORD oapiGetMainInfoVisibilityMode ( )

Returns the display mode of the two info blocks at the top left and right screen corners.

## Returns

0=show, 1=hide, 2=auto-hide

## See also

[oapiSetMainInfoVisibilityMode](#), [oapiGetMainMenuVisibilityMode](#), [oapiSetMainMenuVisibilityMode](#)

## 16.61.2.8 OAPIFUNC DWORD oapiGetMainMenuVisibilityMode ( )

Returns the display mode of the main menu bar.

## Returns

0=show, 1=hide, 2=auto-hide

## See also

[oapiSetMainMenuVisibilityMode](#), [oapiGetMainInfoVisibilityMode](#), [oapiSetMainInfoVisibilityMode](#)

16.61.2.9 OAPIFUNC HWND oapiOpenDialog ( HINSTANCE *hDLLInst*, int *resourceId*, DLGPROC *msgProc*, void \* *context* = 0 )

Open a dialog box defined as a Windows resource.

## Parameters

<i>hDLLInst</i>	module instance handle (as obtained from <code>InitModule</code> )
<i>resourceId</i>	dialog resource identifier
<i>msgProc</i>	pointer to Windows message handler
<i>context</i>	optional user-defined pointer

## Returns

handle of the new dialog box, or NULL if the dialog was open already.

## Note

Use [oapiOpenDialog\(\)](#) instead of standard Windows methods such as `CreateWindow` or `DialogBox`, to make sure the dialog works in fullscreen mode.

Only one instance of a dialog box can be open at a time. A second call to [oapiOpenDialog\(\)](#) with the same dialog id will fail and return NULL.

The interface of the message handler is as follows:

```
1 BOOL CALLBACK MsgProc ( HWND hDlg, UINT uMsg, WPARAM wParam, LPARAM lParam)
```

See standard Windows documentation for usage of the dialog message handler.

The context pointer can be set to user-defined data which can be retrieved via the [oapiGetDialogContext\(\)](#) function. This allows to pass data into the message handler.

Note that [oapiGetDialogContext\(\)](#) can not be used when processing the `WM_INITDIALOG` message. In this case, the context pointer can be accessed via `lParam` instead.

## See also

[oapiFindDialog](#), [oapiCloseDialog](#), [oapiOpenDialogEx](#)

**16.61.2.10 OAPIFUNC HWND oapiOpenDialogEx ( HINSTANCE *hDLLInst*, int *resourceId*, DLGPROC *msgProc*, DWORD *flag* = 0, void \* *context* = 0 )**

Open a dialog box defined as a Windows resource. This version provides additional functionality compared to [oapiOpenDialog\(\)](#).

## Parameters

<i>hDLLInst</i>	module instance handle (as obtained from <code>InitModule</code> )
<i>resourceId</i>	dialog resource identifier
<i>msgProc</i>	pointer to Windows message handler
<i>flag</i>	bit-flags to define dialog box options (see notes)
<i>context</i>	optional user-defined pointer

## Returns

handle of the new dialog box, or `NULL` if the box could not be opened.

## Note

The *flag* parameter can be a combination of the following values:

- `DLG_ALLOWMULTI` : Allows multiple instances of the same dialog resource to be open simultaneously.
- `DLG_CAPTIONCLOSE` : Shows a Close button in the dialog title bar. Pressing it produces an `IDCA_NCEL` notification to the message procedure.
- `DLG_CAPTIONHELP` : Shows a Help button in the dialog title bar. Pressing it produces an `IDHELP` notification to the message procedure.

If customised title bar buttons are requested, the dialog box template should not contain standard title buttons, by omitting the `WS_SYSMENU` window style.

Additional buttons can be created by using the `oapiAddTitleButton` function.

## See also

[oapiFindDialog](#), [oapiCloseDialog](#), [oapiGetDialogContext](#)

**16.61.2.11 OAPIFUNC bool oapiOpenHelp ( HELPCONTEXT \* *hcontext* )**

Opens the ingame help window on the specified help page.

## Parameters

<i>hcontext</i>	help context structure.
-----------------	-------------------------

## Returns

Currently always returns `true`.

**16.61.2.12 OAPIFUNC bool oapiOpenLaunchpadHelp ( HELPCONTEXT \* *hcontext* )**

Opens a help window outside a simulation session, i.e. when the Launchpad dialog is displayed.

## Parameters

<i>hcontext</i>	help context structure.
-----------------	-------------------------

## Returns

Currently always returns *true*.

16.61.2.13 OAPIFUNC DWORD oapiRegisterCustomCmd ( *char \* label*, *char \* desc*, *CustomFunc func*, *void \* context* )

Register a custom function. Custom functions can be accessed in Orbiter by pressing Ctrl-F4. A common use for custom functions is opening plugin dialog boxes.

## Parameters

<i>label</i>	label to appear in the custom function list.
<i>desc</i>	a short description of the function
<i>func</i>	pointer to the function to be executed
<i>context</i>	pointer to custom data which will be passed to func

## Returns

function identifier

## Note

The interface of the custom function is defined as follows:

```
1 typedef void (*CustomFunc)(void *context)
```

where context is the pointer passed to [oapiRegisterCustomCmd\(\)](#).

## See also

[oapiUnregisterCustomCmd](#)

16.61.2.14 OAPIFUNC LAUNCHPADITEM\_HANDLE oapiRegisterLaunchpadItem ( *LaunchpadItem \* item*, *LAUNCHPADITEM\_HANDLE parent = 0* )

Register a new item in the parameter list of the "Extra" tab of the Orbiter Launchpad dialog.

## Parameters

<i>item</i>	pointer to <a href="#">LaunchpadItem</a> structure (see notes)
<i>parent</i>	parent item, or NULL for root item

## Returns

Handle for the new item

## Note

The "Extra" list of the Launchpad dialog is customisable and can be used by modules to allow user selection of global parameters and settings. Data can be written to/read from file and therefore persist across Orbiter sessions.

Item is a pointer to a class instance derived from [LaunchpadItem](#). It defines what is displayed in the list, and how the user accesses the item.

Items can be arranged in a hierarchy. Child items can be defined by passing the handle of a previous item as the parent parameter.

If an entry with the same name as item->Name() already exists, no new entry is generated, and the handle of the existing entry is returned.

Because double-clicking on an item both activates it and expands the child list of parent items, parent items should be inert (i.e. should not define their clbkOpen method) to avoid ambiguities.

[oapiRegisterLaunchpadItem\(\)](#) should usually be called during the DLL initialisation function. A matching [oapiUnregisterLaunchpadItem\(\)](#) should be called during the DLL exit function.

#### See also

[oapiUnregisterLaunchpadItem](#), [oapiFindLaunchpadItem](#)

### 16.61.2.15 OAPIFUNC void oapiSetMainInfoVisibilityMode ( *DWORD mode* )

Set the display mode for the two info blocks at the top left and right screen corners.

#### Parameters

<i>mode</i>	display mode: 0=show, 1=hide, 2=auto-hide
-------------	---

#### See also

[oapiGetMainInfoVisibilityMode](#), [oapiGetMainMenuVisibilityMode](#), [oapiSetMainMenuVisibilityMode](#)

### 16.61.2.16 OAPIFUNC void oapiSetMainMenuVisibilityMode ( *DWORD mode* )

Set the display mode for the main menu bar.

#### Parameters

<i>mode</i>	display mode: 0=show, 1=hide, 2=auto-hide
-------------	---

#### See also

[oapiGetMainMenuVisibilityMode](#), [oapiGetMainInfoVisibilityMode](#), [oapiSetMainInfoVisibilityMode](#)

### 16.61.2.17 OAPIFUNC bool oapiUnregisterCustomCmd ( *int cmdId* )

Unregister a previously defined custom function.

#### Parameters

<i>cmdId</i>	custom function identifier (as returned by <a href="#">oapiRegisterCustomCmd()</a> )
--------------	--

#### Returns

*false* indicates failure (cmdId not recognised)

#### See also

[oapiRegisterCustomCmd](#)

### 16.61.2.18 OAPIFUNC bool oapiUnregisterLaunchpadItem ( *LaunchpadItem \* item* )

Unregister a previously registered entry in the "Extra" tab of the Orbiter Launchpad dialog.

**Parameters**

<i>item</i>	handle of the item to be removed
-------------	----------------------------------

**Returns**

value *true* if item could be unregistered, *false* if no matching item was found.

**Note**

A module must unregister all the launchpad items it has registered before it is unloaded, at the latest during `ExitModule`. Failing to do so will leave stale items in the parameter list of the Extra tab, leading to undefined behaviour.

**See also**

[oapiRegisterLaunchpadItem](#), [oapiFindLaunchpadItem](#)

## 16.62 File IO Functions

### Functions

- OAPIFUNC `FILEHANDLE oapiOpenFile (const char *fname, FileAccessMode mode, PathRoot root=ROOT)`  
*Open a file for reading or writing.*
- OAPIFUNC `void oapiCloseFile (FILEHANDLE file, FileAccessMode mode)`  
*Close a file after reading or writing.*
- OAPIFUNC `bool oapiSaveScenario (const char *fname, const char *desc)`  
*Writes the current simulation state to a scenario file.*
- OAPIFUNC `void oapiWriteLine (FILEHANDLE file, char *line)`  
*Writes a line to a file.*
- OAPIFUNC `void oapiWriteLog (char *line)`  
*Writes a line to the Orbiter log file (`orbiter.log`) in the main orbiter directory.*
- OAPIFUNC `void oapiWriteLogV (const char *format,...)`  
*Writes a formatted string with variable number of arguments to `orbiter.log`.*
- OAPIFUNC `void oapiWriteScenario_string (FILEHANDLE scn, char *item, char *string)`  
*Writes a string-valued item to a scenario file.*
- OAPIFUNC `void oapiWriteScenario_int (FILEHANDLE scn, char *item, int i)`  
*Writes an integer-valued item to a scenario file.*
- OAPIFUNC `void oapiWriteScenario_float (FILEHANDLE scn, char *item, double d)`  
*Writes a floating point-valued item to a scenario file.*
- OAPIFUNC `void oapiWriteScenario_vec (FILEHANDLE scn, char *item, const VECTOR3 &vec)`  
*Writes a vector-valued item to a scenario file.*
- OAPIFUNC `bool oapiReadScenario_nextline (FILEHANDLE scn, char *&line)`  
*Reads an item from a scenario file.*
- OAPIFUNC `bool oapiReadItem_string (FILEHANDLE f, char *item, char *string)`  
*Read the value of a tag from a configuration file.*
- OAPIFUNC `bool oapiReadItem_float (FILEHANDLE f, char *item, double &d)`  
*Read the value of a tag from a configuration file.*
- OAPIFUNC `bool oapiReadItem_int (FILEHANDLE f, char *item, int &i)`  
*Read the value of a tag from a configuration file.*
- OAPIFUNC `bool oapiReadItem_bool (FILEHANDLE f, char *item, bool &b)`  
*Read the value of a tag from a configuration file.*
- OAPIFUNC `bool oapiReadItem_vec (FILEHANDLE f, char *item, VECTOR3 &vec)`  
*Read the value of a tag from a configuration file.*
- OAPIFUNC `void oapiWriteItem_string (FILEHANDLE f, char *item, char *string)`  
*Write a tag and its value to a configuration file.*
- OAPIFUNC `void oapiWriteItem_float (FILEHANDLE f, char *item, double d)`  
*Write a tag and its value to a configuration file.*
- OAPIFUNC `void oapiWriteItem_int (FILEHANDLE f, char *item, int i)`  
*Write a tag and its value to a configuration file.*
- OAPIFUNC `void oapiWriteItem_bool (FILEHANDLE f, char *item, bool b)`  
*Write a tag and its value to a configuration file.*
- OAPIFUNC `void oapiWriteItem_vec (FILEHANDLE f, char *item, const VECTOR3 &vec)`  
*Write a tag and its value to a configuration file.*

### 16.62.1 Detailed Description

#### 16.62.2 Function Documentation

##### 16.62.2.1 OAPIFUNC `void oapiCloseFile ( FILEHANDLE file, FileAccessMode mode )`

Close a file after reading or writing.

## Parameters

<i>file</i>	file handle
<i>mode</i>	access mode with which the file was opened

## Note

Use this function on files opened with `oapiOpenFile` after finishing with it.

The file access mode passed to `oapiCloseFile` must be the same as used to open it.

### 16.62.2.2 OAPIFUNC FILEHANDLE `oapiOpenFile ( const char * fname, FileAccessMode mode, PathRoot root = ROOT )`

Open a file for reading or writing.

## Parameters

<i>fname</i>	file name (with optional path)
<i>mode</i>	read/write mode (see notes)
<i>root</i>	path origin (see notes)

## Returns

file handle

## Note

The following access modes are supported:

- FILE\_IN read
- FILE\_IN\_ZEROONFAIL read
- FILE\_OUT write (overwrite)
- FILE\_APP write (append)

The file path defined in *fname* is relative to either the main Orbiter folder or to one of Orbiter's default subfolders, depending on the *root* parameter:

- ROOT Orbiter main directory
- CONFIG Orbiter config folder
- SCENARIOS Orbiter scenarios folder
- TEXTURES Orbiter standard texture folder
- TEXTURES2 Orbiter high-res texture folder
- MESHES Orbiter mesh folder
- MODULES Orbiter module folder

You should always specify a standard Orbiter subfolder by the above mechanism, rather than manually as a path in `fname`, because Orbiter installations can redirect these directories.

Access mode `FILE_IN` will always return a valid file handle, even if the file doesn't exist or can't be opened for reading (in which case all subsequent read attempts will fail). By contrast, `FILE_IN_ZEROONFAIL` will return 0 if the requested file can't be opened for reading.

Be careful when opening a file for writing in the standard Orbiter subfolders: except for `ROOT` and `SCENA`→`RIOS`, all other standard folders may be readonly (e.g. for CD installations)

#### See also

[oapiCloseFile](#)

##### 16.62.2.3 OAPIFUNC bool oapiReadItem\_bool ( FILEHANDLE *f*, char \* *item*, bool & *b* )

Read the value of a tag from a configuration file.

#### Parameters

<i>f</i>	file handle
<i>item</i>	tag defining the item
<i>b</i>	boolean value

#### Returns

*true* if tag was found in the file, *false* if not.

#### Note

In a file boolean values are represented by the strings "FALSE" and "TRUE".

#### See also

[oapiReadItem\\_string](#) for more details.

##### 16.62.2.4 OAPIFUNC bool oapiReadItem\_float ( FILEHANDLE *f*, char \* *item*, double & *d* )

Read the value of a tag from a configuration file.

#### Parameters

<i>f</i>	file handle
<i>item</i>	tag defining the item
<i>d</i>	double value

#### Returns

*true* if tag was found in the file, *false* if not.

#### See also

[oapiReadItem\\_string](#) for more details.

##### 16.62.2.5 OAPIFUNC bool oapiReadItem\_int ( FILEHANDLE *f*, char \* *item*, int & *i* )

Read the value of a tag from a configuration file.

## Parameters

<i>f</i>	file handle
<i>item</i>	tag defining the item
<i>i</i>	integer value

## Returns

*true* if tag was found in the file, *false* if not.

## See also

[oapiReadItem\\_string](#) for more details.

16.62.2.6 OAPIFUNC bool oapiReadItem\_string ( FILEHANDLE *f*, char \* *item*, char \* *string* )

Read the value of a tag from a configuration file.

## Parameters

<i>f</i>	file handle
<i>item</i>	tag defining the item
<i>string</i>	character-string value

## Returns

*true* if tag was found in the file, *false* if not.

## Note

The tag-value entries of a configuration file have the format <tag> = <value>

The functions search the complete file independent of the current position of the file pointer.

Whitespace around tag and value are discarded, as well as comments beginning with a semicolon (;) to the end of the line.

String values can contain internal whitespace.

16.62.2.7 OAPIFUNC bool oapiReadItem\_vec ( FILEHANDLE *f*, char \* *item*, VECTOR3 & *vec* )

Read the value of a tag from a configuration file.

## Parameters

<i>f</i>	file handle
<i>item</i>	tag defining the item
<i>vec</i>	vector value

## Returns

*true* if tag was found in the file, *false* if not.

## Note

Vector values are represented by space-separated triplets of floating point values.

## See also

[oapiReadItem\\_string](#) for more details.

16.62.2.8 OAPIFUNC bool oapiReadScenario\_nextline ( FILEHANDLE *scn*, char \*& *line* )

Reads an item from a scenario file.

## Parameters

<i>scn</i>	file handle
<i>line</i>	pointer to the scanned line

## Note

The function returns *true* as long as an item for the current block could be read. It returns false at EOF, or when an "END" token is read.

Leading and trailing whitespace, and trailing comments (from ";" to EOL) are automatically removed.

"*line*" points to an internal static character buffer. The buffer grows automatically to hold lines of arbitrary length.

The buffer is overwritten on the next call to `oapiReadScenario_nextline`, so it must be copied or processed before the next call.

## Examples:

[clbkLoadStateEx.cpp](#).

16.62.2.9 OAPIFUNC bool `oapiSaveScenario ( const char * fname, const char * desc )`

Writes the current simulation state to a scenario file.

## Parameters

<i>fname</i>	scenario file name
<i>desc</i>	scenario description

## Returns

*true* if scenario could be written successfully, *false* if an error occurred.

## Note

The file name is always calculated relative from the default orbiter scenario folder (usually Orbiter\Scenarios).

The file name can contain a relative path starting from that directory, but the subdirectories must already exist.

The function will not create new directories. The file name should not contain an absolute path.

The file name should not contain an extension. Orbiter will automatically add a .scn extension.

The description string can be empty ("").

16.62.2.10 OAPIFUNC void `oapiWriteItem_bool ( FILEHANDLE f, char * item, bool b )`

Write a tag and its value to a configuration file.

## Parameters

<i>f</i>	file handle
<i>item</i>	pointer to tag string
<i>b</i>	boolean value

## Note

In a file boolean values are represented by the strings "FALSE" and "TRUE".

## See also

[oapiWriteItem\\_string](#) for more details

16.62.2.11 OAPIFUNC void `oapiWriteItem_float ( FILEHANDLE f, char * item, double d )`

Write a tag and its value to a configuration file.

## Parameters

<i>f</i>	file handle
<i>item</i>	pointer to tag string
<i>d</i>	double value

## See also

[oapiWriteItem\\_string](#) for more details

#### 16.62.2.12 OAPIFUNC void oapiWriteItem\_int ( FILEHANDLE *f*, char \* *item*, int *i* )

Write a tag and its value to a configuration file.

## Parameters

<i>f</i>	file handle
<i>item</i>	pointer to tag string
<i>i</i>	integer value

## See also

[oapiWriteItem\\_string](#) for more details

#### 16.62.2.13 OAPIFUNC void oapiWriteItem\_string ( FILEHANDLE *f*, char \* *item*, char \* *string* )

Write a tag and its value to a configuration file.

## Parameters

<i>f</i>	file handle
<i>item</i>	pointer to tag string
<i>string</i>	character-string value

## Note

Use these functions to write items (tags and values) to configuration files.

The format of the written items is recognised by the corresponding [oapiReadItem\\_xxx](#) functions.

For historic reasons, the format for scenario file entries is different. Use the [oapiWriteLine](#) function.

## See also

[oapiReadItem\\_string](#)

#### 16.62.2.14 OAPIFUNC void oapiWriteItem\_vec ( FILEHANDLE *f*, char \* *item*, const VECTOR3 & *vec* )

Write a tag and its value to a configuration file.

## Parameters

<i>f</i>	file handle
<i>item</i>	pointer to tag string
<i>vec</i>	vector value

## Note

Vector values are represented by space-separated triplets of floating point values.

## See also

[oapiWriteItem\\_string](#) for more details

16.62.2.15 OAPIFUNC void oapiWriteLine ( FILEHANDLE *file*, char \* *line* )

Writes a line to a file.

## Parameters

<i>file</i>	file handle
<i>line</i>	line to be written (zero-terminated)

16.62.2.16 OAPIFUNC void oapiWriteLog ( *char \* line* )

Writes a line to the Orbiter log file (orbiter.log) in the main orbiter directory.

## Parameters

<i>line</i>	line to be written (zero-terminated)
-------------	--------------------------------------

## Note

This function is intended for diagnostic initialisation and error messages by plugin modules. The messages should make it easier to track problems.

Avoid unnecessary output. In particular, don't write to the log file continuously from within the simulation loop.

## See also

[oapiWriteLogV](#)

16.62.2.17 OAPIFUNC void oapiWriteLogV ( *const char \* format, ...* )

Writes a formatted string with variable number of arguments to orbiter.log.

## Parameters

<i>format</i>	Format string. Can contain any C-style parameter flags.
<i>...</i>	List of output parameters. Must match the parameter flags in the format string.

## Note

A newline character is appended to the end of the format string.

## See also

[oapiWriteLog](#)

16.62.2.18 OAPIFUNC void oapiWriteScenario\_float ( *FILEHANDLE scn, char \* item, double d* )

Writes a floating point-valued item to a scenario file.

## Parameters

<i>scn</i>	file handle
<i>item</i>	item id
<i>d</i>	floating point value to be written

16.62.2.19 OAPIFUNC void oapiWriteScenario\_int ( *FILEHANDLE scn, char \* item, int i* )

Writes an integer-valued item to a scenario file.

## Parameters

<i>scn</i>	file handle
<i>item</i>	item id
<i>i</i>	integer value to be written

**16.62.2.20 OAPIFUNC void oapiWriteScenario\_string ( FILEHANDLE *scn*, char \* *item*, char \* *string* )**

Writes a string-valued item to a scenario file.

**Parameters**

<i>scn</i>	file handle
<i>item</i>	item id
<i>string</i>	string to be written (zero-terminated)

**16.62.2.21 OAPIFUNC void oapiWriteScenario\_vec ( FILEHANDLE *scn*, char \* *item*, const VECTOR3 & *vec* )**

Writes a vector-valued item to a scenario file.

**Parameters**

<i>scn</i>	file handle
<i>item</i>	item id
<i>vec</i>	vector to be written

## 16.63 Utility functions

### Functions

- OAPIFUNC double [oapiRand \(\)](#)  
*Returns uniformly distributed pseudo-random number in the range [0..1].*
- OAPIFUNC DWORD [oapiDeflate \(const BYTE \\*ebuf, DWORD nebuf, BYTE \\*zbuf, DWORD nzbuf\)](#)  
*Compress a data block.*
- OAPIFUNC DWORD [oapiInflate \(const BYTE \\*zbuf, DWORD nzbuf, BYTE \\*ebuf, DWORD nebuf\)](#)  
*Uncompress a data block previously compressed with oapiDeflate.*
- OAPIFUNC DWORD [oapiGetColour \(DWORD red, DWORD green, DWORD blue\)](#)  
*Returns a colour value adapted to the current screen colour depth for given red, green and blue components.*

### 16.63.1 Detailed Description

### 16.63.2 Function Documentation

#### 16.63.2.1 OAPIFUNC DWORD oapiDeflate ( const BYTE \* ebuf, DWORD nebuf, BYTE \* zbuf, DWORD nzbuf )

Compress a data block.

#### Parameters

<i>ebuf</i>	input data buffer
<i>nebuf</i>	size of input buffer
<i>zbuf</i>	output data buffer to receive the compressed data
<i>nzbuf</i>	size of output buffer

#### Returns

size of compressed data buffer (0=error)

#### Note

The output buffer must have been allocated by the caller before the call to oapiDeflate, and must be large enough to store the complete compressed data buffer. If the buffer is too small, the output data block is invalid, and the function returns 0.

#### See also

[oapiInflate](#)

#### 16.63.2.2 OAPIFUNC DWORD oapiGetColour ( DWORD red, DWORD green, DWORD blue )

Returns a colour value adapted to the current screen colour depth for given red, green and blue components.

#### Parameters

<i>red</i>	red component (0-255)
<i>green</i>	green component (0-255)
<i>blue</i>	blue component (0-255)

#### Returns

colour value

**Note**

Colour values are required for some surface functions like oapiClearSurface or oapiSetSurfaceColourKey. The colour key for a given RGB triplet depends on the screen colour depth. This function returns the colour value for the closest colour match which can be displayed in the current screen mode.

In 24 and 32 bit modes the requested colour can always be matched. The colour value in that case is (red << 16) + (green << 8) + blue.

For 16 bit displays the colour value is calculated as ((red\*31)/255) << 11 + ((green\*63)/255) << 5 + (blue\*31)/255 assuming a "565" colour mode (5 bits for red, 6, for green, 5 for blue). This means that a requested colour may not be perfectly matched.

These colour values should not be used for Windows (GDI) drawing functions where a COLORREF value is expected.

**16.63.2.3 OAPIFUNC DWORD oapiInflate ( const BYTE \* zbuf, DWORD nzbuff, BYTE \* ebuf, DWORD nebuf )**

Uncompress a data block previously compressed with oapiDeflate.

**Parameters**

<i>zbuf</i>	compressed input data buffer
<i>nzbuff</i>	size of input buffer
<i>ebuf</i>	output data buffer to receive the uncompressed data
<i>nebuf</i>	size of output buffer

**Returns**

size of uncompressed data buffer (0=error)

**Note**

The output buffer must have been allocated by the caller before the call to oapiInflate, and must be large enough to store the complete uncompressed data buffer. If the buffer is too small, the output data block is invalid, and the function returns 0.

**See also**

[oapiDeflate](#)

**16.63.2.4 OAPIFUNC double oapiRand ( )**

Returns uniformly distributed pseudo-random number in the range [0..1].

**Returns**

Random value between 0 and 1.

**Note**

This function uses the system call rand(), so the quality of the random sequence depends on the system implementation. If you need high-quality random sequences you may need to implement your own generator. Orbiter seeds the generator with the system time on startup, so the generated sequences are not reproducible.

## 16.64 User input functions

### Functions

- OAPIFUNC void [oapiOpenInputBox](#) (char \*title, bool(\*Clbk)(void \*, char \*, void \*), char \*buf=0, int vislen=20, void \*userdata=0)
 

*Opens a modal input box requesting a string from the user.*
- OAPIFUNC void [oapiOpenInputBoxEx](#) (const char \*title, bool(\*Clbk\_enter)(void \*, char \*, void \*), bool(\*Clbk\_cancel)(void \*, char \*, void \*), char \*buf=0, int vislen=20, void \*userdata=0, DWORD flags=0)

### 16.64.1 Detailed Description

### 16.64.2 Function Documentation

#### 16.64.2.1 OAPIFUNC void oapiOpenInputBox ( char \* *title*, bool(\*)(void \*, char \*, void \*) *Clbk*, char \* *buf* = 0, int *vislen* = 20, void \* *userdata* = 0 )

Opens a modal input box requesting a string from the user.

#### Parameters

<i>title</i>	input box title
<i>Clbk</i>	callback function receiving the result of the user input (see notes)
<i>buf</i>	initial state of the input string
<i>vislen</i>	number of characters visible in input box
<i>userdata</i>	user-defined data passed to the callback function

#### Note

Format for callback function:

```
1 bool InputCallback (void *id, char *str, void *userdata )
```

where id identifies the input box, str contains the user-supplied string, and userdata contains the data specified in the call to oapiOpenInputBox. The callback function should return *true* if it accepts the string, *false* otherwise (the box will not be closed if the callback function returns *false*).

The box can be closed by the user by pressing Enter ("OK") or Esc ("Cancel"). The callback function is only called in the first case.

The input box is modal, i.e. all keyboard input is redirected into the dialog box. Normal key functions resume after the box is closed.

#### See also

[oapiOpenInputBoxEx](#)

## 16.65 Onscreen annotations

### Functions

- OAPIFUNC **NOTEHANDLE** [oapiCreateAnnotation](#) (bool exclusive, double size, const **VECTOR3** &col)  
*Creates an annotation handle for displaying onscreen text during a simulation.*
- OAPIFUNC bool [oapiDelAnnotation](#) (**NOTEHANDLE** hNote)  
*Deletes an annotation handle.*
- OAPIFUNC void [oapiAnnotationSetPos](#) (**NOTEHANDLE** hNote, double x1, double y1, double x2, double y2)  
*Resets the bounding box of the annotation display area.*
- OAPIFUNC void [oapiAnnotationSetSize](#) (**NOTEHANDLE** hNote, double size)  
*Resets the font size of the annotation text.*
- OAPIFUNC void [oapiAnnotationSetColour](#) (**NOTEHANDLE** hNote, const **VECTOR3** &col)  
*Resets the font colour of the annotation text.*
- OAPIFUNC void [oapiAnnotationSetText](#) (**NOTEHANDLE** hNote, char \*note)  
*Writes a new annotation to screen, or overwrites the previous text.*

### 16.65.1 Detailed Description

These functions can be used to display text on top of the render window during a running simulation. These may include flight parameters of the currently observed spacecraft, user instructions for tutorials, or debugging information during development.

### 16.65.2 Function Documentation

#### 16.65.2.1 OAPIFUNC void [oapiAnnotationSetColour](#) ( **NOTEHANDLE** hNote, const **VECTOR3** & col )

Resets the font colour of the annotation text.

##### Parameters

<i>hNote</i>	annotation handle
<i>col</i>	font colour (RGB triplet with ranges 0-1)

##### See also

[oapiCreateAnnotation](#)

#### 16.65.2.2 OAPIFUNC void [oapiAnnotationSetPos](#) ( **NOTEHANDLE** hNote, double x1, double y1, double x2, double y2 )

Resets the bounding box of the annotation display area.

##### Parameters

<i>hNote</i>	annotation handle
<i>x1</i>	left edge of bounding box ( $0 \leq x1 < x2$ )
<i>y1</i>	top edge of bounding box ( $0 \leq y1 < y2$ )
<i>x2</i>	right edge of bounding box ( $x1 < x2 \leq 1$ )
<i>y2</i>	bottom edge of bounding box ( $y1 < y2 \leq 1$ )

##### Note

boundary values are specified in units of the render window area, with (0,0) being the top left corner, and (1,1) the bottom right corner.

If the bounding box is set too small, part of the annotation may not be visible.

## See also

[oapiCreateAnnotation](#)**16.65.2.3 OAPIFUNC void oapiAnnotationSetSize ( NOTEHANDLE *hNote*, double *size* )**

Resets the font size of the annotation text.

## Parameters

<i>hNote</i>	annotation handle
<i>size</i>	font size in relative units ( $> 0$ )

## Note

Annotations are sized in relation to the simulation window size. Size 1 is the default annotation size.

## See also

[oapiCreateAnnotation](#)**16.65.2.4 OAPIFUNC void oapiAnnotationSetText ( NOTEHANDLE *hNote*, char \* *note* )**

Writes a new annotation to screen, or overwrites the previous text.

## Parameters

<i>hNote</i>	annotation handle
<i>note</i>	annotation text

## See also

[oapiCreateAnnotation](#)**16.65.2.5 OAPIFUNC NOTEHANDLE oapiCreateAnnotation ( bool *exclusive*, double *size*, const VECTOR3 & *col* )**

Creates an annotation handle for displaying onscreen text during a simulation.

## Parameters

<i>exclusive</i>	exclusive mode flag
<i>size</i>	text scaling factor ( $> 0$ , 1=standard)
<i>col</i>	text colour (RGB triplet, range 0-1 for each component)

## Returns

Annotation handle

## See also

[oapiDelAnnotation](#), [oapiAnnotationSetPos](#), [oapiAnnotationSetSize](#), [oapiAnnotationSetColour](#), [oapiAnnotationSetText](#)**16.65.2.6 OAPIFUNC bool oapiDelAnnotation ( NOTEHANDLE *hNote* )**

Deletes an annotation handle.

**Parameters**

<i>hNote</i>	annotation handle
--------------	-------------------

**Returns**

*true* on success, *false* if an annotation corresponding to *hNote* was not found.

**See also**

[oapiCreateAnnotation](#)

## 16.66 Obsolete functions

### Functions

- OAPIFUNC `OBJHANDLE oapiGetStationByName (char *name)`
- OAPIFUNC `OBJHANDLE oapiGetStationByIndex (int index)`
- OAPIFUNC `DWORD oapiGetStationCount ()`
- OAPIFUNC `BOOL oapiGetAirspeedVector (OBJHANDLE hVessel, VECTOR3 *speedvec)`

*Returns a vessel's airspeed vector w.r.t. the closest planet or moon in the local horizon's frame of reference.*
- OAPIFUNC `BOOL oapiGetShipAirspeedVector (OBJHANDLE hVessel, VECTOR3 *speedvec)`

*Returns a vessel's airspeed vector w.r.t. the closest planet or moon in the vessel's local frame of reference.*
- OAPIFUNC `BOOL oapiGetFocusAirspeed (double *airspeed)`

*Returns the current focus vessel's airspeed w.r.t. the closest planet or moon.*
- OAPIFUNC `BOOL oapiGetFocusAirspeedVector (VECTOR3 *speedvec)`

*Returns the current focus vessel's airspeed vector w.r.t. the closest planet or moon in the local horizon's frame of reference.*
- OAPIFUNC `BOOL oapiGetFocusShipAirspeedVector (VECTOR3 *speedvec)`

*Returns the current focus vessel's airspeed vector w.r.t. closest planet or moon in the vessel's local frame of reference.*
- OAPIFUNC `void oapiGetAtmPressureDensity (OBJHANDLE hVessel, double *pressure, double *density)`

*Returns the atmospheric pressure and density caused by a planetary atmosphere at the current vessel position.*
- OAPIFUNC `void oapiGetFocusAtmPressureDensity (double *pressure, double *density)`

*Returns the atmospheric pressure and density caused by a planetary atmosphere at the current focus vessel's position.*
- OAPIFUNC `bool oapiAcceptDelayedKey (char key, double interval)`
- OAPIFUNC `int oapiRegisterMFDMode (MFDMODESPEC &spec)`

*Register a custom [MFD](#) mode.*
- OAPIFUNC `int oapiGetMFDModeSpec (char *name, MFDMODESPEC **spec=0)`

*Returns the mode identifier and spec for an [MFD](#) mode defined by its name.*
- OAPIFUNC `void oapiTriggerPanelRedrawArea (int panel_id, int area_id)`
- OAPIFUNC `void oapiTriggerRedrawArea (int panel_id, int vc_id, int area_id)`

### 16.66.1 Detailed Description

### 16.66.2 Function Documentation

#### 16.66.2.1 OAPIFUNC `BOOL oapiGetAirspeedVector ( OBJHANDLE hVessel, VECTOR3 * speedvec )`

Returns a vessel's airspeed vector w.r.t. the closest planet or moon in the local horizon's frame of reference.

**Deprecated** This method has been replaced by `oapiGetAirspeedVector(OBJHANDLE,REFFRAME,VECTOR3*)`

#### 16.66.2.2 OAPIFUNC `void oapiGetAtmPressureDensity ( OBJHANDLE hVessel, double * pressure, double * density )`

Returns the atmospheric pressure and density caused by a planetary atmosphere at the current vessel position.

**Deprecated** This function has been replaced by `oapiGetAtm`.

### Parameters

<i>hVessel</i>	vessel handle
<i>pressure</i>	pointer to variable receiving pressure value [Pa]
<i>density</i>	pointer to variable receiving density value [kg/m <sup>3</sup> ]

#### Note

Pressure and density are calculated using an exponential barometric equation, without accounting for local variations.

#### See also

[oapiGetAtm](#)

##### 16.66.2.3 OAPIFUNC BOOL oapiGetFocusAirspeed ( double \* *airspeed* )

Returns the current focus vessel's airspeed w.r.t. the closest planet or moon.

**Deprecated** This method has been replaced by [oapiGetAirspeed\(\)](#)

##### 16.66.2.4 OAPIFUNC BOOL oapiGetFocusAirspeedVector ( VECTOR3 \* *speedvec* )

Returns the current focus vessel's airspeed vector w.r.t. the closest planet or moon in the local horizon's frame of reference.

**Deprecated** This method has been replaced by [oapiGetAirspeedVector\(OBJHANDLE,REFFRAME,VECTOR3\\*\)](#)

##### 16.66.2.5 OAPIFUNC void oapiGetFocusAtmPressureDensity ( double \* *pressure*, double \* *density* )

Returns the atmospheric pressure and density caused by a planetary atmosphere at the current focus vessel's position.

**Deprecated** This function has been replaced by [oapiGetAtm](#).

#### Parameters

<i>pressure</i>	pointer to variable receiving pressure value [Pa]
<i>density</i>	pointer to variable receiving density value [kg/m <sup>3</sup> ]

#### Note

Pressure and density are calculated using an exponential barometric equation, without accounting for local variations.

#### See also

[oapiGetAtm](#)

##### 16.66.2.6 OAPIFUNC BOOL oapiGetFocusShipAirspeedVector ( VECTOR3 \* *speedvec* )

Returns the current focus vessel's airspeed vector w.r.t. closest planet or moon in the vessel's local frame of reference.

**Deprecated** This method has been replaced by [oapiGetAirspeedVector\(OBJHANDLE,REFFRAME,VECTOR3\\*\)](#)

**16.66.2.7 OAPIFUNC int oapiGetMFDModeSpec ( *char \* name, MFDMODESPEC \*\* spec = 0* )**

Returns the mode identifier and spec for an [MFD](#) mode defined by its name.

**Deprecated** This function has been replaced by [oapiGetMFDModeSpecEx](#)

See also

[oapiGetMFDModeSpecEx](#)

**16.66.2.8 OAPIFUNC BOOL oapiGetShipAirspeedVector ( *OBJHANDLE hVessel, VECTOR3 \* speedvec* )**

Returns a vessel's airspeed vector w.r.t. the closest planet or moon in the vessel's local frame of reference.

**Deprecated** This method has been replaced by [oapiGetAirspeedVector\(OBJHANDLE,REFFRAME,VECTOR3\\*\)](#)

**16.66.2.9 OAPIFUNC OBJHANDLE oapiGetStationByIndex ( *int index* )**

**Deprecated** Stations are no longer distinguished from vessels. This function does not perform any action other than writing a warning to the log file. Use [oapiGetVesselByIndex](#) instead.

**16.66.2.10 OAPIFUNC OBJHANDLE oapiGetStationByName ( *char \* name* )**

**Deprecated** Stations are no longer distinguished from vessels. This function does not perform any action other than writing a warning to the log file. Use [oapiGetVesselByName](#) instead.

**16.66.2.11 OAPIFUNC DWORD oapiGetStationCount ( )**

**Deprecated** Stations are no longer distinguished from vessels. This function always returns 0. Use [oapiGetVesselCount](#) instead.

**16.66.2.12 OAPIFUNC int oapiRegisterMFDMode ( *MFDMODESPEC & spec* )**

Register a custom [MFD](#) mode.

**Deprecated** This function has been replaced by [oapiRegisterMFDMode\(MFDMODESPEC&\)](#).

See also

[oapiRegisterMFDMode\(MFDMODESPEC&\)](#)

**16.66.2.13 OAPIFUNC void oapiTriggerPanelRedrawArea ( *int panel\_id, int area\_id* )**

**Deprecated** This function is unsafe because it can be used by vessels who don't own the current cockpit visuals. Use [VESSEL::TriggerPanelRedrawArea](#) instead.

**16.66.2.14 OAPIFUNC void oapiTriggerRedrawArea ( *int panel\_id, int vc\_id, int area\_id* )**

**Deprecated** This function is unsafe because it can be used by vessels who don't own the current cockpit visuals. Use [VESSEL::TriggerRedrawArea](#) instead.

## 16.67 Keyboard key identifiers

### Macros

- `#define OAPI_KEY_ESCAPE 0x01`  
*Escape key.*
- `#define OAPI_KEY_1 0x02`  
*'1' key on main keyboard*
- `#define OAPI_KEY_2 0x03`  
*'2' key on main keyboard*
- `#define OAPI_KEY_3 0x04`  
*'3' key on main keyboard*
- `#define OAPI_KEY_4 0x05`  
*'4' key on main keyboard*
- `#define OAPI_KEY_5 0x06`  
*'5' key on main keyboard*
- `#define OAPI_KEY_6 0x07`  
*'6' key on main keyboard*
- `#define OAPI_KEY_7 0x08`  
*'7' key on main keyboard*
- `#define OAPI_KEY_8 0x09`  
*'8' key on main keyboard*
- `#define OAPI_KEY_9 0x0A`  
*'9' key on main keyboard*
- `#define OAPI_KEY_MINUS 0x0B`  
*'-' key on main keyboard*
- `#define OAPI_KEY_EQUALS 0x0D`  
*'=' key on main keyboard*
- `#define OAPI_KEY_BACK 0x0E`  
*backspace key*
- `#define OAPI_KEY_TAB 0x0F`  
*tab key*
- `#define OAPI_KEY_Q 0x10`  
*'Q' key*
- `#define OAPI_KEY_W 0x11`  
*'W' key*
- `#define OAPI_KEY_E 0x12`  
*'E' key*
- `#define OAPI_KEY_R 0x13`  
*'R' key*
- `#define OAPI_KEY_T 0x14`  
*'T' key*
- `#define OAPI_KEY_Y 0x15`  
*'Y' key*
- `#define OAPI_KEY_U 0x16`  
*'U' key*
- `#define OAPI_KEY_I 0x17`  
*'I' key*
- `#define OAPI_KEY_O 0x18`

- #define OAPI\_KEY\_P 0x19  
    'P' key
- #define OAPI\_KEY\_LBRACKET 0x1A  
    '[' (left bracket) key
- #define OAPI\_KEY\_RBRACKET 0x1B  
    ']' (right bracket) key
- #define OAPI\_KEY\_RETURN 0x1C  
    'Enter' key on main keyboard
- #define OAPI\_KEY\_LCONTROL 0x1D  
    Left 'Ctrl' key.
- #define OAPI\_KEY\_A 0x1E  
    'A' key
- #define OAPI\_KEY\_S 0x1F  
    'S' key
- #define OAPI\_KEY\_D 0x20  
    'D' key
- #define OAPI\_KEY\_F 0x21  
    'F' key
- #define OAPI\_KEY\_G 0x22  
    'G' key
- #define OAPI\_KEY\_H 0x23  
    'H' key
- #define OAPI\_KEY\_J 0x24  
    'J' key
- #define OAPI\_KEY\_K 0x25  
    'K' key
- #define OAPI\_KEY\_L 0x26  
    'L' key
- #define OAPI\_KEY\_SEMICOLON 0x27  
    ';' (semicolon) key
- #define OAPI\_KEY\_APOSTROPHE 0x28  
    ' (apostrophe) key
- #define OAPI\_KEY\_GRAVE 0x29  
    accent grave
- #define OAPI\_KEY\_LSHIFT 0x2A  
    Left 'Shift' key.
- #define OAPI\_KEY\_BACKSLASH 0x2B  
    '\' (Backslash) key
- #define OAPI\_KEY\_Z 0x2C  
    'Z' key
- #define OAPI\_KEY\_X 0x2D  
    'X' key
- #define OAPI\_KEY\_C 0x2E  
    'C' key
- #define OAPI\_KEY\_V 0x2F  
    'V' key
- #define OAPI\_KEY\_B 0x30  
    'B' key
- #define OAPI\_KEY\_N 0x31  
    'N' key

- `#define OAPI_KEY_M 0x32`  
'M' key
- `#define OAPI_KEY_COMMA 0x33`  
',' (comma) key
- `#define OAPI_KEY_PERIOD 0x34`  
'.' key on main keyboard
- `#define OAPI_KEY_SLASH 0x35`  
'/' key on main keyboard
- `#define OAPI_KEY_RSHIFT 0x36`  
Right 'Shift' key.
- `#define OAPI_KEY_MULTIPLY 0x37`
- `#define OAPI_KEY_LALT 0x38`  
left Alt
- `#define OAPI_KEY_SPACE 0x39`  
'Space' key
- `#define OAPI_KEY_CAPITAL 0x3A`  
caps lock key
- `#define OAPI_KEY_F1 0x3B`  
F1 function key.
- `#define OAPI_KEY_F2 0x3C`  
F2 function key.
- `#define OAPI_KEY_F3 0x3D`  
F3 function key.
- `#define OAPI_KEY_F4 0x3E`  
F4 function key.
- `#define OAPI_KEY_F5 0x3F`  
F5 function key.
- `#define OAPI_KEY_F6 0x40`  
F6 function key.
- `#define OAPI_KEY_F7 0x41`  
F7 function key.
- `#define OAPI_KEY_F8 0x42`  
F8 function key.
- `#define OAPI_KEY_F9 0x43`  
F9 function key.
- `#define OAPI_KEY_F10 0x44`  
F10 function key.
- `#define OAPI_KEY_NUMLOCK 0x45`  
'Num Lock' key
- `#define OAPI_KEY_SCROLL 0x46`  
Scroll lock.
- `#define OAPI_KEY_NUMPAD7 0x47`  
'7' key on numeric keypad
- `#define OAPI_KEY_NUMPAD8 0x48`  
'8' key on numeric keypad
- `#define OAPI_KEY_NUMPAD9 0x49`  
'9' key on numeric keypad
- `#define OAPI_KEY_SUBTRACT 0x4A`  
'-' key on numeric keypad
- `#define OAPI_KEY_NUMPAD4 0x4B`  
'4' key on numeric keypad

- #define OAPI\_KEY\_NUMPAD5 0x4C  
*'5' key on numeric keypad*
- #define OAPI\_KEY\_NUMPAD6 0x4D  
*'6' key on numeric keypad*
- #define OAPI\_KEY\_ADD 0x4E  
 *'+' key on numeric keypad*
- #define OAPI\_KEY\_NUMPAD1 0x4F  
*'1' key on numeric keypad*
- #define OAPI\_KEY\_NUMPAD2 0x50  
*'2' key on numeric keypad*
- #define OAPI\_KEY\_NUMPAD3 0x51  
*'3' key on numeric keypad*
- #define OAPI\_KEY\_NUMPAD0 0x52  
*'0' key on numeric keypad*
- #define OAPI\_KEY\_DECIMAL 0x53  
*'.' key on numeric keypad*
- #define OAPI\_KEY\_OEM\_102 0x56  
*| < > on UK/German keyboards*
- #define OAPI\_KEY\_F11 0x57  
*F11 function key.*
- #define OAPI\_KEY\_F12 0x58  
*F12 function key.*
- #define OAPI\_KEY\_NUMPADENTER 0x9C  
*Enter on numeric keypad.*
- #define OAPI\_KEY\_RCONTROL 0x9D  
*right Control key*
- #define OAPI\_KEY\_DIVIDE 0xB5  
*'/' key on numeric keypad*
- #define OAPI\_KEY\_SYSRQ 0xB7  
*SysRq/PrtScn key.*
- #define OAPI\_KEY\_RALT 0xB8  
*right Alt*
- #define OAPI\_KEY\_PAUSE 0xC5  
*Break/Pause key.*
- #define OAPI\_KEY\_HOME 0xC7  
*Home on cursor keypad.*
- #define OAPI\_KEY\_UP 0xC8  
*up-arrow on cursor keypad*
- #define OAPI\_KEY\_PRIOR 0xC9  
*PgUp on cursor keypad.*
- #define OAPI\_KEY\_LEFT 0xCB  
*left-arrow on cursor keypad*
- #define OAPI\_KEY\_RIGHT 0xCD  
*right-arrow on cursor keypad*
- #define OAPI\_KEY\_END 0xCF  
*End on cursor keypad.*
- #define OAPI\_KEY\_DOWN 0xD0  
*down-arrow on cursor keypad*
- #define OAPI\_KEY\_NEXT 0xD1  
*PgDn on cursor keypad.*
- #define OAPI\_KEY\_INSERT 0xD2  
*Insert on cursor keypad.*
- #define OAPI\_KEY\_DELETE 0xD3  
*Delete on cursor keypad.*

## 16.67.1 Detailed Description

## 16.67.2 Macro Definition Documentation

16.67.2.1 `#define OAPI_KEY_MULTIPLY 0x37`

- on numeric keypad

## 16.68 Logical key ids

### Macros

- `#define OAPI_LKEY_CockpitRotateLeft 0`  
*rotate camera left in cockpit view*
- `#define OAPI_LKEY_CockpitRotateRight 1`  
*rotate camera right in cockpit view*
- `#define OAPI_LKEY_CockpitRotateUp 2`  
*rotate camera up in cockpit view*
- `#define OAPI_LKEY_CockpitRotateDown 3`  
*rotate camera down in cockpit view*
- `#define OAPI_LKEY_CockpitDontLean 4`  
*return to default cockpit camera position*
- `#define OAPI_LKEY_CockpitLeanForward 5`  
*move cockpit camera forward*
- `#define OAPI_LKEY_CockpitLeanLeft 6`  
*move cockpit camera left*
- `#define OAPI_LKEY_CockpitLeanRight 7`  
*move cockpit camera right*
- `#define OAPI_LKEY_CockpitResetCam 8`  
*rotate and shift cockpit camera back to default*
- `#define OAPI_LKEY_PanelShiftLeft 9`  
*shift 2D instrument panel left*
- `#define OAPI_LKEY_PanelShiftRight 10`  
*shift 2D instrument panel right*
- `#define OAPI_LKEY_PanelShiftUp 11`  
*shift 2D instrument panel up*
- `#define OAPI_LKEY_PanelShiftDown 12`  
*shift 2D instrument panel down*
- `#define OAPI_LKEY_PanelSwitchLeft 13`  
*switch to left neighbour panel*
- `#define OAPI_LKEY_PanelSwitchRight 14`  
*switch to right neighbour panel*
- `#define OAPI_LKEY_PanelSwitchUp 15`  
*switch to upper neighbour panel*
- `#define OAPI_LKEY_PanelSwitchDown 16`  
*switch to lower neighbour panel*
- `#define OAPI_LKEY_TrackRotateLeft 17`  
*turn track view camera left*
- `#define OAPI_LKEY_TrackRotateRight 18`  
*turn track view camera right*
- `#define OAPI_LKEY_TrackRotateUp 19`  
*turn track view camera up*
- `#define OAPI_LKEY_TrackRotateDown 20`  
*turn track view camera down*
- `#define OAPI_LKEY_TrackAdvance 21`  
*advance track view camera towards target*
- `#define OAPI_LKEY_TrackRetreat 22`  
*retreat track view camera from target*
- `#define OAPI_LKEY_GroundTiltLeft 23`

- `tilt camera left in ground view`
  - `#define OAPI_LKEY_GroundTiltRight 24`  
*tilt camera right in ground view*
  - `#define OAPI_LKEY_GroundTiltUp 25`  
*tilt camera up in ground view*
  - `#define OAPI_LKEY_GroundTiltDown 26`  
*tilt camera down in ground view*
- `#define OAPI_LKEY_IncMainThrust 27`  
*increment thrust of main thrusters*
- `#define OAPI_LKEY_DecMainThrust 28`  
*decrement thrust of main thrusters*
- `#define OAPI_LKEY_KillMainRetro 29`  
*kill main and retro thrusters*
- `#define OAPI_LKEY_FullMainThrust 30`  
*temporary full main thrust*
- `#define OAPI_LKEY_FullRetroThrust 31`  
*temporary full retro thrust*
- `#define OAPI_LKEY_IncHoverThrust 32`  
*increment thrust of hover thrusters*
- `#define OAPI_LKEY_DecHoverThrust 33`  
*decrement thrust of hover thrusters*
- `#define OAPI_LKEY_RCSEnable 34`  
*enable/disable RCS (reaction control system)*
- `#define OAPI_LKEY_RCSMode 35`  
*toggle linear/rotational RCS mode*
- `#define OAPI_LKEY_RCSPitchUp 36`  
*rotational RCS: pitch up*
- `#define OAPI_LKEY_RCSPitchDown 37`  
*rotational RCS: pitch down*
- `#define OAPI_LKEY_RCSYawLeft 38`  
*rotational RCS: yaw left*
- `#define OAPI_LKEY_RCSYawRight 39`  
*rotational RCS: yaw right*
- `#define OAPI_LKEY_RCSBankLeft 40`  
*rotational RCS: bank left*
- `#define OAPI_LKEY_RCSBankRight 41`  
*rotational RCS: bank right*
- `#define OAPI_LKEY_RCSUp 42`  
*linear RCS: accelerate up (+y)*
- `#define OAPI_LKEY_RCSDown 43`  
*linear RCS: accelerate down (-y)*
- `#define OAPI_LKEY_RCSLeft 44`  
*linear RCS: accelerate left (-x)*
- `#define OAPI_LKEY_RCSRight 45`  
*linear RCS: accelerate right (+x)*
- `#define OAPI_LKEY_RCSForward 46`  
*linear RCS: accelerate forward (+z)*
- `#define OAPI_LKEY_RCSBack 47`  
*linear RCS: accelerate backward (-z)*
- `#define OAPI_LKEY_LPRCSPitchUp 48`  
*rotational RCS: pitch up 10%*

- `#define OAPI_LKEY_LPRCSPitchDown` 49
  - rotational RCS: pitch down 10%*
- `#define OAPI_LKEY_LPRCSYawLeft` 50
  - rotational RCS: yaw left 10%*
- `#define OAPI_LKEY_LPRCSYawRight` 51
  - rotational RCS: yaw right 10%*
- `#define OAPI_LKEY_LPRCSBankLeft` 52
  - rotational RCS: bank left 10%*
- `#define OAPI_LKEY_LPRCSBankRight` 53
  - rotational RCS: bank right 10%*
- `#define OAPI_LKEY_LPRCSUp` 54
  - linear RCS: accelerate up 10% (+y)*
- `#define OAPI_LKEY_LPRCSDown` 55
  - linear RCS: accelerate down 10% (-y)*
- `#define OAPI_LKEY_LPRCSLeft` 56
  - linear RCS: accelerate left 10% (-x)*
- `#define OAPI_LKEY_LPRCSRRight` 57
  - linear RCS: accelerate right 10% (+x)*
- `#define OAPI_LKEY_LPRCSForward` 58
  - linear RCS: accelerate forward 10% (+z)*
- `#define OAPI_LKEY_LPRCSBack` 59
  - linear RCS: accelerate backward 10% (-z)*
- `#define OAPI_LKEY_NMHoldAltitude` 60
  - toggle navmode: hold altitude*
- `#define OAPI_LKEY_NMHLevel` 61
  - toggle navmode: level with horizon*
- `#define OAPI_LKEY_NMPrograde` 62
  - toggle navmode: prograde*
- `#define OAPI_LKEY_NMRetrograde` 63
  - toggle navmode: retrograde*
- `#define OAPI_LKEY_NMNormal` 64
  - toggle navmode: normal to orbital plane*
- `#define OAPI_LKEY_NMAntinormal` 65
  - toggle navmode: antinormal to orbital plane*
- `#define OAPI_LKEY_NMKillrot` 66
  - toggle navmode: kill rotation*
- `#define OAPI_LKEY_Undock` 67
  - undock from docked vessel*
- `#define OAPI_LKEY_IncElevatorTrim` 68
  - increment elevator trim setting*
- `#define OAPI_LKEY_DecElevatorTrim` 69
  - decrement elevator trim setting*
- `#define OAPI_LKEY_WheelbrakeLeft` 70
  - apply wheelbrake left*
- `#define OAPI_LKEY_WheelbrakeRight` 71
  - apply wheelbrake right*
- `#define OAPI_LKEY_HUD` 72
  - toggle HUD on/off*
- `#define OAPI_LKEY_HUDMode` 73
  - switch through HUD modes*
- `#define OAPI_LKEY_HUDReference` 74

- query reference object for HUD display*
  - `#define OAPI_LKEY_HUDTarget 75`  
        *query target object for HUD display*
  - `#define OAPI_LKEY_HUDColour 76`  
        *switch through HUD colours*
  - `#define OAPI_LKEY_IncSimSpeed 77`  
        *increase simulation speed x10*
  - `#define OAPI_LKEY_DecSimSpeed 78`  
        *decrease simulation speed x0.1*
  - `#define OAPI_LKEY_IncFOV 79`  
        *increment field of view*
  - `#define OAPI_LKEY_DecFOV 80`  
        *decrement field of view*
  - `#define OAPI_LKEY_StepIncFOV 81`  
        *increment field of view by 10 deg*
  - `#define OAPI_LKEY_StepDecFOV 82`  
        *decrement field of view by 10 deg*
  - `#define OAPI_LKEY_MainMenu 83`  
        *open main menu*
  - `#define OAPI_LKEY_DlgHelp 84`  
        *open help dialog*
  - `#define OAPI_LKEY_DlgCamera 85`  
        *open camera dialog*
  - `#define OAPI_LKEY_DlgSimspeed 86`  
        *open simulation speed dialog*
  - `#define OAPI_LKEY_DlgCustomCmd 87`  
        *open custom command dialog*
  - `#define OAPI_LKEY_DlgVisHelper 88`  
        *open visual helper dialog*
  - `#define OAPI_LKEY_DlgRecorder 89`  
        *open flight recorder dialog*
  - `#define OAPI_LKEY_DlgInfo 90`  
        *open object info dialog*
  - `#define OAPI_LKEY_DlgMap 91`  
        *open map dialog*
  - `#define OAPI_LKEY_ToggleCamInternal 92`  
        *switch between cockpit and external camera*
  - `#define OAPI_LKEY_ToggleTrackMode 93`  
        *switch between track camera modes*
  - `#define OAPI_LKEY_TogglePanelMode 94`  
        *switch between cockpit modes*
  - `#define OAPI_LKEY_TogglePlanetarium 95`  
        *toggle celestial marker display on/off*
  - `#define OAPI_LKEY_ToggleRecPlay 96`  
        *toggle flight recorder/playback on/off*
  - `#define OAPI_LKEY_Pause 97`  
        *toggle simulation pause on/off*
  - `#define OAPI_LKEY_Quicksave 98`  
        *quick-save current simulation state*
  - `#define OAPI_LKEY_Quit 99`  
        *quit simulation session*

- #define **OAPI\_LKEY\_DlgSelectVessel** 100  
*open vessel selection dialog*
- #define **OAPI\_LKEY\_SelectPrevVessel** 101  
*switch focus to previous vessel*
- #define **OAPI\_LKEY\_DlgCapture** 102  
*open screen capture dialog*
- #define **LKEY\_COUNT** 103  
*number of logical key definitions*

#### 16.68.1 Detailed Description

## 16.69 Top-level module callback functions

### Modules

- [General module callback functions](#)
- [Vessel module callback functions](#)
- [Plugin module callback functions](#)

#### 16.69.1 Detailed Description

This section contains a list of global nonmember callback functions that can be defined by an addon module. Orbiter will call these functions when specific events occur, e.g. a module is activated or deactivated, a simulation session is opened or closed, etc.

## 16.70 General module callback functions

### Functions

- DLLCLBK void [InitModule](#) (HINSTANCE hModule)  
*Module initialisation callback function.*
- DLLCLBK void [ExitModule](#) (HINSTANCE hModule)  
*Module exit notification callback function.*

#### 16.70.1 Detailed Description

Module initialisation and exit notifications. The two callback functions in this group are called by Orbiter when the module is loaded or unloaded, respectively. It is used for all module types (plugin and vessel modules).

#### 16.70.2 Function Documentation

##### 16.70.2.1 DLLCLBK void [ExitModule](#) ( HINSTANCE hModule )

Module exit notification callback function.

#### Parameters

<i>hModule</i>	module handle
----------------	---------------

#### Note

This function is called by Orbiter when a module is deactivated.

For plugin modules, `ExitModule` is called at program shutdown for all active modules, or whenever a user deactivates a module in the *Modules* tab of the Orbiter launchpad.

For vessel modules, `ExitModule` is called when a simulation session is closed for any vessel types active at that time, or during a session when the last vessel of this type is destroyed.

##### 16.70.2.2 DLLCLBK void [InitModule](#) ( HINSTANCE hModule )

Module initialisation callback function.

#### Parameters

<i>hModule</i>	module handle
----------------	---------------

#### Note

This function is called by Orbiter when a module becomes active.

For plugin modules, `InitModule` is called at program start for all modules in the *active module list* of `orbiter.def`, or whenever a user activates a module in the *Modules* tab of the Orbiter launchpad.

For vessel modules, `InitModule` is called whenever the first vessel of the corresponding type is created (usually at the start of a simulation session, or during a simulation if the first vessel instance is created dynamically).

`hModule` is the module handle that identifies the addon DLL being initialised. It can be stored and used later, e.g. for loading resources from the module. To get the handle of the Orbiter core module, use [oapiGetOrbiterInstance](#).

## 16.71 Vessel module callback functions

### Functions

- DLLCLBK `VESSEL * ovcInit (OBJHANDLE hvessel, int flightmodel)`  
*Vessel instance creation notification.*
- DLLCLBK `void ovcExit (VESSEL *vessel)`  
*Vessel deletion notification.*

### 16.71.1 Detailed Description

This section contains a list of nonmember callback functions for vessel modules. Apart from the general module initialisation and exit functions in [Top-level module callback functions](#), the only vessel-specific top-level callback functions are notifications for vessel creation and deletion. During the vessel creation callback, the module should create an instance of a class derived from `VESSEL2` or `VESSEL3`, and delete the instance during the vessel deletion callback. All other events should be handled by overloading the appropriate `VESSEL2` and `VESSEL3` member callback functions.

### 16.71.2 Function Documentation

#### 16.71.2.1 DLLCLBK void ovcExit ( `VESSEL * vessel` )

Vessel deletion notification.

##### Parameters

<code>vessel</code>	pointer to vessel instance
---------------------	----------------------------

##### Note

This function is called by Orbiter whenever a vessel of the type defined by the module is about to be destroyed at the end or during a simulation session.

The pointer passed to the function is the same as the one returned by `ovcInit` for the corresponding vessel. Typically, the implementation of this function should cast the pointer to a pointer to the derived vessel class, and delete the object.

##### Examples:

[VESSEL2.cpp](#).

#### 16.71.2.2 DLLCLBK `VESSEL* ovcInit ( OBJHANDLE hvessel, int flightmodel )`

Vessel instance creation notification.

##### Parameters

<code>hessel</code>	vessel handle
<code>flightmodel</code>	flight model selection identifier

##### Returns

The function should return a pointer to the derived `VESSEL` instance it created.

**Note**

This function is called by Orbiter whenever a vessel of the type defined by the module is created at the beginning or during a simulation session.

The implementation should create an instance of a vessel class derived from [VESSEL](#), [VESSEL2](#) or [VESSEL3](#) and return a pointer to it.

`hvessel` is a handle that identifies the vessel instance in Orbiter.

`flightmodel` identifies the realism level of the requested flight model. This value may be 0 (simple) or 1 (complex). Vessel implementation that support different flight models for easy/realistic setups can use this value to define the appropriate model.

**Examples:**

[VESSEL2.cpp](#).

## 16.72 Plugin module callback functions

### Functions

- DLLCLBK void [opcOpenRenderViewport](#) (HWND hRenderWindow, DWORD width, DWORD height, BOOL fullscreen)  
*Called by Orbiter when a graphics-enabled simulation session is started.*
- DLLCLBK void [opcCloseRenderViewport](#) ()  
*Called by Orbiter when a graphics-enabled simulation session is closed.*
- DLLCLBK void [opcPreStep](#) (double simt, double simdt, double mjd)  
*Time step notification before state update.*
- DLLCLBK void [opcPostStep](#) (double simt, double simdt, double mjd)  
*Time step notification after state update.*
- DLLCLBK void [opcFocusChanged](#) (OBJHANDLE hGainsFocus, OBJHANDLE hLosesFocus)  
*Change of input focus notification.*
- DLLCLBK void [opcTimeAccChanged](#) (double new\_warp, double old\_warp)  
*Change of time acceleration notification.*
- DLLCLBK void [opcPause](#) (bool pause)  
*Simulation pause/resume notification.*
- DLLCLBK void [opcDeleteVessel](#) (OBJHANDLE hVessel)  
*Vessel destruction notification.*

### 16.72.1 Detailed Description

The callback functions in this group are specific for *plugin* modules, i.e. modules that can be activated or deactivated in the Modules tab of the Orbiter Launchpad. They can not be used in vessel modules.

Note that most of the top-level plugin callback functions (opcXXX) are now obsolete and should no longer be used. Addon modules should instead create an instance of a class derived from the [oapi::Module](#) class during [InitModule](#), and overload the appropriate class-level callback functions.

### 16.72.2 Function Documentation

#### 16.72.2.1 DLLCLBK void [opcCloseRenderViewport](#) ( )

Called by Orbiter when a graphics-enabled simulation session is closed.

**Deprecated** This function has been replaced by [oapi::Module::clbkSimulationEnd](#).

##### Note

Plugins should no longer implement this function. Instead they should create an instance of a class derived from [oapi::Module](#) during [InitModule](#) that overloads the [oapi::Module::clbkSimulationEnd](#) method, and register it with [oapiRegisterModule](#).

[opcCloseRenderViewport](#) is called by Orbiter only if no instance of [oapi::Module](#) is created and registered during [InitModule](#), or if a registered module does not overload the [oapi::Module::clbkSimulationEnd](#) method.

#### 16.72.2.2 DLLCLBK void [opcDeleteVessel](#) ( OBJHANDLE hVessel )

Vessel destruction notification.

Sent to modules immediately before a vessel is destroyed. After this callback method returns, the object handle (hVessel) and will no longer be valid. Modules should make sure that they don't access the vessel in any form after this point.

**Deprecated** This function has been replaced by [oapi::Module::clbkDeleteVessel](#).

## Parameters

<i>hVessel</i>	object handle for the vessel being destroyed.
----------------	---

## Note

Plugins should no longer implement this function. Instead they should create an instance of a class derived from [oapi::Module](#) during [InitModule](#) that overloads the [oapi::Module::clbkDeleteVessel](#) method, and register it with [oapiRegisterModule](#). [opcDeleteVessel](#) is called by Orbiter only if no instance of [oapi::Module](#) is created and registered during [InitModule](#), or if a registered module does not overload the [oapi::Module::clbkDeleteVessel](#) method.

16.72.2.3 DLLCLBK void [opcFocusChanged](#) ( [OBJHANDLE](#) *hGainsFocus*, [OBJHANDLE](#) *hLosesFocus* )

Change of input focus notification.

Called when input focus (keyboard and joystick control) is switched to a new vessel (for example as a result of a call to [oapiSetFocus](#)).

**Deprecated** This function has been replaced by [oapi::Module::clbkFocusChanged](#).

## Parameters

<i>hGainsFocus</i>	handle of vessel receiving the input focus
<i>hLosesFocus</i>	handle of vessel losing focus

## Note

Plugins should no longer implement this function. Instead they should create an instance of a class derived from [oapi::Module](#) during [InitModule](#) that overloads the [oapi::Module::clbkFocusChanged](#) method, and register it with [oapiRegisterModule](#). [opcFocusChanged](#) is called by Orbiter only if no instance of [oapi::Module](#) is created and registered during [InitModule](#), or if a registered module does not overload the [oapi::Module::clbkFocusChanged](#) method.

16.72.2.4 DLLCLBK void [opcOpenRenderViewport](#) ( [HWND](#) *hRenderWindow*, [DWORD](#) *width*, [DWORD](#) *height*, [BOOL](#) *fullscreen* )

Called by Orbiter when a graphics-enabled simulation session is started.

**Deprecated** This function has been replaced by [oapi::Module::clbkSimulationStart](#).

## Parameters

<i>hRenderWindow</i>	render window handle
<i>width</i>	viewport width [pixel]
<i>height</i>	viewport height [pixel]
<i>fullscreen</i>	flag for fullscreen mode

## Note

Plugins should no longer implement this function. Instead they should create an instance of a class derived from [oapi::Module](#) during [InitModule](#) that overloads the [oapi::Module::clbkSimulationStart](#) method, and register it with [oapiRegisterModule](#). [opcOpenRenderViewport](#) is called by Orbiter only if no instance of [oapi::Module](#) is created and registered during [InitModule](#), or if a registered module does not overload the [oapi::Module::clbkSimulationStart](#) method.

16.72.2.5 DLLCLBK void [opcPause](#) ( [bool](#) *pause* )

Simulation pause/resume notification.

Called when the pause/resume state of the simulation has changed.

**Deprecated** This function has been replaced by [oapi::Module::clbkPause](#).

## Parameters

<i>pause</i>	pause/resume state: true if simulation has been paused, false if simulation has been resumed.
--------------	---

## Note

Plugins should no longer implement this function. Instead they should create an instance of a class derived from [oapi::Module](#) during [InitModule](#) that overloads the [oapi::Module::clbkPause](#) method, and register it with [oapiRegisterModule](#).

`opcPause` is called by Orbiter only if no instance of [oapi::Module](#) is created and registered during [InitModule](#), or if a registered module does not overload the [oapi::Module::clbkPause](#) method.

16.72.2.6 DLLCLBK void `opcPostStep` ( `double simt, double simdt, double mjd` )

Time step notification after state update.

Called at each time step of the simulation, after the state has been updated to the current simulation time.

**Deprecated** This function has been replaced by [oapi::Module::clbkPostStep](#).

## Parameters

<i>simt</i>	current simulation time [s]
<i>simdt</i>	length of the last time step [s]
<i>mjd</i>	simulation time in Modified Julian Date format [days]

## Note

Plugins should no longer implement this function. Instead they should create an instance of a class derived from [oapi::Module](#) during [InitModule](#) that overloads the [oapi::Module::clbkPostStep](#) method, and register it with [oapiRegisterModule](#).

`opcPostStep` is called by Orbiter only if no instance of [oapi::Module](#) is created and registered during [InitModule](#), or if a registered module does not overload the [oapi::Module::clbkPostStep](#) method.

16.72.2.7 DLLCLBK void `opcPreStep` ( `double simt, double simdt, double mjd` )

Time step notification before state update.

Called at each time step of the simulation, before the state is updated to the current simulation time. This function is only called when the "physical" state of the simulation is propagated in time. `opcPreStep` is not called while the simulation is paused, even if the user moves the camera.

**Deprecated** This function has been replaced by [oapi::Module::clbkPreStep](#).

## Parameters

<i>simt</i>	simulation time after the currently processed step [s]
<i>simdt</i>	length of the currently processed step [s]
<i>mjd</i>	simulation time after the currently processed step in Modified Julian Date format [days]

## Note

Plugins should no longer implement this function. Instead they should create an instance of a class derived from [oapi::Module](#) during [InitModule](#) that overloads the [oapi::Module::clbkPreStep](#) method, and register it with [oapiRegisterModule](#).

`opcPreStep` is called by Orbiter only if no instance of [oapi::Module](#) is created and registered during [InitModule](#), or if a registered module does not overload the [oapi::Module::clbkPreStep](#) method.

16.72.2.8 DLLCLBK void opcTimeAccChanged ( double *new\_warp*, double *old\_warp* )

Change of time acceleration notification.

Called when the simulation time acceleration factor changes.

**Deprecated** This function has been replaced by [oapi::Module::clbkTimeAccChanged](#).

**Parameters**

<i>new_warp</i>	new time acceleration factor
<i>old_warp</i>	old time acceleration factor

**Note**

Plugins should no longer implement this function. Instead they should create an instance of a class derived from [oapi::Module](#) during [InitModule](#) that overloads the [oapi::Module::clbkTimeAccChanged](#) method, and register it with [oapiRegisterModule](#).

`opcTimeAccChanged` is called by Orbiter only if no instance of [oapi::Module](#) is created and registered during [InitModule](#), or if a registered module does not overload the [oapi::Module::clbkTimeAccChanged](#) method.

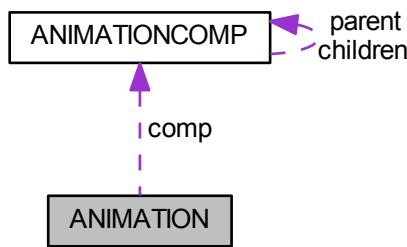
## 17 Class Documentation

### 17.1 ANIMATION Struct Reference

Animation definition.

```
#include <OrbiterAPI.h>
```

Collaboration diagram for ANIMATION:



#### Public Attributes

- double **defstate**  
*default animation state in the mesh*
- double **state**  
*current state*
- **UINT ncomp**  
*number of components*
- **ANIMATIONCOMP \*\* comp**  
*list of components*

#### 17.1.1 Detailed Description

Animation definition.

Defines a complete animation, including a list of components, the current animation state, and the default state (as represented by the original mesh).

The documentation for this struct was generated from the following file:

- Orbitersdk/include/OrbiterAPI.h

### 17.2 ANIMATIONCOMP Struct Reference

Animation component definition.

```
#include <OrbiterAPI.h>
```

Collaboration diagram for ANIMATIONCOMP:



#### Public Attributes

- double **state0**  
*first end state*
- double **state1**  
*second end state*
- MGROUP\_TRANSFORM \* **trans**  
*transformation*
- ANIMATIONCOMP \* **parent**  
*parent transformation*
- ANIMATIONCOMP \*\* **children**  
*list of children*
- UINT **nchildren**  
*number of children*

#### 17.2.1 Detailed Description

Animation component definition.

Defines one component of an animation, including the mesh transformation, the relative start and end points within the entire animation, and any parent and child relationships with other animations.

#### See also

[VESSEL::AddAnimationComponent](#)

The documentation for this struct was generated from the following file:

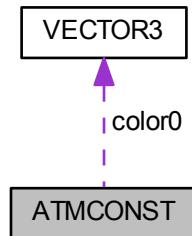
- Orbitersdk/include/OrbiterAPI.h

## 17.3 ATMCONST Struct Reference

Planetary atmospheric constants structure.

```
#include <OrbiterAPI.h>
```

Collaboration diagram for ATMCONST:



#### Public Attributes

- double **p0**  
*pressure at mean radius ('sea level') [Pa]*
- double **rho0**  
*density at mean radius*
- double **R**  
*specific gas constant [J/(K kg)]*
- double **gamma**  
*ratio of specific heats,  $c_p/c_v$*
- double **C**  
*exponent for pressure equation (temporary)*
- double **O2pp**  
*partial pressure of oxygen*
- double **altdlimit**  
*atmosphere altitude limit [m]*
- double **radlimit**  
*radius limit (altdlimit + mean radius)*
- double **horizontalt**  
*horizon rendering altitude*
- VECTOR3 **color0**  
*sky colour at sea level during daytime*

#### 17.3.1 Detailed Description

Planetary atmospheric constants structure.

The documentation for this struct was generated from the following file:

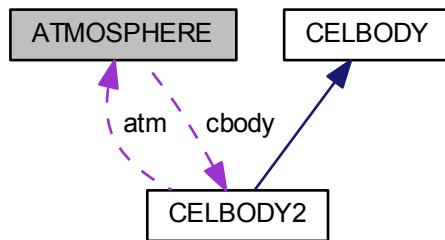
- Orbitersdk/include/OrbiterAPI.h

## 17.4 ATMOSPHERE Class Reference

Defines the physical atmospheric properties for a celestial body.

```
#include <CelBodyAPI.h>
```

Collaboration diagram for ATMOSPHERE:



### Classes

- struct [PRM\\_IN](#)  
*Input parameters for atmospheric data calculation.*
- struct [PRM\\_OUT](#)  
*Output parameters for atmospheric data calculation.*

### Public Types

- enum [PRM\\_IN\\_FLAG](#) {  
[PRM\\_ALT](#) =0x0001, [PRM\\_LNG](#) =0x0002, [PRM\\_LAT](#) =0x0004, [PRM\\_FBR](#) =0x0008,  
[PRM\\_F](#) =0x0010, [PRM\\_AP](#) =0x0020 }  
*Parameter flags for atmospheric data input.*

### Public Member Functions

- [ATMOSPHERE \(CELBODY2 \\*body\)](#)  
*Constructor. Creates an atmosphere instance for 'body'.*
- virtual const char \* [clbkName \(\) const](#) =0  
*A brief name that identifies the atmosphere model.*
- virtual bool [clbkConstants \(ATMCONST \\*atmc\) const](#)  
*Returns some general properties of the atmosphere.*
- virtual bool [clbkParams \(const PRM\\_IN \\*prm\\_in, PRM\\_OUT \\*prm\\_out\)](#)  
*Called by Orbiter to obtain atmospheric parameters for a given set of input parameters at the current simulation time.*

### Protected Attributes

- [CELBODY2 \\* cbody](#)  
*associated celestial body instance*

#### 17.4.1 Detailed Description

Defines the physical atmospheric properties for a celestial body.

See also

[CELBODY2](#)

#### 17.4.2 Member Enumeration Documentation

##### 17.4.2.1 enum ATMOSPHERE::PRM\_IN\_FLAG

Parameter flags for atmospheric data input.

See also

[ATMPRM\\_IN](#)

Enumerator

- PRM\_ALT** altitude valid (otherwise use alt=0)
- PRM\_LNG** longitude valid (otherwise use lng=0)
- PRM\_LAT** latitude valid (otherwise use lat=0)
- PRM\_FBR** average flux valid (otherwise use f107avg=140)
- PRM\_F** current flux valid (otherwise use f107=f107avg)
- PRM\_AP** geomagnetic index valid (otherwise use ap=3)

#### 17.4.3 Constructor & Destructor Documentation

##### 17.4.3.1 ATMOSPHERE::ATMOSPHERE ( **CELBODY2** \* *body* )

Constructor. Creates an atmosphere instance for 'body'.

Parameters

<i>body</i>	pointer to celestial body
-------------	---------------------------

#### 17.4.4 Member Function Documentation

##### 17.4.4.1 virtual bool ATMOSPHERE::clbkConstants ( **ATMCONST** \* *atmc* ) const [virtual]

Returns some general properties of the atmosphere.

Parameters

<i>atmc</i>	pointer to structure to be filled by clbkConstants
-------------	--

Returns

*true* if parameters were supplied, *false* otherwise.

Default action:

Sets the following structure entries to default values:

- *atmc->R* = 286.91
- *atmc->gamma* = 1.4 but leaves the other values unchanged. Returns *false*.

**Note**

This function should be overloaded to provide appropriate basic physical atmospheric properties, such as sea level density and pressure, gas constant, cutoff altitude, as well as rendering colour and rendering altitude.

For complex atmospheric models, some of the parameters in the [ATMCONST](#) structure may not be constants (e.g. ground density and pressure. In that case, the return values should be reasonable mean values.

Some of these values may be overwritten by configuration file settings.

#### 17.4.4.2 virtual const char\* ATMOSPHERE::clbkName ( ) const [pure virtual]

A brief name that identifies the atmosphere model.

**Returns**

Pointer to persistent string buffer that contains the model name.

**Note**

The returned name should not be longer than approx. 10 characters.

#### 17.4.4.3 virtual bool ATMOSPHERE::clbkParams ( const PRM\_IN \* prm\_in, PRM\_OUT \* prm\_out ) [virtual]

Called by Orbiter to obtain atmospheric parameters for a given set of input parameters at the current simulation time.

**Parameters**

<i>prm_in</i>	input parameters for atmospheric data calculation (see <a href="#">PRM_IN</a> )
<i>prm_out</i>	returned data (see <a href="#">PRM_OUT</a> )

**Returns**

*true* if atmospheric data were calculated and returned, *false* if the planet has no atmosphere or if the specified position is outside the supported distance of the atmospheric model.

**Default action:**

None, returns *false*.

The documentation for this class was generated from the following file:

- OrbiterSDK/include/[CeIBodyAPI.h](#)

## 17.5 ATMPARAM Struct Reference

Atmospheric parameters structure.

```
#include <OrbiterAPI.h>
```

**Public Attributes**

- double **T**  
*temperature [K]*
- double **p**  
*pressure [Pa]*
- double **rho**  
*density [kg/m<sup>3</sup>]*

### 17.5.1 Detailed Description

Atmospheric parameters structure.

The documentation for this struct was generated from the following file:

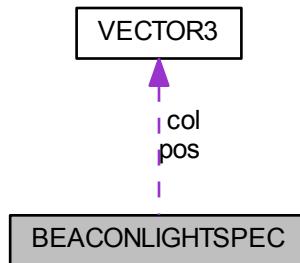
- Orbitersdk/include/OrbiterAPI.h

## 17.6 BEACONLIGHTSPEC Struct Reference

vessel beacon light parameters

```
#include <OrbiterAPI.h>
```

Collaboration diagram for BEACONLIGHTSPEC:



### Public Attributes

- **DWORD shape**  
*beacon shape identifier (see [Light beacon shape parameters](#))*
- **VECTOR3 \* pos**  
*pointer to position in vessel coordinates*
- **VECTOR3 \* col**  
*pointer to beacon RGB colour*
- **double size**  
*beacon radius*
- **double falloff**  
*distance falloff parameter*
- **double period**  
*strobe period (0 for continuous)*
- **double duration**  
*strobe duration*
- **double tofs**  
*strobe time offset*
- **bool active**  
*beacon lit?*

### 17.6.1 Detailed Description

vessel beacon light parameters

The documentation for this struct was generated from the following file:

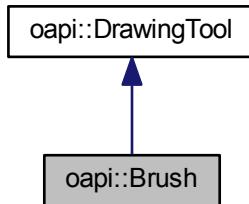
- Orbitersdk/include/OrbiterAPI.h

## 17.7 oapi::Brush Class Reference

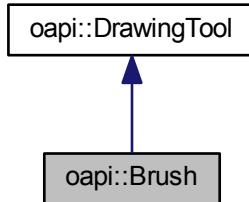
A brush is a drawing resource for filling closed figures (rectangles, ellipses, polygons).

```
#include <DrawAPI.h>
```

Inheritance diagram for oapi::Brush:



Collaboration diagram for oapi::Brush:



### Public Member Functions

- virtual [~Brush \(\)](#)  
*Brush destructor.*

### Protected Member Functions

- [Brush \(DWORD col\)](#)  
*Brush constructor.*

### 17.7.1 Detailed Description

A brush is a drawing resource for filling closed figures (rectangles, ellipses, polygons).

### 17.7.2 Constructor & Destructor Documentation

#### 17.7.2.1 `oapi::Brush::Brush ( DWORD col )` [inline], [protected]

`Brush` constructor.

##### Parameters

<code>col</code>	brush colour (format: 0xBBGGRR)
------------------	---------------------------------

The documentation for this class was generated from the following file:

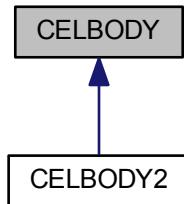
- Orbitersdk/include/DrawAPI.h

## 17.8 CELBODY Class Reference

This is the base class for celestial body classes.

```
#include <CelBodyAPI.h>
```

Inheritance diagram for CELBODY:



### Public Member Functions

- int `Version () const`  
*Return version number.*
- virtual bool `bEphemeris () const`  
*Returns true or false depending on whether the module supports ephemeris calculation.*
- virtual void `clbkInit (FILEHANDLE cfg)`  
*Called when the planet is initialised at the beginning of a simulation run.*
- virtual int `clbkEphemeris (double mjd, int req, double *ret)`  
*Called when Orbiter requires (non-sequential) ephemeris data from the planet for a given time.*
- virtual int `clbkFastEphemeris (double simt, int req, double *ret)`  
*Called by Orbiter to update the body's state to the next simulation frame.*
- virtual bool `clbkAtmParam (double alt, ATMPARAM *prm)`  
*Called by Orbiter to obtain atmospheric parameters at a given altitude.*

**Protected Member Functions**

- void [Pol2Crt](#) (double \*pol, double \*crt)  
*Convert from polar to cartesian coordinates.*

**Protected Attributes**

- short [version](#)  
*version number*

**17.8.1 Detailed Description**

This is the base class for celestial body classes.

[CELBODY](#) defines callback methods which Orbiter will call whenever it requires information from your planet module. You define the behaviour of the planet by overloading the relevant methods. Below is a list of public [CELBODY](#) methods:

**See also**

[Planet Modules](#)

**17.8.2 Member Function Documentation****17.8.2.1 virtual bool CELBODY::bEphemeris ( ) const [virtual]**

Returns *true* or *false* depending on whether the module supports ephemeris calculation.

**Returns**

If your module supports ephemeris calculation (that is, if it defines the `clbkEphemeris` and `clbkFastEphemeris` methods) return *true*. Otherwise return *false*.

**Default action:**

Returns *false*.

**17.8.2.2 virtual bool CELBODY::clbkAtmParam ( double alt, ATMPARAM \* prm ) [virtual]**

Called by Orbiter to obtain atmospheric parameters at a given altitude.

**Parameters**

<i>alt</i>	altitude over planet mean radius
<i>prm</i>	pointer to <a href="#">ATMPARAM</a> structure receiving results

**Returns**

*true* if parameters have been retrieved successfully, *false* to indicate that the planet has no atmosphere, or if *alt* is above the cutoff limit for atmospheric calculations.

**Default action**

None, returning *false*.

**Note**

The `ATMPARAM` structure contains the following fields:

```
typedef struct {
    double T;           // temperature [K]
    double p;           // pressure [Pa]
    double rho;         // density [kg/m3]
} ATMPARAM;
```

Currently, atmospheric parameters are assumed to be functions of altitude only. Local variations ("weather") are not yet supported.

### 17.8.2.3 virtual int CELBODY::clbkEphemeris ( double *mjd*, int *req*, double \* *ret* ) [virtual]

Called when Orbiter requires (non-sequential) ephemeris data from the planet for a given time.

**Parameters**

<i>mjd</i>	ephemeris date (days, in Modified Julian Date format)
<i>req</i>	data request bitflags (see notes)
<i>ret</i>	pointer to result vector

**Returns**

bitflags describing returned data (see notes)

**Default action:**

None, returning 0

**Note**

The ephemeris data should be calculated with respect to the body's parent body, in the ecliptic frame (J2000 equator and equinox).

*req* specifies the data that should be calculated by the callback function. This can be any combination of

- `EPHEM_TRUEPOS` (true body position)
- `EPHEM_TRUEVEL` (true body velocity)
- `EPHEM_BARYPOS` (barycentric position)
- `EPHEM_BARYVEL` (barycentric velocity)

where the barycentre refers to the system consisting of the body itself and all its children (e.g. moons).

*ret* is a pointer to an array of 12 doubles, to which the function should write its results:

- *ret[0-2]*: true position (if requested)
- *ret[3-5]*: true velocity (if requested)
- *ret[6-8]*: barycentric position (if requested)
- *ret[9-11]*: barycentric velocity (if requested)

Data can be returned in either polar or cartesian format. In cartesian format, the position data blocks should contain x,y and z position (in meters), and the velocity data blocks should contain dx/dt, dy/dt and dz/dt (in m/s), where x points to the vernal equinox, y points to ecliptic zenith, and z is orthogonal to both.

In polar format, the position data blocks should contain longitude *j* [rad], latitude *q* [rad] and radial distance *r* [AU], and the velocity data blocks should contain dj/dt [rad/s], dq/dt [rad/s] and d *r*/dt [AU/s]. When returning data in polar format, include the `EPHEM_POLAR` flag in the return value.

The return value should contain the flags for the data that were actually computed. For example, if both true and barycentric data were requested, but the module can only compute true positions, it should return `EPHEM_TRUEPOS | EPHEM_TRUEVEL`.

If the true and barycentric positions are identical (that is, if the body has no child objects) the return value should contain the additional flag `EPHEM_BARYISTRUE`.

If both true and barycentric data are requested, but are computationally expensive to compute (for example, if they require two separate series evaluations), the module can return true positions only. Orbiter will then calculate the barycentric data directly, after evaluating the child object positions.

If a request can't be satisfied at all (e.g. if barycentric data were requested, but the module can only compute true positions), the module should calculate whatever data it can, and signal so via the return value. Orbiter will then try to convert these data to the required ones.

If the returned ephemerides are computed in terms of the barycentre of the parent body's system, the return value should include the `EPHEM_PARENTBARY` flag. If the ephemerides are computed in terms of the parent body's true position, this flag should not be included.

This function is not called by Orbiter to update the planet's position during the normal simulation frame update. (For that purpose, `clbkFastEphemeris()` is called instead). `clbkEphemeris()` is only called if the planet state at some arbitrary time point is required, e.g. by an instrument calculating a transfer orbit.

#### 17.8.2.4 virtual int CELBODY::clbkFastEphemeris ( double *simt*, int *req*, double \* *ret* ) [virtual]

Called by Orbiter to update the body's state to the next simulation frame.

##### Parameters

<i>simt</i>	simulation time (seconds)
<i>req</i>	data request bitflags (see notes)
<i>ret</i>	pointer to result vector

##### Returns

bitflags describing returned data (see notes)

##### Default action:

None, returning 0

##### Note

This function should perform the same function as `clbkEphemeris()`, but it will be called at each simulation frame. This means that the sampling times will be incremented in small steps, allowing for a potentially more efficient implementation, e.g. by using an interpolation scheme.

If possible, a full evaluation of a long series of perturbation terms should be avoided here, to avoid performance hits.

Note that the time parameter is passed in the form of simulation time (seconds) unlike `clbkEphemeris()`, which uses absolute MJD time. This avoids rounding errors in the time variable, and allows higher temporal resolutions.

#### 17.8.2.5 virtual void CELBODY::clbkInit ( FILEHANDLE *cfg* ) [virtual]

Called when the planet is initialised at the beginning of a simulation run.

This function allows to read any parameters from the configuration file, and perform additional initialisation tasks such as reading data files.

##### Parameters

<i>cfg</i>	file handle of configuration file
------------	-----------------------------------

##### Default action:

None.

Reimplemented in `CELBODY2`.

### 17.8.2.6 int CELBODY::Version ( ) const [inline]

Return version number.

#### Returns

Version number (1 for [CELBODY](#), 2 for [CELBODY2](#))

The documentation for this class was generated from the following file:

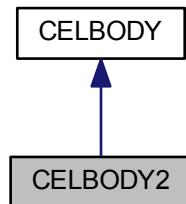
- [Orbitersdk/include/CelBodyAPI.h](#)

## 17.9 CELBODY2 Class Reference

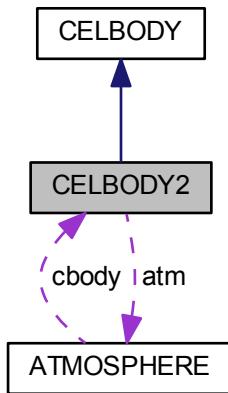
Extension to [CELBODY](#) class.

```
#include <CelBodyAPI.h>
```

Inheritance diagram for CELBODY2:



Collaboration diagram for CELBODY2:



## Public Member Functions

- [CELBODY2 \(OBJHANDLE hCBody\)](#)  
*Constructor. Creates a `CELBODY2` instance for a celestial body.*
- [virtual ~CELBODY2 \(\)](#)  
*Destructor. Destroys the `CELBODY2` instance.*
- [virtual void clbkInit \(FILEHANDLE cfg\)](#)  
*Module initialisation from configuration file settings.*
- [OBJHANDLE GetHandle \(\) const](#)  
*Returns the handle of the associated object.*
- [OBJHANDLE GetParent \(\) const](#)  
*Returns the handle for the parent body in the solar system hierarchy.*
- [OBJHANDLE GetChild \(DWORD idx\) const](#)  
*Returns for a child body in the solar system hierarchy.*
- [double SidRotPeriod \(\) const](#)  
*Returns the siderial period of the celestial body.*
- [ATMOSPHERE \\* GetAtmosphere \(\) const](#)  
*Returns the body's atmosphere instance.*
- [virtual bool LegacyAtmosphereInterface \(\) const](#)  
*Flags the atmosphere interface version.*

## Protected Member Functions

- [void SetAtmosphere \(ATMOSPHERE \\*a\)](#)  
*Assigns an atmosphere object for the celestial body.*
- [bool FreeAtmosphere \(\)](#)  
*Remove the atmosphere instance.*
- [bool LoadAtmosphereModule \(const char \\*fname\)](#)  
*Loads an atmosphere instance from a DLL plugin.*
- [bool FreeAtmosphereModule \(\)](#)  
*Unload the current atmosphere module.*

## Protected Attributes

- [OBJHANDLE hBody](#)  
*handle for the associated celestial body*
- [ATMOSPHERE \\* atm](#)  
*pointer to atmosphere object*
- [HINSTANCE hAtmModule](#)  
*library handle for external atmosphere module*

## Friends

- class **ATMOSPHERE**

### 17.9.1 Detailed Description

Extension to [CELBODY](#) class.

This class introduces extended atmosphere support. It contains an [ATMOSPHERE](#) class instance which handles all atmosphere data requests. The atmosphere class can be either defined directly in the celestial body's plugin module, or it can be loaded from an external module. This latter option allows to replace atmospheric models easily, without having to re-implement other parts of the code, such as the ephemeris calculations.

See also

[CELBODY](#), [ATMOSPHERE](#)

### 17.9.2 Constructor & Destructor Documentation

#### 17.9.2.1 CELBODY2::CELBODY2 ( [OBJHANDLE](#) *hCBody* )

Constructor. Creates a [CELBODY2](#) instance for a celestial body.

Parameters

<i>hCBody</i>	body handle
---------------	-------------

#### 17.9.2.2 virtual CELBODY2::~CELBODY2 ( ) [virtual]

Destructor. Destroys the [CELBODY2](#) instance.

Default action:

Calls the [FreeAtmosphere](#) method, to delete the atmosphere instance and unload any external atmosphere modules.

### 17.9.3 Member Function Documentation

#### 17.9.3.1 virtual void CELBODY2::clbkInit ( [FILEHANDLE](#) *cfg* ) [virtual]

Module initialisation from configuration file settings.

Parameters

<i>cfg</i>	file handle for configuration file
------------	------------------------------------

Default action:

- Calls the base class [CELBODY::clbkInit](#) method
- If an atmosphere module is not already loaded, and if the configuration file contains a [MODULE\\_ATM](#) entry, the [LoadAtmosphereModule](#) method is called with the corresponding module file name.

Reimplemented from [CELBODY](#).

#### 17.9.3.2 bool CELBODY2::FreeAtmosphere ( ) [protected]

Remove the atmosphere instance.

Returns

*true* on success, *false* on failure (no atmosphere defined).

Note

This method calls [FreeAtmosphereModule](#), if an external atmosphere module is loaded. Otherwise, it just deletes the atm instance.

17.9.3.3 **bool CELBODY2::FreeAtmosphereModule( )** [protected]

Unload the current atmosphere module.

**Returns**

*true* indicates success, *false* indicates failure (no module loaded)

**Note**

Before unloading the module, this function first deletes the atmosphere instance by calling the module's DeleteAtmosphere function. The interface is

```
void DeleteAtmosphere (ATMOSPHERE *atm);
```

If this function is not found in the module, the atmosphere instance is deleted directly.

17.9.3.4 **ATMOSPHERE\* CELBODY2::GetAtmosphere( ) const** [inline]

Returns the body's atmosphere instance.

**Returns**

pointer to atmosphere object, or NULL if the body has no atmosphere.

**Note**

To provide an atmosphere for the body, the [CELBODY2](#) object should instantiate the atm member as an object of a derived [ATMOSPHERE](#) class.

17.9.3.5 **OBJHANDLE CELBODY2::GetChild( DWORD idx ) const**

Returns for a child body in the solar system hierarchy.

**Parameters**

<i>idx</i>	child body index ( $\geq 0$ )
------------	-------------------------------

**Returns**

Child body handle, or NULL if not available.

**Note**

For the central star, this returns the handles of the primary planets.

For planets, it returns the handles of the moons.

If *idx*  $\geq$  number of children, the function returns NULL.

17.9.3.6 **OBJHANDLE CELBODY2::GetParent( ) const**

Returns the handle for the parent body in the solar system hierarchy.

**Returns**

Parent body handle, or NULL if no parent.

**Note**

For primary planets, this method returns a handle to the central star. For moons, it returns a handle to the parent planet. For the central star itself, it returns NULL.

### 17.9.3.7 virtual bool CELBODY2::LegacyAtmosphereInterface( ) const [inline], [virtual]

Flags the atmosphere interface version.

#### Returns

*false* indicates that Orbiter should use the [ATMOSPHERE](#) object returned by [GetAtmosphere](#) to query atmospheric parameters. *true* indicates that Orbiter should use the [CELBODY::clbkAtmParam](#) method instead.

#### Note

If the body does not have an atmosphere, this method should return *false*, and [GetAtmosphere](#) should return *NULL*.

#### See also

[GetAtmosphere](#), [CELBODY::clbkAtmParam](#)

### 17.9.3.8 bool CELBODY2::LoadAtmosphereModule( const char \* *fname* ) [protected]

Loads an atmosphere instance from a DLL plugin.

#### Parameters

<i>fname</i>	DLL file name (excluding '.dll' extension and relative to 'Modules' folder)
--------------	---

#### Returns

*true* if atmosphere module could be loaded, *false* otherwise

#### Note

If successful, this method sets the *hAtmModule* member to the atmospheric module instance handle, and sets the *atm* member by calling the *CreateAtmosphere* function in the module. The *CreateAtmosphere* function has the following interface:

```
ATMOSPHERE *CreateAtmosphere (CELBODY2 *cbody);
```

### 17.9.3.9 void CELBODY2::SetAtmosphere( ATMOSPHERE \* *a* ) [protected]

Assigns an atmosphere object for the celestial body.

#### Parameters

<i>a</i>	pointer to <a href="#">ATMOSPHERE</a> object
----------	--

#### Note

Any previously defined atmosphere object is deallocated and replaced.

*a* = *NULL* will eliminate the body's atmosphere.

By default (prior to the first call to *SetAtmosphere*, a celestial body does not have an atmosphere.

Use this function if the atmosphere class is defined directly in the celestial body's module. For example,

```
class MyAtmosphere: public ATMOSPHERE
{
    MyAtmosphere (CELBODY2 *body) : ATMOSPHERE (body)
    {}
    ...
};

class MyCelbody: public CELBODY2
{
    MyCelbody (OBJHANDLE body) : CELBODY2 (body)
    {
        SetAtmosphere (new MyAtmosphere (this));
        ...
    }
    ...
};
```

If the atmosphere class is defined in an external module, use the [LoadAtmosphereModule](#) method instead.

#### 17.9.3.10 double CELBODY2::SidRotPeriod( ) const

Returns the siderial period of the celestial body.

Returns

Siderial rotation period [s]

The documentation for this class was generated from the following file:

- Orbitersdk/include/[CelBodyAPI.h](#)

## 17.10 COLOUR4 Struct Reference

colour definition

```
#include <OrbiterAPI.h>
```

### Public Attributes

- float **r**  
*read colour component [0..1]*
- float **g**  
*green colour component [0..1]*
- float **b**  
*blue colour component [0..1]*
- float **a**  
*alpha (opacity) component (0..1)*

#### 17.10.1 Detailed Description

colour definition

The documentation for this struct was generated from the following file:

- Orbitersdk/include/[OrbiterAPI.h](#)

## 17.11 VESSELSTATUS2::DOCKINFOSPEC Struct Reference

dock info list

```
#include <OrbiterAPI.h>
```

### Public Attributes

- DWORD **idx**  
*docking port index*
- DWORD **ridx**  
*docking port index of docked vessel*
- **OBJHANDLE rvessel**  
*docked vessel*

### 17.11.1 Detailed Description

dock info list

The documentation for this struct was generated from the following file:

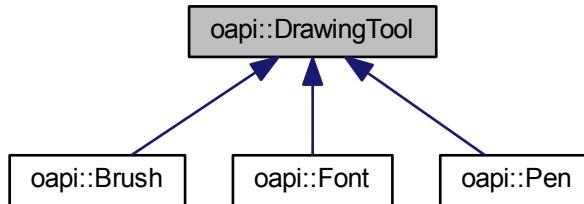
- Orbitersdk/include/OrbiterAPI.h

## 17.12 oapi::DrawingTool Class Reference

Base class for various 2-D drawing resources (fonts, pens, brushes, etc.)

```
#include <DrawAPI.h>
```

Inheritance diagram for oapi::DrawingTool:



### Public Member Functions

- [DrawingTool \(\)](#)  
*Drawing tool constructor.*
- [virtual ~DrawingTool \(\)](#)  
*Drawing tool destructor.*

### 17.12.1 Detailed Description

Base class for various 2-D drawing resources (fonts, pens, brushes, etc.)

The documentation for this class was generated from the following file:

- Orbitersdk/include/DrawAPI.h

## 17.13 ELEMENTS Struct Reference

Kepler orbital elements.

```
#include <OrbiterAPI.h>
```

Inherits orbit.

### Public Attributes

- [double a](#)

- double **e**  
*semi-major axis [m]*
- double **i**  
*eccentricity*
- double **i**  
*inclination [rad]*
- double **theta**  
*longitude of ascending node [rad]*
- double **omegab**  
*longitude of periapsis [rad]*
- double **L**  
*mean longitude at epoch*

### 17.13.1 Detailed Description

Kepler orbital elements.

A set of 6 scalar parameters defining the state of an object in a 2-body (Keplerian) orbit. The orbital trajectory is a conic section, either closed (circular, elliptic), or open (parabolic, hyperbolic).

#### Note

semi-major axis a is positive for closed orbits, and negative for open orbits (in that case, a is referred to as real semi-axis).

eccentricity e:

- circular orbit:  $e = 0$
- elliptic orbit:  $0 < e < 1$
- parabolic orbit:  $e = 1$
- hyperbolic orbit:  $e > 1$

The a and e parameters define the shape of the orbit, the i, theta and omegab parameters define the orientation of the orbital plane in space, and the L parameter defines the object position along the trajectory at a given time.

This is a generic data format. Additional data are required to fully define an object's state in space (position and velocity vectors). These include the position of the orbited body, the orientation of the reference coordinate system, and the date to which the mean longitude parameter refers.

#### See also

[ORBITPARAM](#), [Basics of orbital mechanics](#)

The documentation for this struct was generated from the following file:

- Orbitersdk/include/OrbiterAPI.h

## 17.14 ENGINESTATUS Struct Reference

Engine status.

```
#include <OrbiterAPI.h>
```

## Public Attributes

- double **main**  
 $-1$  (full retro) ..  $+1$  (full main)
- double **hover**  
 $0$  ..  $+1$  (full hover)
- int **attmode**  
 $0=rotation, 1=translation$

### 17.14.1 Detailed Description

Engine status.

The documentation for this struct was generated from the following file:

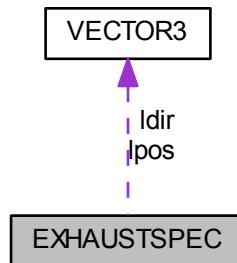
- Orbitersdk/include/OrbiterAPI.h

## 17.15 EXHAUSTSPEC Struct Reference

Engine exhaust render parameters.

```
#include <OrbiterAPI.h>
```

Collaboration diagram for EXHAUSTSPEC:



## Public Attributes

- **THRUSTER\_HANDLE** *th*  
 $handle$  of associated thruster (or `NULL` if none)
- double \* **level**  
pointer to variable containing exhaust level (0..1)
- **VECTOR3 \* lpos**  
pointer to exhaust position vector [m]
- **VECTOR3 \* ldir**  
pointer to engine thrust direction (=negative exhaust direction)
- double **lsize**  
exhaust length [m]
- double **wsize**

- *exhaust width [m]*
- double **lofs**
  - longitudinal offset from engine [m]*
- double **modulate**
  - magnitude of random intensity variations (0..1)*
- **SURFHANDLE tex**
  - custom texture handle*
- **DWORD flags**
  - Bit flags (see [Bitflags for EXHAUSTSPEC flags field.](#))*
- **UINT id**
  - reserved*

#### 17.15.1 Detailed Description

Engine exhaust render parameters.

#### See also

[VESSEL::AddExhaust\(EXHAUSTSPEC\\*\)](#)

The documentation for this struct was generated from the following file:

- [Orbitersdk/include/OrbiterAPI.h](#)

## 17.16 ExternMFD Class Reference

[ExternMFD](#) provides support for defining an [MFD](#) display in a plugin module.

```
#include <MFDAPIS.h>
```

#### Public Member Functions

- **ExternMFD** (const MFDSPEC &spec)
  - Constructor. Creates a new instance of [ExternMFD](#).*
- virtual **~ExternMFD** ()
  - Destructor. Deallocates the [ExternMFD](#) instance.*
- **UINT Id** () const
  - Returns an identifier for the [MFD](#) instance.*
- **bool Active** () const
  - Returns a flag indicating active/passive [MFD](#) state.*
- **OBJHANDLE GetVessel** () const
  - Returns the handle of the vessel associated with the [MFD](#).*
- virtual void **SetVessel** (OBJHANDLE hV)
  - Attaches the [MFD](#) to a different vessel.*
- **SURFHANDLE GetDisplaySurface** () const
  - Returns a handle to the surface containing the current [MFD](#) display.*
- **const char \* GetButtonLabel** (int bt) const
  - Returns the label currently associated with one of the [MFD](#) buttons.*
- **bool ProcessButton** (int bt, int event)
  -
- **bool SendKey** (DWORD key)
  -
- **bool Resize** (const MFDSPEC &spec)
  -
- **bool SetMode** (int mode)
  -

- bool `OpenModeHelp () const`
- virtual void `clbkUpdate ()`
- virtual void `clbkRefreshDisplay (SURFHANDLE hSurf)`
- virtual void `clbkRefreshButtons ()`
- virtual void `clbkFocusChanged (OBJHANDLE hFocus)`

#### Public Attributes

- `Instrument * instr`

#### Protected Attributes

- `OBJHANDLE hVessel`  
*vessel associated with the MFD*
- `int DW`
- `int DH`  
*display width, height (pixel)*
- `int pmode`  
*previous mode identifier*
- `int nbt1`
- `int nbt2`  
*number of left, right buttons*
- `int bty0`
- `int btdy`  
*geometry parameters*
- `int btpressed`  
*currently pressed button (-1 if none)*

#### 17.16.1 Detailed Description

`ExternMFD` provides support for defining an `MFD` display in a plugin module.

`ExternMFD` provides support for defining an `MFD` display in a plugin module, e.g. for displaying the `MFD` in a dialog box. Unlike the `MFD` class described above, which defines a logical `MFD` mode, this class represents an actual `MFD` instrument, i.e. the physical display and associated push buttons.

A plugin module should derive its own `MFD` class from `ExternMFD` and overload the virtual notification callback methods.

The class interface is defined in `Orbitersdk\include\MFD.h`.

For an example using the `ExternMFD` class, see project `Orbitersdk\samples\ExtMFD`.

#### 17.16.2 Constructor & Destructor Documentation

##### 17.16.2.1 `ExternMFD::ExternMFD ( const MFDSPEC & spec )`

Constructor. Creates a new instance of `ExternMFD`.

###### Parameters

<code>spec</code>	structure containing <code>MFD</code> layout geometry data
-------------------	--

###### Note

To use a new `MFD` instance, it must be registered with Orbiter via a call to `oapiRegisterExternMFD()`, e.g. with `oapiRegisterExternMFD(new ExternMFD (spec))`;

To unregister an `MFD` instance, use `oapiUnregisterExternMFD()`. Note that `oapiUnregisterExternMFD()` automatically calls the `~ExternMFD()` destructor, so the plugin should not try to delete the `MFD` instance manually.

## 17.16.2.2 virtual ExternMFD::~ExternMFD( ) [virtual]

Destructor. Deallocates the [ExternMFD](#) instance.

**Note**

The destructor should not be called directly by the module. Instead, a call to `oapiUnregisterExternMFD()` will invoke the [~ExternMFD\(\)](#) destructor (or the overloaded destructor of a derived class), as well as remove the [MFD](#) instance from Orbiter's internal list of MFDs.

## 17.16.3 Member Function Documentation

## 17.16.3.1 bool ExternMFD::Active( ) const

Returns a flag indicating active/passive [MFD](#) state.

**Returns**

`true` indicates that the [MFD](#) is active (switched on), `false` indicates inactive (switched off).

17.16.3.2 virtual void ExternMFD::clbkFocusChanged( [OBJHANDLE](#) *hFocus* ) [virtual]**TODO**

## 17.16.3.3 virtual void ExternMFD::clbkRefreshButtons( ) [virtual]

**TODO**17.16.3.4 virtual void ExternMFD::clbkRefreshDisplay( [SURFHANDLE](#) *hSurf* ) [virtual]**TODO**

## 17.16.3.5 virtual void ExternMFD::clbkUpdate( ) [virtual]

**TODO**17.16.3.6 const char\* ExternMFD::GetButtonLabel( int *bt* ) const

Returns the label currently associated with one of the [MFD](#) buttons.

**Parameters**

<i>bt</i>	button number ( $0 \leq bt < \text{nbuttons}$ )
-----------	---

**Returns**

Pointer to the label associated with the button (up to 3 characters, zeroterminated), or `NULL` if no function is associated with the button by the current [MFD](#) mode.

**Note**

The number of buttons provided by the [MFD](#) depends on the data passed to the constructor in the [MFDSPEC](#) structure.

The module can use this method to update its button labels within the [clbkRefreshButtons\(\)](#) callback function.

17.16.3.7 [SURFHANDLE](#) ExternMFD::GetDisplaySurface( ) const

Returns a handle to the surface containing the current [MFD](#) display.

**Returns**

Handle to the [MFD](#) display surface.

**Note**

The handle can be used to modify or copy the current contents of the [MFD](#) display. For example, you can obtain a GDI drawing device context for the surface with [oapiGetDC\(\)](#).

**17.16.3.8 OBJHANDLE ExternMFD::GetVessel ( ) const**

Returns the handle of the vessel associated with the [MFD](#).

**Returns**

Vessel handle associated with the [MFD](#).

**Note**

Normally, the [ExternMFD](#) class always connects to the "focus vessel", i.e. the vessel receiving user input. If the user switches to a different vessel (e.g. via F3), then [ExternMFD](#) re-attaches itself to the new vessel.

This behaviour can be changed by overloading the [clbkFocusChanged\(\)](#) method. For example, the [MFD](#) could be forced to stick to a given vessel, regardless of the focus object.

**17.16.3.9 UINT ExternMFD::Id ( ) const**

Returns an identifier for the [MFD](#) instance.

**Returns**

A unique identifier for the [MFD](#) instance.

**Note**

Unlike the internal [MFD](#) instances (e.g. MFDs embedded in panels) whose identifiers are in the range 0 ... MAXMFD-1, the [ExternMFD](#) class simply uses its own instance pointer (UINT) to create an identifier.

**17.16.3.10 bool ExternMFD::OpenModeHelp ( ) const****TODO****17.16.3.11 bool ExternMFD::ProcessButton ( int *bt*, int *event* )****TODO****17.16.3.12 bool ExternMFD::Resize ( const MFDSPEC & *spec* )****TODO****17.16.3.13 bool ExternMFD::SendKey ( DWORD *key* )****TODO****17.16.3.14 bool ExternMFD::SetMode ( int *mode* )****TODO****17.16.3.15 virtual void ExternMFD::SetVessel ( OBJHANDLE *hV* ) [virtual]**

Attaches the [MFD](#) to a different vessel.

## Parameters

hV	vessel handle
<b>Default behaviour:</b> Sets the vessel reference to hV. If an <a href="#">MFD</a> mode is active, the mode is closed and reopened with the new vessel reference.	

The documentation for this class was generated from the following file:

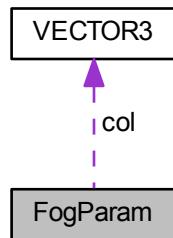
- Orbitersdk/include/[MFD API.h](#)

## 17.17 FogParam Struct Reference

Distance fog render parameters.

```
#include <GraphicsAPI.h>
```

Collaboration diagram for FogParam:



### Public Attributes

- double **dens\_0**  
*fog density at ground level*
- double **dens\_ref**  
*fog density at reference altitude*
- double **alt\_ref**  
*reference altitude [m]*
- **VECTOR3 col**  
*fog colour*

### 17.17.1 Detailed Description

Distance fog render parameters.

The documentation for this struct was generated from the following file:

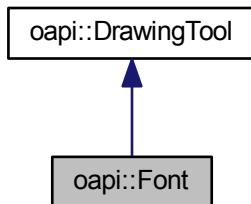
- Orbitersdk/include/GraphicsAPI.h

## 17.18 oapi::Font Class Reference

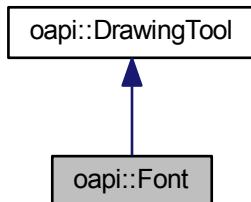
A font resource for drawing text. A font has a defined size, typeface, slant, weight, etc. Fonts can be selected into a [Sketchpad](#) and then apply to all subsequent Text calls.

```
#include <DrawAPI.h>
```

Inheritance diagram for oapi::Font:



Collaboration diagram for oapi::Font:



### Public Types

- enum `Style` { `NORMAL` =0, `BOLD` =1, `ITALIC` =2, `UNDERLINE` =4 }  
*Font decoration style.*

### Public Member Functions

- virtual `~Font()`  
*Font destructor.*
- virtual `HFONT GetGDIFont() const`  
*Return the GDI handle for the font, if available.*

### Protected Member Functions

- `Font` (int height, bool prop, const char \*face, `Style` style=`NORMAL`, int orientation=0)  
*Font constructor.*

## 17.18.1 Detailed Description

A font resource for drawing text. A font has a defined size, typeface, slant, weight, etc. Fonts can be selected into a [Sketchpad](#) and then apply to all subsequent Text calls.

## 17.18.2 Member Enumeration Documentation

## 17.18.2.1 enum oapi::Font::Style

[Font](#) decoration style.

## See also

[Font\(int,bool,char\\*,Style\)](#)

## Enumerator

**NORMAL** no decoration

**BOLD** boldface

**ITALIC** italic

**UNDERLINE** underlined

## 17.18.3 Constructor &amp; Destructor Documentation

17.18.3.1 oapi::Font::Font ( *int height, bool prop, const char \* face, Style style = NORMAL, int orientation = 0* )  
[inline], [protected]

[Font](#) constructor.

## Parameters

<i>height</i>	cell or character height [pixel]
<i>prop</i>	proportional/fixed width flag
<i>face</i>	font face name
<i>style</i>	font decoration
<i>orientation</i>	text orientation [1/10 deg]

## Note

If *height* > 0, it represents the font cell height. If *height* < 0, its absolute value represents the character height. The *style* parameter can be any combination of the [Style](#) enumeration items.

Overloaded font implementations should understand at least the following generic face names: "Fixed" (fixed pitch font), "Sans" (sans-serif font, and "Serif" (serif font) and translate them to appropriate specific fonts, e.g. "Courier" or "Courier New" for "Fixed", "Helvetica" or "Arial" for "Sans", and "Times" or "Times New Roman" for "Serif".

If a font name is not recognised, the *prop* value should be checked. If *prop*=true, the default "Sans" font should be used. If false, the default "Fixed" font should be used.

## 17.18.4 Member Function Documentation

## 17.18.4.1 virtual HFONT oapi::Font::GetGDIFont ( ) const [inline], [virtual]

Return the GDI handle for the font, if available.

## Returns

GDI font handle

**Note**

Non-GDI clients should not overload this method.

The documentation for this class was generated from the following file:

- Orbitersdk/include/DrawAPI.h

## 17.19 VESSELSTATUS2::FUELSPEC Struct Reference

propellant list

```
#include <OrbiterAPI.h>
```

**Public Attributes**

- DWORD `idx`  
*propellant index*
- double `level`  
*propellant level*

### 17.19.1 Detailed Description

propellant list

The documentation for this struct was generated from the following file:

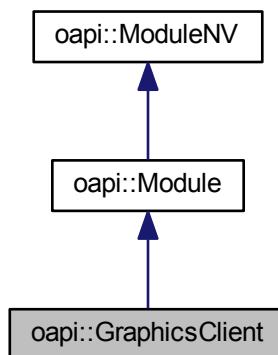
- Orbitersdk/include/OrbiterAPI.h

## 17.20 oapi::GraphicsClient Class Reference

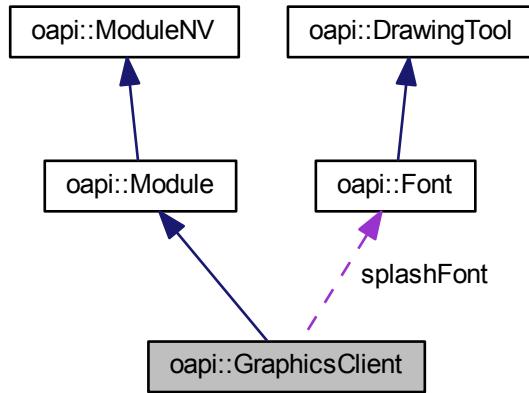
Base class for external graphics client modules.

```
#include <GraphicsAPI.h>
```

Inheritance diagram for oapi::GraphicsClient:



Collaboration diagram for oapi::GraphicsClient:



## Classes

- struct [LABELLIST](#)  
*Label list description for celestial and surface markers.*
- struct [VIDEODATA](#)  
*Structure containing default video options, as stored in Orbiter.cfg.*

## Public Member Functions

- [GraphicsClient](#) (HINSTANCE hInstance)  
*Create a graphics object.*
- virtual [~GraphicsClient](#) ()  
*Destroy the graphics object.*
- virtual bool [clbkInitialise](#) ()  
*Perform any one-time setup tasks.*
- virtual void [clbkRefreshVideoData](#) ()  
*Request for video configuration data.*
- virtual [SURFHANDLE](#) [clbkLoadTexture](#) (const char \*fname, DWORD flags=0)  
*Texture request.*
- virtual [SURFHANDLE](#) [clbkLoadSurface](#) (const char \*fname, DWORD attrib)  
*Load a surface from file into a surface object, and return a SURFHANDLE for it.*
- virtual bool [clbkSaveSurfaceToImage](#) ([SURFHANDLE](#) surf, const char \*fname, ImageFileFormat fmt, float quality=0.7f)  
*Save the contents of a surface to a formatted image file or to the clipboard.*
- virtual void [clbkReleaseTexture](#) ([SURFHANDLE](#) hTex)  
*Texture release request.*
- virtual bool [clbkSetMeshTexture](#) ([DEVMESHHANDLE](#) hMesh, DWORD texidx, [SURFHANDLE](#) tex)  
*Replace a texture in a device-specific mesh.*
- virtual int [clbkSetMeshMaterial](#) ([DEVMESHHANDLE](#) hMesh, DWORD matidx, const [MATERIAL](#) \*mat)  
*Replace properties of an existing mesh material.*

- virtual int `clbkMeshMaterial` (DEVMESHHANDLE hMesh, DWORD matidx, MATERIAL \*mat)  
*Retrieve the properties of one of the mesh materials.*
- virtual bool `clbkSetMeshProperty` (DEVMESHHANDLE hMesh, DWORD property, DWORD value)  
*Set custom properties for a device-specific mesh.*
- virtual `ScreenAnnotation` \* `clbkCreateAnnotation` ()  
*Create an annotation object for displaying on-screen text.*
- HWND `GetRenderWindow` () const  
*Returns the handle of the main render window.*
- virtual LRESULT `RenderWndProc` (HWND hWnd, UINT uMsg, WPARAM wParam, LPARAM lParam)  
*Render window message handler.*
- virtual BOOL `LaunchpadVideoWndProc` (HWND hWnd, UINT uMsg, WPARAM wParam, LPARAM lParam)  
*Message handler for 'video' tab in Orbiter Launchpad dialog.*
- `VIDEODATA` \* `GetVideoData` ()  
*Returns a pointer to the VideoData structure.*
- DWORD `GetPopupList` (const HWND \*\*hPopupWnd) const  
*returns a list of popup windows owned by the render window.*
- virtual bool `clbkFullscreenMode` () const =0  
*Fullscreen mode flag.*
- virtual void `clbkGetViewportSize` (DWORD \*width, DWORD \*height) const =0  
*Returns the dimensions of the render viewport.*
- virtual bool `clbkGetRenderParam` (DWORD prm, DWORD \*value) const =0  
*Returns a specific render parameter.*
- const void \* `GetConfigParam` (DWORD paramtype) const  
*Returns a pointer to an Orbiter configuration parameter.*
- bool `TexturePath` (const char \*fname, char \*path) const  
*Return the full path for a texture file.*
- SURFHANDLE `GetVCHUDSurface` (const VCHUDSPEC \*\*hudspec) const  
*Returns the surface containing the virtual cockpit HUD.*
- SURFHANDLE `GetMFDSurface` (int mfd) const  
*Returns the surface containing an MFD display.*
- SURFHANDLE `GetVCMFDSurface` (int mfd, const VCMFDSPEC \*\*mfdspec) const  
*Returns the surface containing a virtual cockpit MFD display.*
- DWORD `GetBaseTileList` (OBJHANDLE hBase, const SurftileSpec \*\*tile) const  
*Returns a list of high-res surface tile specifications for a base.*
- void `GetBaseStructures` (OBJHANDLE hBase, MESHHANDLE \*\*mesh\_bs, DWORD \*nmesh\_bs, MESHHANDLE \*\*mesh\_as, DWORD \*nmesh\_as) const  
*Returns meshes for generic base objects.*
- void `GetBaseShadowGeometry` (OBJHANDLE hBase, MESHHANDLE \*\*mesh\_sh, double \*\*elev, DWORD \*nmesh\_sh) const  
*Returns base meshes in a format that can be used for shadow projections.*
- virtual void `clbkRender2DPanel` (SURFHANDLE \*hSurf, MESHHANDLE hMesh, MATRIX3 \*T, bool additive=false)  
*Render an instrument panel in cockpit view as a 2D billboard.*
- virtual void `clbkRender2DPanel` (SURFHANDLE \*hSurf, MESHHANDLE hMesh, MATRIX3 \*T, float alpha, bool additive=false)  
*Render an instrument panel in cockpit view as a 2D billboard.*
- bool `ElevationGrid` (ELEVHANDLE emgr, int ilat, int ilng, int lvl, int pilat, int pilng, int plvl, INT16 \*pelev, INT16 \*elev, double \*emean=0) const  
*Constructs a synthetic elevation grid for a tile by interpolating ancestor elevation data.*
- DWORD `LoadStars` (DWORD n, StarRec \*rec)  
*Load star data from Orbiter's data base file.*

- **DWORD LoadConstellationLines** (DWORD n, ConstRec \*rec)  
*Load constellation line data from Orbiter's data base file.*

### Visual object interface

- **void RegisterVisObject** (OBJHANDLE hObj, VISHANDLE vis)  
*Register a new visual object with Orbiter.*
- **void UnregisterVisObject** (OBJHANDLE hObj)  
*Unregister a visual before deleting it.*
- **virtual int clbkVisEvent** (OBJHANDLE hObj, VISHANDLE vis, DWORD msg, UINT context)  
*Message callback for a visual object.*
- **virtual MESHHANDLE clbkGetMesh** (VISHANDLE vis, UINT idx)  
*Return a mesh handle for a visual, defined by its index.*
- **virtual int clbkGetMeshGroup** (DEVMESHHANDLE hMesh, DWORD grpidx, GROUPREQUESTSPEC \*C \*grs)  
*Mesh group data retrieval interface for device-specific meshes.*
- **virtual int clbkEditMeshGroup** (DEVMESHHANDLE hMesh, DWORD grpidx, GROUPEDITSPEC \*ges)  
*Mesh group editing interface for device-specific meshes.*

### Dialog interface

- **virtual void clbkPreOpenPopup** ()  
*Popup window open notification.*

### Particle stream methods

- **virtual ParticleStream \* clbkCreateParticleStream** (PARTICLESTREAMSPEC \*pss)  
*Create a generic particle stream.*
- **virtual ParticleStream \* clbkCreateExhaustStream** (PARTICLESTREAMSPEC \*pss, OBJHANDLE hVessel, const double \*lvl, const VECTOR3 \*ref, const VECTOR3 \*dir)  
*Create a particle stream associated with a vessel.*
- **virtual ParticleStream \* clbkCreateExhaustStream** (PARTICLESTREAMSPEC \*pss, OBJHANDLE hVessel, const double \*lvl, const VECTOR3 &ref, const VECTOR3 &dir)  
*Create a particle stream associated with a vessel.*
- **virtual ParticleStream \* clbkCreateReentryStream** (PARTICLESTREAMSPEC \*pss, OBJHANDLE hVessel)  
*Create a vessel particle stream for reentry heating effect.*

### Surface-related methods

- **virtual SURFHANDLE clbkCreateSurfaceEx** (DWORD w, DWORD h, DWORD attrib)  
*Create a surface for texturing, as a blitting source, etc.*
- **virtual SURFHANDLE clbkCreateSurface** (DWORD w, DWORD h, SURFHANDLE hTemplate=NULL)  
*Create an offscreen surface.*
- **virtual SURFHANDLE clbkCreateTexture** (DWORD w, DWORD h)  
*Create a texture for rendering.*
- **virtual SURFHANDLE clbkCreateSurface** (HBITMAP hBmp)  
*Create an offscreen surface from a bitmap.*
- **virtual void clbkIncrSurfaceRef** (SURFHANDLE surf)  
*Increment the reference counter of a surface.*
- **virtual bool clbkReleaseSurface** (SURFHANDLE surf)  
*Decrement surface reference counter, release surface if counter reaches 0.*
- **virtual bool clbkGetSurfaceSize** (SURFHANDLE surf, DWORD \*w, DWORD \*h)  
*Return the width and height of a surface.*
- **virtual bool clbkSetSurfaceColourKey** (SURFHANDLE surf, DWORD ckey)  
*Set transparency colour key for a surface.*
- **virtual DWORD clbkGetDeviceColour** (BYTE r, BYTE g, BYTE b)  
*Convert an RGB colour triplet into a device-specific colour value.*

## Surface blitting methods

- virtual bool `clbkBlt` (`SURFHANDLE` tgt, `DWORD` tgtx, `DWORD` tgy, `SURFHANDLE` src, `DWORD` flag=0) const  
*Copy one surface into an area of another one.*
- virtual bool `clbkBlt` (`SURFHANDLE` tgt, `DWORD` tgtx, `DWORD` tgy, `SURFHANDLE` src, `DWORD` srcx, `DWORD` srcy, `DWORD` w, `DWORD` h, `DWORD` flag=0) const  
*Copy a rectangle from one surface to another.*
- virtual bool `clbkScaleBlt` (`SURFHANDLE` tgt, `DWORD` tgtx, `DWORD` tgy, `DWORD` tgtw, `DWORD` tgtb, `SURFHANDLE` src, `DWORD` srcx, `DWORD` srcy, `DWORD` srcw, `DWORD` srcb, `DWORD` srch, `DWORD` flag=0) const  
*Copy a rectangle from one surface to another, stretching or shrinking as required.*
- virtual int `clbkBeginBltGroup` (`SURFHANDLE` tgt)  
*Begins a block of blitting operations to the same target surface.*
- virtual int `clbkEndBltGroup` ()  
*Ends a block of blitting operations to the same target surface.*
- virtual bool `clbkFillSurface` (`SURFHANDLE` surf, `DWORD` col) const  
*Fill a surface with a uniform colour.*
- virtual bool `clbkFillSurface` (`SURFHANDLE` surf, `DWORD` tgtx, `DWORD` tgy, `DWORD` w, `DWORD` h, `DWORD` col) const  
*Fill an area in a surface with a uniform colour.*
- virtual bool `clbkCopyBitmap` (`SURFHANDLE` pdds, `HBITMAP` hbm, `int` x, `int` y, `int` dx, `int` dy)  
*Copy a bitmap object into a surface.*

## 2-D drawing interface

- virtual `Sketchpad` \* `clbkGetSketchpad` (`SURFHANDLE` surf)  
*Create a 2-D drawing object ("sketchpad") associated with a surface.*
- virtual void `clbkReleaseSketchpad` (`Sketchpad` \*sp)  
*Release a drawing object.*
- virtual `Font` \* `clbkCreateFont` (`int` height, `bool` prop, `const char` \*face, `oapi::Font::Style` style=`oapi::Font::NORMAL`, `int` orientation=0) const  
*Create a font resource for 2-D drawing.*
- virtual void `clbkReleaseFont` (`Font` \*font) const  
*De-allocate a font resource.*
- virtual `Pen` \* `clbkCreatePen` (`int` style, `int` width, `DWORD` col) const  
*Create a pen resource for 2-D drawing.*
- virtual void `clbkReleasePen` (`Pen` \*pen) const  
*De-allocate a pen resource.*
- virtual `Brush` \* `clbkCreateBrush` (`DWORD` col) const  
*Create a brush resource for 2-D drawing.*
- virtual void `clbkReleaseBrush` (`Brush` \*brush) const  
*De-allocate a brush resource.*

## GDI-related methods

- virtual `HDC` `clbkGetSurfaceDC` (`SURFHANDLE` surf)  
*Return a Windows graphics device interface handle for a surface.*
- virtual void `clbkReleaseSurfaceDC` (`SURFHANDLE` surf, `HDC` hDC)  
*Release a Windows graphics device interface.*

## Marker and label-related methods

- `DWORD` `GetCelestialMarkers` (`const LABELLIST` \*\*cm\_list) const  
*Returns an array of celestial marker lists.*
- `DWORD` `GetSurfaceMarkers` (`OBJHANDLE` hObj, `const LABELLIST` \*\*sm\_list) const  
*Returns an array of surface marker lists for a planet.*

**Public Attributes**

- **HWND hVid**

*Window handle of Launchpad video tab, if available.*

**Protected Member Functions**

- **virtual bool clbkUseLaunchpadVideoTab () const**

*Launchpad video tab indicator.*

- **virtual HWND clbkCreateRenderWindow ()**

*Simulation session start notification.*

- **virtual void clbkPostCreation ()**

*Simulation startup finalisation.*

- **virtual void clbkCloseSession (bool fastclose)**

*End of simulation session notification.*

- **virtual void clbkDestroyRenderWindow (bool fastclose)**

*Render window closure notification.*

- **virtual void clbkUpdate (bool running)**

*Per-frame update notification.*

- **virtual void clbkRenderScene ()=0**

*Per-frame render notification.*

- **virtual bool clbkDisplayFrame ()**

*Display a scene on screen after rendering it.*

- **virtual bool clbkSplashLoadMsg (const char \*msg, int line)**

*Display a load status message on the splash screen.*

- **void Render2DOverlay ()**

*Notifies Orbiter to to initiate rendering of the 2D scene overlay.*

- **virtual void clbkStoreMeshPersistent (MESHHANDLE hMesh, const char \*fname)**

*Store a persistent mesh template.*

- **void ShowDefaultSplash ()**

*Displays the default Orbiter splash screen on top of the render window.*

- **bool WriteImageDataToFile (const ImageData &data, const char \*fname, ImageFileFormat fmt=IMAGE\_JPG, float quality=0.7f)**

*Write a block of raw image data to a formatted image file.*

- **HBITMAP ReadImageFromMemory (BYTE \*pBuf, DWORD nBuf, UINT w, UINT h)**

*Read an image from a memory buffer.*

- **HBITMAP ReadImageFromFile (const char \*fname, UINT w=0, UINT h=0)**

*Read an image from a file into a bitmap.*

- **HINSTANCE ModuleInstance () const**

*Returns the graphics module instance handle.*

- **HINSTANCE OrbiterInstance () const**

*Returns the orbiter core instance handle.*

- **HWND LaunchpadVideoTab () const**

*Returns the window handle of the 'video' tab of the Orbiter Launchpad dialog.*

**Protected Attributes**

- **SURFHANDLE surfBltTgt**

*target surface for a blitting group (-1=none, NULL=main window render surface)*

- **oapi::Font \* splashFont**

## Friends

- class [:Orbiter](#)

*Orbiter private class.*

## Additional Inherited Members

### 17.20.1 Detailed Description

Base class for external graphics client modules.

This class defines the interface between the graphics-less version of the Orbiter core and any external plugins providing a rendering environment for the orbiter-generated scene. The [GraphicsClient](#) base class is defined in terms of generic graphics objects (meshes, textures, etc.) Derived classes can then adapt these into specific rendering objects for a given 3-D rendering engine (DX, OGL, etc.)

### 17.20.2 Constructor & Destructor Documentation

#### 17.20.2.1 `oapi::GraphicsClient::GraphicsClient ( HINSTANCE hInstance )`

Create a graphics object.

The graphics object is typically created during module initialisation (see [InitModule](#)). Once the client is created, it must be registered with the Orbiter core via the [oapiRegisterGraphicsClient](#) function.

##### Parameters

<code>hInstance</code>	module instance handle (as passed to <a href="#">InitModule</a> )
------------------------	---

#### 17.20.2.2 `virtual oapi::GraphicsClient::~GraphicsClient ( ) [virtual]`

Destroy the graphics object.

Usually, the graphics object is destroyed when the module is unloaded (see [opcDLLExit](#)), after it has been detached from the Orbiter core via a call to [oapiUnregisterGraphicsClient](#).

### 17.20.3 Member Function Documentation

#### 17.20.3.1 `virtual int oapi::GraphicsClient::clbkBeginBltGroup ( SURFHANDLE tgt ) [virtual]`

Begins a block of blitting operations to the same target surface.

##### Parameters

<code>tgt</code>	Target surface for subsequent blitting calls.
------------------	---

##### Returns

Should return an error code (0 on success, the return value from the base class call, or a client-specific code)

##### Default action:

If no target is currently set, stores tgt in surfBltTgt and returns 0. Returns -2 if a target was already set. Returns -3 if tgt==RENDERTGT\_NONE

**Note**

All blitting calls following this function use the same target until [clbkEndBltGroup](#) is called. Clients which have to perform initialisations for a new blitting target can do this here, and then assume for the following oapiBlt calls that the target is already initialised.

The special target RENDERTGT\_MAINWINDOW refers to the main render surface.

Within the blitting block, multiple source surfaces may be used. No particular order or grouping according to source surface can be guaranteed.

Blitting calls using a different target within a blitting group are not filtered out. It is up to the client how to handle this (honour the call, ignore it or throw an error)

**See also**

[clbkEndBltGroup](#)

**17.20.3.2 virtual bool oapi::GraphicsClient::clbkBlt( SURFHANDLE *tgt*, DWORD *tgtx*, DWORD *tgyt*, SURFHANDLE *src*, DWORD *flag* = 0 ) const [inline], [virtual]**

Copy one surface into an area of another one.

**Parameters**

<i>tgt</i>	target surface handle
<i>tgtx</i>	left edge of target rectangle
<i>tgyt</i>	top edge of target rectangle
<i>src</i>	source surface handle
<i>flag</i>	blitting parameters (see notes)

**Returns**

true on success, false if the blit cannot be performed.

**Default action:**

None, returns false.

**Note**

By convention, *tgt*=NULL is valid and refers to the primary render surface (e.g. for copying 2-D overlay surfaces).

The following bit-flags are defined:

BLT_SRCCOLORKEY	Use the colour key defined by the source surface for transparency
BLT_TGTCOLORKEY	Use the colour key defined by the target surface for transparency

If a client doesn't support some of the flags, it should quietly ignore it.

**See also**

[clbkBlt\(SURFHANDLE,DWORD,DWORD,SURFHANDLE,DWORD,DWORD,DWORD,DWORD,DWORD\)](#)

**17.20.3.3 virtual bool oapi::GraphicsClient::clbkBlt( SURFHANDLE *tgt*, DWORD *tgtx*, DWORD *tgyt*, SURFHANDLE *src*, DWORD *srcx*, DWORD *srcy*, DWORD *w*, DWORD *h*, DWORD *flag* = 0 ) const [inline], [virtual]**

Copy a rectangle from one surface to another.

## Parameters

<i>tgt</i>	target surfac handle
<i>tgtx</i>	left edge of target rectangle
<i>tgy</i>	top edge of target rectangle
<i>src</i>	source surface handle
<i>srcx</i>	left edge of source rectangle
<i>srcy</i>	top edge of source rectangle
<i>w</i>	width of rectangle
<i>h</i>	height of rectangle
<i>flag</i>	blitting parameters (see notes)

## Returns

true on success, false if the blit cannot be performed.

## Default action:

None, returns false.

## Note

By convention, *tgt*==NULL is valid and refers to the primary render surface (e.g. for copying 2-D overlay surfaces).

The following bit-flags are defined:

BLT_SRCCOLORKEY	Use the colour key defined by the source surface for transparency
BLT_TGTCOLORKEY	Use the colour key defined by the target surface for transparency

If a client doesn't support some of the flags, it should quietly ignore it.

## See also

[clbkBlt\(SURFHANDLE,DWORD,DWORD,SURFHANDLE,DWORD\)](#)

**17.20.3.4 virtual void oapi::GraphicsClient::clbkCloseSession ( bool *fastclose* ) [inline], [protected], [virtual]**

End of simulation session notification.

Called before the end of a simulation session. At the point of call, logical objects still exist (OBJHANDLES valid), and external modules are still loaded.

## Parameters

<i>fastclose</i>	Indicates a "fast shutdown" request (see notes)
------------------	---

## Default action:

None.

## Note

Derived clients can use this function to perform cleanup operations for which the simulation objects are still required.

If *fastclose* == true, the user has selected one of the fast shutdown options (terminate Orbiter, or respawn Orbiter process). In this case, the current process will terminate, and the graphics client can skip object cleanup and deallocation in order to speed up the closedown process.

## See also

[clbkDestroyRenderWindow](#)

17.20.3.5 virtual bool oapi::GraphicsClient::clbkCopyBitmap ( **SURFHANDLE** *pdds*, **HBITMAP** *hbm*, int *x*, int *y*, int *dx*, int *dy* ) [virtual]

Copy a bitmap object into a surface.

## Parameters

<i>pdds</i>	surface handle
<i>hbm</i>	bitmap handle
<i>x</i>	left edge of source bitmap area to be copied
<i>y</i>	top edge of source bitmap area to be copied
<i>dx</i>	width of source bitmap area to be copied
<i>dy</i>	height of source bitmap area to be copied

## Returns

*true* on success, *false* if surface or bitmap handle are invalid.

## Note

The source bitmap area is stretched as required to fit the area of the target surface.

17.20.3.6 virtual **ScreenAnnotation\*** oapi::GraphicsClient::clbkCreateAnnotation ( ) [virtual]

Create an annotation object for displaying on-screen text.

## Returns

Pointer to new screen annotation object.

## Default action:

Dynamically allocates a 'ScreenAnnotation' instance and returns a pointer to it.

17.20.3.7 virtual **Brush\*** oapi::GraphicsClient::clbkCreateBrush ( **DWORD** *col* ) const [inline], [virtual]

Create a brush resource for 2-D drawing.

## Parameters

<i>col</i>	line colour (format: 0xBBGGRR)
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## Returns

Pointer to brush resource

## Default action:

None, returns NULL.

## See also

[clbkReleaseBrush](#), [oapi::Brush](#)

17.20.3.8 virtual **ParticleStream\*** oapi::GraphicsClient::clbkCreateExhaustStream ( **PARTICLESTREAMSPEC** \* *pss*, **OBJHANDLE** *hVessel*, const **double** \* *lvl*, const **VECTOR3** \* *ref*, const **VECTOR3** \* *dir* ) [virtual]

Create a particle stream associated with a vessel.

Typically used for exhaust and plasma effects, but can also be used for other types of particles.

**Parameters**

<i>pss</i>	particle stream parameters
<i>hVessel</i>	vessel handle
<i>lvl</i>	pointer to exhaust level control variable
<i>ref</i>	pointer to stream source position (vessel frame) [m]
<i>dir</i>	pointer to stream direction (vessel frame)

**Returns**

Pointer to new particle stream

**Default action:**

None, returns NULL. Derived classes should overload this method to return a ParticleStream-derived class instance in order to support exhaust streams.

**Note**

The *lvl*, *ref* and *dir* parameters may be modified by orbiter after the stream has been created, e.g. to reflect changes in engine thrust level or gimballing.

**17.20.3.9 virtual ParticleStream\* oapi::GraphicsClient::clbkCreateExhaustStream ( PARTICLESTREAMSPEC \* *pss*,  
OBJHANDLE *hVessel*, const double \* *lvl*, const VECTOR3 & *ref*, const VECTOR3 & *dir* ) [virtual]**

Create a particle stream associated with a vessel.

Typically used for exhaust and plasma effects, but can also be used for other types of particles.

**Parameters**

<i>pss</i>	particle stream parameters
<i>hVessel</i>	vessel handle
<i>lvl</i>	pointer to exhaust level control variable
<i>ref</i>	pointer to stream source position (vessel frame) [m]
<i>dir</i>	pointer to stream direction (vessel frame)

**Returns**

Pointer to new particle stream

**Default action:**

None, returns NULL. Derived classes should overload this method to return a ParticleStream-derived class instance in order to support exhaust streams.

**Note**

The *lvl* parameter may be modified by orbiter after the stream has been created, e.g. to reflect changes in engine thrust level.

The *ref* and *dir* parameters are fixed in this version of the method.

**17.20.3.10 virtual Font\* oapi::GraphicsClient::clbkCreateFont ( int *height*, bool *prop*, const char \* *face*, oapi::Font::Style *style* = oapi::Font::NORMAL, int *orientation* = 0 ) const [inline], [virtual]**

Create a font resource for 2-D drawing.

**Parameters**

<i>height</i>	cell or character height [pixel]
<i>prop</i>	proportional/fixed width flag
<i>face</i>	font face name
<i>style</i>	font decoration style
<i>orientation</i>	text orientation [1/10 deg]

**Returns**

Pointer to font resource

**Default action:**

None, returns NULL.

**Note**

For a description of the parameters, see [Font](#) constructor [oapi::Font::Font](#)

**See also**

[clbkReleaseFont](#), [oapi::Font](#)

**17.20.3.11 virtual ParticleStream\* oapi::GraphicsClient::clbkCreateParticleStream ( **PARTICLESTREAMSPEC** \* *pss* ) [virtual]**

Create a generic particle stream.

**Parameters**

<i>pss</i>	particle stream parameters
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**Returns**

Pointer to new particle stream.

**Default action:**

None, returns NULL. Derived classes should overload this method to return a ParticleStream-derived class instance in order to support particle streams.

**See also**

[ParticleStream](#)

**17.20.3.12 virtual Pen\* oapi::GraphicsClient::clbkCreatePen ( int *style*, int *width*, **DWORD** *col* ) const [inline], [virtual]**

Create a pen resource for 2-D drawing.

**Parameters**

<i>style</i>	line style (0=invisible, 1=solid, 2=dashed)
<i>width</i>	line width [pixel]

col	line colour (format: 0xBBGGRR)
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**Returns**

Pointer to pen resource

**Default action:**

None, returns NULL.

**See also**

[clbkReleasePen](#), [oapi::Pen](#)

**17.20.3.13 virtual ParticleStream\* oapi::GraphicsClient::clbkCreateReentryStream ( PARTICLESTREAMSPEC \* pss, OBJHANDLE hVessel ) [virtual]**

Create a vessel particle stream for reentry heating effect.

**Parameters**

<i>pss</i>	particle stream parameters
<i>hVessel</i>	vessel handle

**Returns**

Pointer to new particle stream

**Default action:**

None, returns NULL. Derived classes should overload this method to return a ParticleStream-derived class instance in order to support reentry streams.

**17.20.3.14 virtual HWND oapi::GraphicsClient::clbkCreateRenderWindow ( ) [protected], [virtual]**

Simulation session start notification.

Called at the beginning of a simulation session to allow the client to create the 3-D rendering window (or to switch into fullscreen mode).

**Returns**

Should return window handle of the rendering window.

**Default action:**

For windowed mode, opens a window of the size specified by the VideoData structure (for fullscreen mode, opens a small dummy window) and returns the window handle.

**Note**

For windowed modes, the viewW and viewH parameters should return the window client area size. For fullscreen mode, they should contain the screen resolution.

Derived classes should perform any required per-session initialisation of the 3D render environment here.

**17.20.3.15 virtual SURFHANDLE oapi::GraphicsClient::clbkCreateSurface ( DWORD w, DWORD h, SURFHANDLE hTemplate = NULL ) [inline], [virtual]**

Create an offscreen surface.

Surfaces are used for offscreen bitmap and texture manipulation, blitting and rendering. Derived classes should create a device-specific surface, and return a cast to a generic Orbiter SURFHANDLE.

## Parameters

w	surface width [pixels]
h	surface height [pixels]
<i>hTemplate</i>	surface format template

## Returns

pointer to surface, cast into a SURFHANDLE, or NULL to indicate failure.

## Default action:

None, returns NULL.

## Note

If *hTemplate* is provided, this method should create the new surface with the same pixel format.

## See also

[clbkCreateTexture](#), [clbkReleaseSurface](#)

17.20.3.16 virtual SURFHANDLE oapi::GraphicsClient::clbkCreateSurface ( HBITMAP *hBmp* ) [virtual]

Create an offscreen surface from a bitmap.

## Parameters

<i>hBmp</i>	bitmap handle
-------------	---------------

## Returns

surface handle, or NULL to indicate failure

## Default action:

Creates a surface of the same size as the bitmap, and uses clbkCopyBitmap to copy the bitmap over.

## Note

The reference counter for the new surface is set to 1.

## See also

[clbkIncrSurfaceRef](#), [clbkReleaseSurface](#)

17.20.3.17 virtual SURFHANDLE oapi::GraphicsClient::clbkCreateSurfaceEx ( DWORD *w*, DWORD *h*, DWORD *attrib* ) [inline], [virtual]

Create a surface for texturing, as a blitting source, etc.

Surfaces are used for offscreen bitmap and texture manipulation, blitting and rendering. Derived classes should create a device-specific surface, and return a cast to a generic Orbiter SURFHANDLE.

## Parameters

w	surface width [pixels]
h	surface height [pixels]
attrib	<a href="#">Surface and texture attributes</a> (bitflags). See notes.

## Returns

Surface handle (in the simplest case, just a pointer to the surface, cast to a SURFHANDLE). On failure, this method should return NULL.

## Default action:

None, returns NULL.

## Note

The attribute flag can contain one of the following main attributes:

- OAPISURFACE\_RO: create a surface that can be read by the GPU pipeline, and that can be updated from system memory.
- OAPISURFACE\_RW: create a surface that can be read and written by the GPU pipeline, and that can be updated from system memory.
- OAPISURFACE\_GDI: create a surface that can be read and written from the CPU, and can be blitted into an uncompressed RO or RW surface without an alpha channel. In addition, the flag can contain any combination of the following auxiliary attributes:
- OAPISURFACE\_MIPMAPS: create a full chain of mipmaps for the surface if possible
- OAPISURFACE\_NOALPHA: create a surface without an alpha channel

### 17.20.3.18 virtual SURFHANDLE oapi::GraphicsClient::clbkCreateTexture ( DWORD w, DWORD h ) [inline], [virtual]

Create a texture for rendering.

## Parameters

w	texture width
h	texture height

## Returns

pointer to texture, returned as generic SURFHANDLE. NULL indicates failure.

## Note

This method is similar to [clbkCreateSurface](#), but the returned surface handle must be usable as a texture when rendering the scene. Clients which don't differentiate between offscreen surfaces and textures may use identical code for both functions.

Some clients may put restrictions on the texture format (e.g. require square size (w=h), and/or powers of two ( $w=2^n$ )). If the texture cannot be created with the requested size, this method should return NULL.

## See also

[clbkCreateSurface](#), [clbkReleaseSurface](#)

**17.20.3.19 virtual void oapi::GraphicsClient::clbkDestroyRenderWindow ( bool *fastclose* ) [protected], [virtual]**

Render window closure notification.

Called at the end of a simulation session to allow the client to close the 3-D rendering window (or to switch out of fullscreen mode) and clean up the session environment. At the point of call, all logical simulation objects have been destroyed, and object modules have been unloaded. This method should not access any OBJHANDLE or **VESSEL** objects any more. For closedown operations that require access to the simulation objects, use clbkCloseSession instead.

**Parameters**

<i>fastclose</i>	Indicates a "fast shutdown" request (see notes)
------------------	---

**Default action:**

None.

**Note**

Derived classes should perform any required cleanup of the 3D render environment here.

The user may change the video parameters before starting a new simulation session. Therefore, device-specific options should be destroyed and re-created at the start of the next session.

If *fastclose* == true, the user has selected one of the fast shutdown options (terminate Orbiter, or respawn Orbiter process). In this case, the current process will terminate, and the graphics client can skip object cleanup and deallocation in order to speed up the closedown process.

**See also**

[clbkCloseSession](#)

**17.20.3.20 virtual bool oapi::GraphicsClient::clbkDisplayFrame( ) [inline], [protected], [virtual]**

Display a scene on screen after rendering it.

Called after *clbkRenderScene* to allow the client to display the rendered scene (e.g. by page-flipping, or blitting from background to primary frame buffer. This method can also be used by the client to display any top-level 2-D overlays (e.g. dialogs) on the primary frame buffer.

**Returns**

Should return true on successful operation, false on failure or if no operation was performed.

**Default action:**

None, returns false.

**17.20.3.21 virtual int oapi::GraphicsClient::clbkEditMeshGroup( DEVMESSHHANDLE *hMesh*, DWORD *grpidx*, GROUPEDITSPEC \* *ges* ) [inline], [virtual]**

Mesh group editing interface for device-specific meshes.

**Parameters**

<i>hMesh</i>	device mesh handle
<i>grpidx</i>	mesh group index (>= 0)
<i>ges</i>	mesh group modification specs

**Returns**

Should return 0 on success, or error flags > 0.

**Default action:**

None, returns -2.

**Note**

Clients should implement this method to allow the modification of individual groups in a device-specific mesh. Modifications may include vertex values, index lists, texture and material indices, and user flags.

**17.20.3.22 virtual int oapi::GraphicsClient::clbkEndBltGroup( ) [virtual]**

Ends a block of blitting operations to the same target surface.

**Returns**

Should return an error code (0 on success, the return value from the base class call, or a client-specific code)

**Default action:**

If surfBltTgt was set, clears it (to RENDERGT\_NONE) and returns 0. Otherwise returns -2;

**See also**

[clbkBeginBltGroup](#)

**17.20.3.23 virtual bool oapi::GraphicsClient::clbkFillSurface( SURFHANDLE *surf*, DWORD *col* ) const [inline], [virtual]**

Fill a surface with a uniform colour.

**Parameters**

<i>surf</i>	surface handle
<i>col</i>	colour value

**Returns**

true on success, false if the fill operation cannot be performed.

**Default action:**

None, returns false.

**Note**

Parameter *col* is a device-dependent colour value (see [clbkGetDeviceColour](#)).

**See also**

[clbkFillSurface\(SURFHANDLE,DWORD,DWORD,DWORD,DWORD,DWORD\)](#)

**17.20.3.24 virtual bool oapi::GraphicsClient::clbkFillSurface( SURFHANDLE *surf*, DWORD *tgtx*, DWORD *tgyt*, DWORD *w*, DWORD *h*, DWORD *col* ) const [inline], [virtual]**

Fill an area in a surface with a uniform colour.

**Parameters**

<i>surf</i>	surface handle
<i>tgtx</i>	left edge of target rectangle
<i>tgyt</i>	top edge of target rectangle
<i>w</i>	width of rectangle
<i>h</i>	height of rectangle

<i>col</i>	colour value
------------	--------------

**Returns**

true on success, false if the fill operation cannot be performed.

**Default action:**

None, returns false.

**Note**

Parameter col is a device-dependent colour value (see [clbkGetDeviceColour](#)).

**See also**

[clbkFillSurface\(SURFHANDLE,DWORD\)](#)

**17.20.3.25 virtual bool oapi::GraphicsClient::clbkFullscreenMode( ) const [pure virtual]**

Fullscreen mode flag.

**Returns**

true if the client is set up for running in fullscreen mode, false for windowed mode.

**17.20.3.26 virtual DWORD oapi::GraphicsClient::clbkGetDeviceColour( BYTE r, BYTE g, BYTE b ) [inline], [virtual]**

Convert an RGB colour triplet into a device-specific colour value.

**Parameters**

<i>r</i>	red component
<i>g</i>	green component
<i>b</i>	blue component

**Returns**

colour value

**Note**

Derived classes should overload this method to convert RGB colour definitions into device-compatible colour values, taking into account the colour depth of the render device etc.

**Default action:**

Packs the RGB values into a DWORD of the form 0x00RRGGBB, with 8 bits per colour component.

**See also**

[clbkFillSurface](#)

**17.20.3.27 virtual MESHHANDLE oapi::GraphicsClient::clbkGetMesh( VISHANDLE vis, UINT idx ) [inline], [virtual]**

Return a mesh handle for a visual, defined by its index.

## Parameters

<i>vis</i>	visual identifier
<i>idx</i>	mesh index ( $\geq 0$ )

## Returns

Mesh handle (client-specific)

## Note

Derived clients should return a handle that identifies a mesh for the visual (in client-specific format). Orbiter calls this method in response to a [VESSEL::GetMesh](#) call by an vessel module.

**17.20.3.28** `virtual int oapi::GraphicsClient::clbkGetMeshGroup ( DEVMESSHHANDLE hMesh, DWORD grpidx, GROUPREQUESTSPEC * grs ) [inline], [virtual]`

Mesh group data retrieval interface for device-specific meshes.

## Parameters

<i>hMesh</i>	device mesh handle
<i>grpidx</i>	mesh group index ( $\geq 0$ )
<i>grs</i>	data buffers and buffer size information. See <a href="#">oapiGetMeshGroup</a> for details.

## Returns

Should return 0 on success, or error flags  $> 0$ .

## Default action:

None, returns -2.

**17.20.3.29** `virtual bool oapi::GraphicsClient::clbkGetRenderParam ( DWORD prm, DWORD * value ) const [pure virtual]`

Returns a specific render parameter.

## Parameters

<i>in</i>	<i>prm</i>	parameter identifier (see
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## See also

[Render parameter identifiers](#))

## Parameters

<i>out</i>	<i>value</i>	value of the queried parameter
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## Returns

true if the specified parameter is supported by the client, false if not.

**17.20.3.30** `virtual Sketchpad* oapi::GraphicsClient::clbkGetSketchpad ( SURFHANDLE surf ) [inline], [virtual]`

Create a 2-D drawing object ("sketchpad") associated with a surface.

## Parameters

<i>surf</i>	surface handle
-------------	----------------

## Returns

Pointer to drawing object.

## Default action:

None, returns NULL.

## Note

Clients should overload this function to provide 2-D drawing support. This requires an implementation of a class derived from [Sketchpad](#) which provides the drawing context and drawing primitives.

## See also

[Sketchpad](#), [clbkReleaseSketchpad](#)

17.20.3.31 virtual HDC oapi::GraphicsClient::clbkGetSurfaceDC ( **SURFHANDLE** *surf* ) [inline], [virtual]

Return a Windows graphics device interface handle for a surface.

## Parameters

<i>surf</i>	surface handle
-------------	----------------

## Returns

GDI handle, or NULL on failure

## Default action:

None, returns NULL.

## Note

Clients which can obtain a Windows GDI handle for a surface should overload this method.

**Todo** This method should be moved into the GDIClient class

17.20.3.32 virtual bool oapi::GraphicsClient::clbkGetSurfaceSize ( **SURFHANDLE** *surf*, **DWORD** \* *w*, **DWORD** \* *h* ) [inline], [virtual]

Return the width and height of a surface.

## Parameters

<b>in</b>	<i>surf</i>	surface handle
<b>out</b>	<i>w</i>	surface width
<b>out</b>	<i>h</i>	surface height

## Returns

true if surface dimensions could be obtained.

## Default action:

Sets *w* and *h* to 0 and returns false.

## See also

[clbkCreateSurface](#)

```
17.20.3.33 virtual void oapi::GraphicsClient::clbkGetViewportSize( DWORD * width, DWORD * height ) const [pure  
virtual]
```

Returns the dimensions of the render viewport.

## Parameters

<i>width</i>	render viewport width [pixel]
<i>height</i>	render viewport height [pixel]

## Note

This function is called by orbiter after the render window or fullscreen renderer has been created (see [clbkCreateRenderWindow](#)).

This should normally return the screen resolution in fullscreen mode, and the size of the render window client area in windowed mode, clients can also return smaller values if they only use part of the screen area for scene rendering.

17.20.3.34 virtual void oapi::GraphicsClient::clbkIncrSurfaceRef ( **SURFHANDLE** *surf* ) [inline], [virtual]

Increment the reference counter of a surface.

## Parameters

<i>surf</i>	surface handle
-------------	----------------

## Default action:

None.

## Note

Derived classes should keep track on surface references, and overload this function to increment the reference counter.

## 17.20.3.35 virtual bool oapi::GraphicsClient::clbkInitialise ( ) [virtual]

Perform any one-time setup tasks.

This includes enumerating drivers, graphics modes, etc. Derived classes should also call the base class method to allow default setup.

## Default action:

Initialises the VideoData structure from the Orbiter.cfg file

## Calling sequence:

Called during processing of oapiRegisterGraphicsClient, after the Launchpad Video tab has been inserted (if clbkUseLaunchpadVideoTab returns true).

17.20.3.36 virtual **SURFHANDLE** oapi::GraphicsClient::clbkLoadSurface ( **const char** \* *fname*, **DWORD** *attrib* ) [inline], [virtual]

Load a surface from file into a surface object, and return a SURFHANDLE for it.

## Parameters

<i>fname</i>	texture file name with path relative to orbiter texture folders
<i>attrib</i>	<a href="#">Surface and texture attributes</a> (see notes)

## Returns

A SURFHANDLE for the loaded surface, for example a pointer to the surface object.

**Note**

If the request refers to a static surface that has already be loaded, or if the client buffers the unmodified surfaces after loading, it can simply return a handle to the existing surface object, instead of reading it again from file.

The attrib bitflag can contain one of the following main attributes:

- OAPISURFACE\_RO: Load the surface to be readable by the GPU pipeline
- OAPISURFACE\_RW: Load the surface to be readable and writable by the GPU pipeline
- OAPISURFACE\_GDI: Load the surface to be readable and writable by the CPU, and can be blitted into an uncompressed RO or RW surface without alpha channel
- OAPISURFACE\_STATIC: Load the surface to be readable by the GPU pipeline In addition, the flag can contain any of the following auxiliary attributes:
  - OAPISURFACE\_MIPMAPS: Load the mipmaps for the surface from file, or create them if necessary
  - OAPISURFACE\_NOMIPMAPS: Don't load mipmaps, even if they are available in the file
  - OAPISURFACE\_NOALPHA: Load the surface without an alpha channel
  - OAPISURFACE\_UNCOMPRESS: Uncompress the surface on loading.

**See also**

[oapiCreateSurface\(DWORD,DWORD,DWORD\)](#)

**17.20.3.37 virtual SURFHANDLE oapi::GraphicsClient::clbkLoadTexture ( const char \* *fname*, DWORD *flags* = 0 )  
[inline], [virtual]**

Texture request.

Load a texture from a file into a device-specific texture object, and return a generic SURFHANDLE for it. Derived classes should overload this method to add texture support. Usually, the client should read Orbiter's default texture files (in DXT? format). However, the client also has the option to load its own texture files stored in a different format, and pass them back via the SURFHANDLE interface.

**Parameters**

<i>fname</i>	texture file name with path relative to orbiter texture folders; can be used as input for <a href="#">OpenTextureFile</a> .
<i>flags</i>	request for texture properties

**Returns**

Texture handle, cast into generic SURFHANDLE, or NULL if texture could not be loaded.

**Default action:**

Return NULL.

**Note**

If the client loads its own of texture files, they can either be installed in the default locations, replacing Orbiter's set of textures, or stored alongside the original textures, using different names or directory locations. In the latter case, the fname parameter passed to clbkLoadTexture must be adapted accordingly (for example, by replacing the dds extension with jpg, or by adding an 'OGL' prefix to the path name, etc). Not overwriting the original texture set has the advantage that other graphics clients relying on the original textures can still be used.

The following flags are supported:

- bit 0 set: force creation in system memory
- bit 1 set: decompress, even if format is supported by device
- bit 2 set: don't load mipmaps, even if supported by device

- bit 3 set: load as global resource (can be managed by graphics client)

If bit 3 of flags is set, orbiter will not try to modify or release the texture. The client should manage the texture (i.e. keep it in a repository and release it at destruction). Any further call of clbkLoadTexture should first scan the repository. If the texture is already present, the function should just return a pointer to it.

**17.20.3.38** `virtual int oapi::GraphicsClient::clbkMeshMaterial ( DEVMESSHHANDLE hMesh, DWORD matidx, MATERIAL * mat ) [inline], [virtual]`

Retrieve the properties of one of the mesh materials.

**Parameters**

<i>hMesh</i>	device mesh handle
<i>matidx</i>	material index ( $\geq 0$ )
<i>mat</i>	[out] pointer to <a href="#">MATERIAL</a> structure to be filled by the method.

**Returns**

true if successful, false on error (index out of range)

**Default action:**

None, returns 2 ("client does not support operation").

**17.20.3.39** `virtual void oapi::GraphicsClient::clbkPostCreation( ) [inline], [protected], [virtual]`

Simulation startup finalisation.

Called at the beginning of a simulation session after the scenario has been parsed and the logical object have been created.

**Default action:**

None

**17.20.3.40** `virtual void oapi::GraphicsClient::clbkPreOpenPopup( ) [inline], [virtual]`

Popup window open notification.

**Note**

This method is called just before a popup window (e.g. dialog box) is opened. It allows the client to prepare for subsequent rendering of the window, if necessary.

**17.20.3.41** `virtual void oapi::GraphicsClient::clbkRefreshVideoData( ) [inline], [virtual]`

Request for video configuration data.

Called by Orbiter before the render window is opened or configuration parameters are written to file. Applications should here either update the provided [VIDEODATA](#) structure from any user selections made in the Launchpad Video tab and leave it to Orbiter to write these parameters to Orbiter.cfg, or write the current video settings to their own configuration file.

**Default action:**

None.

**17.20.3.42** `virtual void oapi::GraphicsClient::clbkReleaseBrush ( Brush * brush ) const [inline], [virtual]`

De-allocate a brush resource.

## Parameters

<i>brush</i>	pointer to brush resource
--------------	---------------------------

## Default action:

None.

## See also

[clbkCreateBrush](#), [oapi::Brush](#)

17.20.3.43 virtual void oapi::GraphicsClient::clbkReleaseFont ( *Font* \* *font* ) const [inline], [virtual]

De-allocate a font resource.

## Parameters

<i>font</i>	pointer to font resource
-------------	--------------------------

## Default action:

None.

## See also

[clbkCreateFont](#), [oapi::Font](#)

17.20.3.44 virtual void oapi::GraphicsClient::clbkReleasePen ( *Pen* \* *pen* ) const [inline], [virtual]

De-allocate a pen resource.

## Parameters

<i>pen</i>	pointer to pen resource
------------	-------------------------

## Default action:

None.

## See also

[clbkCreatePen](#), [oapi::Pen](#)

17.20.3.45 virtual void oapi::GraphicsClient::clbkReleaseSketchpad ( *Sketchpad* \* *sp* ) [inline], [virtual]

Release a drawing object.

## Parameters

<i>sp</i>	pointer to drawing object
-----------	---------------------------

## Default action:

None.

## See also

[Sketchpad](#), [clbkGetSketchpad](#)

17.20.3.46 virtual bool oapi::GraphicsClient::clbkReleaseSurface ( **SURFHANDLE** *surf* ) [inline], [virtual]

Decrement surface reference counter, release surface if counter reaches 0.

## Parameters

<i>surf</i>	surface handle
-------------	----------------

## Returns

true on success

## Default action:

None, returns false.

## Note

Derived classes should overload this function to decrement a surface reference counter and release the surface if required.

## See also

[clbkCreateSurface](#), [clbkIncrSurfaceRef](#)

**17.20.3.47** `virtual void oapi::GraphicsClient::clbkReleaseSurfaceDC ( SURFHANDLE surf, HDC hDC ) [inline], [virtual]`

Release a Windows graphics device interface.

## Parameters

<i>surf</i>	surface handle
<i>hDC</i>	GDI handle

## Default action:

None.

## Note

Clients which can obtain a Windows GDI handle for a surface should overload this method to release an existing GDI.

**Todo** This method should be moved into the GDIClient class

**17.20.3.48** `virtual void oapi::GraphicsClient::clbkReleaseTexture ( SURFHANDLE hTex ) [inline], [virtual]`

Texture release request.

Called by Orbiter when a previously loaded texture can be released from memory. The client can use the appropriate device-specific method to release the texture.

## Parameters

<i>hTex</i>	texture handle
-------------	----------------

## Default action:

None.

**17.20.3.49** `virtual void oapi::GraphicsClient::clbkRender2DPanel ( SURFHANDLE * hSurf, MESHHANDLE hMesh, MATRIX3 * T, bool additive = false ) [virtual]`

Render an instrument panel in cockpit view as a 2D billboard.

## Parameters

<i>hSurf</i>	array of texture handles for the panel surface
<i>hMesh</i>	billboard mesh handle
<i>T</i>	transformation matrix for panel mesh vertices (2D)
<i>additive</i>	If true, panel should be rendered additive (transparent)

## Default action:

None.

## Note

The texture index of each group in the mesh is interpreted as index into the *hSurf* array. Special indices are `TEXIDX_MFD0` and above, which specify the surfaces representing the [MFD](#) displays. These are obtained separately and don't need to be present in the *hSurf* list.

The *additive* flag is used when rendering the default "glass cockpit" if the user requested. "transparent MFDs". The renderer can then use e.g. additive blending for rendering the panel.

**17.20.3.50** `virtual void oapi::GraphicsClient::clbkRender2DPanel ( SURFHANDLE * hSurf, MESHHANDLE hMesh, MATRIX3 * T, float alpha, bool additive = false ) [virtual]`

Render an instrument panel in cockpit view as a 2D billboard.

## Parameters

<i>hSurf</i>	array of texture handles for the panel surface
<i>hMesh</i>	billboard mesh handle
<i>T</i>	transformation matrix for panel mesh vertices (2D)
<i>alpha</i>	opacity value, between 0 (transparent) and 1 (opaque)
<i>additive</i>	If true, panel should be rendered additive (transparent)

## Default action:

None.

## Note

The texture index of each group in the mesh is interpreted as index into the *hSurf* array. Special indices are `TEXIDX_MFD0` and above, which specify the surfaces representing the [MFD](#) displays. These are obtained separately and don't need to be present in the *hSurf* list.

The *additive* flag is used when rendering the default "glass cockpit" if the user requested. "transparent MFDs". The renderer can then use e.g. additive blending for rendering the panel.

**17.20.3.51** `virtual void oapi::GraphicsClient::clbkRenderScene ( ) [protected], [pure virtual]`

Per-frame render notification.

Called once per frame, after the logical world state has been updated, to allow the client to render the current scene.

## Note

This method is also called continuously while the simulation is paused, to allow camera panning (although in that case the logical world state won't change between frames).

After the 3D scene has been rendered, this function should call [Render2DOverlay](#) to initiate rendering of 2D elements (2D instrument panel, HUD, etc.)

**17.20.3.52** `virtual bool oapi::GraphicsClient::clbkSaveSurfaceToImage ( SURFHANDLE surf, const char * fname, ImageFormat fmt, float quality = 0.7f ) [inline], [virtual]`

Save the contents of a surface to a formatted image file or to the clipboard.

**Parameters**

<i>surf</i>	surface handle (0 for primary render surface)
<i>fname</i>	image file path relative to orbiter root directory (excluding file extension), or NULL to save to clipboard
<i>fmt</i>	output file format
<i>quality</i>	quality request if the format supports it (0-1)

**Returns**

Should return true on success

**Default action:**

Nothing, returns false

**Note**

Implementations can make use of the [WriteImageDataToFile](#) method to write to a file in the desired format once a pointer to the image data in 24-bit uncompressed format has been obtained.

**17.20.3.53 virtual bool oapi::GraphicsClient::clbkScaleBlt ( SURFHANDLE *tgt*, DWORD *tgtx*, DWORD *tgy*, DWORD *tgtw*, DWORD *tgth*, SURFHANDLE *src*, DWORD *srcx*, DWORD *srcy*, DWORD *srcw*, DWORD *srch*, DWORD *flag* = 0 ) const [inline], [virtual]**

Copy a rectangle from one surface to another, stretching or shrinking as required.

**Parameters**

<i>tgt</i>	target surface handle
<i>tgtx</i>	left edge of target rectangle
<i>tgy</i>	top edge of target rectangle
<i>tgtw</i>	width of target rectangle
<i>tgth</i>	height of target rectangle
<i>src</i>	source surface handle
<i>srcx</i>	left edge of source rectangle
<i>srcy</i>	top edge of source rectangle
<i>srcw</i>	width of source rectangle
<i>srch</i>	height of source rectangle
<i>flag</i>	blitting parameters

**Returns**

true on success, false if the blit cannot be performed.

**Default action:**

None, returns false.

**Note**

By convention, *tgt*=NULL is valid and refers to the primary render surface (e.g. for copying 2-D overlay surfaces).

**See also**

[clbkBlt\(SURFHANDLE,DWORD,DWORD,SURFHANDLE,DWORD\)](#), [clbkBlt\(SURFHANDLE,DWORD,DWORD,SURFHANDLE,DWORD,DWORD,DWORD,DWORD\)](#)

---

```
17.20.3.54 virtual int oapi::GraphicsClient::clbkSetMeshMaterial( DEVMESSHANDLE hMesh, DWORD matidx, const  
MATERIAL * mat ) [inline], [virtual]
```

Replace properties of an existing mesh material.

## Parameters

<i>hMesh</i>	device mesh handle
<i>matidx</i>	material index ( $\geq 0$ )
<i>mat</i>	pointer to material structure

## Returns

Overloaded functions should return an integer error flag, with the following codes: 0="success", 3="invalid mesh handle", 4="material index out of range"

## Default action:

None, returns 2 ("client does not support operation").

**17.20.3.55 virtual bool oapi::GraphicsClient::clbkSetMeshProperty ( **DEVMESHHANDLE** *hMesh*, **DWORD** *property*, **DWORD** *value* ) [inline], [virtual]**

Set custom properties for a device-specific mesh.

## Parameters

<i>hMesh</i>	device mesh handle
<i>property</i>	property tag
<i>value</i>	new mesh property value

## Returns

The method should return *true* if the property tag was recognised and the request could be executed, *false* otherwise.

## Note

Currently only a single mesh property request type will be sent, but this may be extended in future versions:

- MESHPROPERTY\_MODULATEMATERIALPHA
  - if *value*==0 (default) disable material alpha information in textured mesh groups (only use texture alpha channel).
  - if *value*<>0 modulate (mix) material alpha values with texture alpha maps.

## Default action:

None, returns *false*.

**17.20.3.56 virtual bool oapi::GraphicsClient::clbkSetMeshTexture ( **DEVMESHHANDLE** *hMesh*, **DWORD** *texidx*, **SURFHANDLE** *tex* ) [inline], [virtual]**

Replace a texture in a device-specific mesh.

## Parameters

<i>hMesh</i>	device mesh handle
<i>texidx</i>	texture index ( $\geq 0$ )
<i>tex</i>	texture handle

## Returns

Should return *true* if operation successful, *false* otherwise.

## Default action:

None, returns *false*.

17.20.3.57 `virtual bool oapi::GraphicsClient::clbkSetSurfaceColourKey ( SURFHANDLE surf, DWORD ckey )`  
[inline], [virtual]

Set transparency colour key for a surface.

## Parameters

<i>surf</i>	surface handle
<i>ckey</i>	transparency colour key value

## Default action:

None, returns false.

## Note

Derived classes should overload this method if the renderer supports colour key transparency for surfaces.

**17.20.3.58** `virtual bool oapi::GraphicsClient::clbkSplashLoadMsg ( const char * msg, int line ) [inline], [protected], [virtual]`

Display a load status message on the splash screen.

Called repeatedly while a simulation session is loading, to allow the client to echo load status messages on its splash screen if desired.

## Parameters

<i>msg</i>	Pointer to load status message string
<i>line</i>	message line to be displayed (0 or 1), where 0 indicates a group or category heading, and 1 indicates an individual action relating to the most recent group.

## Returns

Should return true if it displays the message, false if not.

## Default action:

None, returns false.

**17.20.3.59** `virtual void oapi::GraphicsClient::clbkStoreMeshPersistent ( MESHHANDLE hMesh, const char * fname ) [inline], [protected], [virtual]`

Store a persistent mesh template.

Called when a plugin loads a mesh with `oapiLoadMeshGlobal`, to allow the client to store a copy of the mesh in client-specific format. Whenever the mesh is required later, the client can create an instance as a copy of the template, rather than creating it by converting from Orbiter's mesh format.

## Parameters

<i>hMesh</i>	mesh handle
<i>fname</i>	mesh file name

## Default action:

None.

## Note

Use `oapiMeshGroup` to obtain mesh data and convert them to a suitable format.

the mesh templates loaded with `oapiLoadMeshGlobal` are shared between all vessel instances and should never be edited. Vessels should make individual copies of the mesh before modifying them (e.g. for animations)

The file name is provided to allow the client to parse the mesh directly from file, rather than copying it from the `hMesh` object, or to use an alternative mesh file.

The file name contains a path relative to Orbiter's main mesh directory.

**17.20.3.60 virtual void oapi::GraphicsClient::clbkUpdate ( bool *running* ) [inline], [protected], [virtual]**

Per-frame update notification.

Called once per frame, after the logical world state has been updated, but before [clbkRenderScene\(\)](#), to allow the client to perform any logical state updates.

**Parameters**

<i>running</i>	true if simulation is running, false if paused.
----------------	---

**Default action:**

None.

**Note**

Unlike [clbkPreStep](#) and [clbkPostStep](#), this method is also called while the simulation is paused.

**17.20.3.61 virtual bool oapi::GraphicsClient::clbkUseLaunchpadVideoTab ( ) const [inline], [protected], [virtual]**

Launchpad video tab indicator.

Indicate if the the default video tab in the Orbiter launchpad dialog is to be used for obtaining user video preferences. If a derived class returns false here, the video tab is not shown.

**Returns**

true if the module wants to use the video tab in the launchpad dialog, false otherwise.

**Default action:**

Return true.

**17.20.3.62 virtual int oapi::GraphicsClient::clbkVisEvent ( OBJHANDLE *hObj*, VISHANDLE *vis*, DWORD *msg*, UINT *context* ) [virtual]**

Message callback for a visual object.

**Parameters**

<i>hObj</i>	handle of the object that created the message
<i>vis</i>	client-supplied identifier for the visual
<i>msg</i>	event identifier
<i>context</i>	message context

**Returns**

Function should return 1 if it processes the message, 0 otherwise.

**Default action:**

None, returns 0.

**Note**

Messages are generated by Orbiter for objects that have been registered with [RegisterVisObject](#) by the client, until they are un-registered with [UnregisterVisObject](#).

Currently only vessel objects create visual messages.

For currently supported event types, see [Identifiers for visual events](#).

The *vis* pointer passed to this function is the same as that provided by [RegisterVisObject](#). It can be used by the client to identify the visual object for which the message was created.

## See also

[RegisterVisObject](#), [UnregisterVisObject](#), [Identifiers for visual events](#)

17.20.3.63 `bool oapi::GraphicsClient::ElevationGrid ( ELEVHANDLE emgr, int ilat, int ilng, int lvl, int pilat, int pilng, int plvl, INT16 * pelev, INT16 * elev, double * emean = 0 ) const`

Constructs a synthetic elevation grid for a tile by interpolating ancestor elevation data.

## Parameters

	<i>emgr</i>	elevation manager handle (retrieve with <code>oapiElevationManager</code> )
in	<i>ilat</i>	patch latitude index
in	<i>ilng</i>	patch longitude index
in	<i>lvl</i>	patch resolution level
in	<i>pilat</i>	ancestor latitude index
in	<i>pilng</i>	ancestor longitude index
in	<i>plvl</i>	ancestor resolution level
in	<i>pelev</i>	pointer to ancestor elevation grid data
out	<i>elev</i>	pointer to array receiving interpolated elevation grid data
out	<i>emean</i>	pointer to variable receiving mean elevation data

## Note

This function is used by the surface managers to construct an elevation grid for a tile for which no native elevation data are available.

The specified ancestor must be an actual ancestor of the destination tile, i.e. the area of the destination tile must be contained in the ancestor area.

17.20.3.64 `void oapi::GraphicsClient::GetBaseShadowGeometry ( OBJHANDLE hBase, MESHHANDLE ** mesh_sh, double ** elev, DWORD * nmesh_sh ) const`

Returns base meshes in a format that can be used for shadow projections.

## Parameters

<i>hBase</i>	surface base handle
<i>mesh_sh</i>	list of base object meshes
<i>elev</i>	list of object elevation references [m]
<i>nmesh_sh</i>	length of <i>mesh_sh</i> list

## Note

This method returns the mesh geometry (without textures and materials) for all mesh objects rendered *after* shadows. Unlike [GetBaseStructures\(\)](#), this does not merge mesh groups from different objects, so shadow projections can be calculated on a per-object basis (onto the local horizon plane).

the *elev* list is filled with elevation offsets of each object from the reference plane of the base.

17.20.3.65 `void oapi::GraphicsClient::GetBaseStructures ( OBJHANDLE hBase, MESHHANDLE ** mesh_bs, DWORD * nmesh_bs, MESHHANDLE ** mesh_as, DWORD * nmesh_as ) const`

Returns meshes for generic base objects.

## Parameters

<i>hBase</i>	surface base handle
--------------	---------------------

<i>mesh_bs</i>	mesh list for objects rendered before shadows (NULL if none)
<i>nmesh_bs</i>	list length of mesh_bs list
<i>mesh_as</i>	mesh list for objects rendered after shadows (NULL if none)
<i>nmesh_as</i>	list length of mesh_as list

**Note**

The lists contain mesh objects as well as generic object primitives (blocks, tanks, hangars, etc.)

All generic objects are separated into objects rendered before and after shadows, and compressed into one mesh each, such that all objects with the same textures are merged into a single group.

**17.20.3.66 DWORD oapi::GraphicsClient::GetBaseTileList ( OBJHANDLE *hBase*, const SurfileSpec \*\* *tile* ) const**

Returns a list of high-res surface tile specifications for a base.

**Parameters**

<i>hBase</i>	surface base handle
<i>tile</i>	pointer to a list of tile specifications, or NULL if none defined

**Returns**

number of surface tiles defined for the base

**17.20.3.67 DWORD oapi::GraphicsClient::GetCelestialMarkers ( const LABELLIST \*\* *cm\_list* ) const**

Returns an array of celestial marker lists.

**Parameters**

<i>cm_list</i>	array of marker lists
----------------	-----------------------

**Returns**

number of lists in the array

**See also**

[LABELLIST](#)

**17.20.3.68 const void\* oapi::GraphicsClient::GetConfigParam ( DWORD *paramtype* ) const**

Returns a pointer to an Orbiter configuration parameter.

This function can be used to access various configuration parameters defined in the Orbiter core (e.g. user selections in the Launchpad dialog box).

**Parameters**

<i>paramtype</i>	Parameter identifier (see <a href="#">Configuration parameter identifiers</a> )
------------------	---

**Returns**

Pointer to parameter

**Note**

The pointer must be cast into the appropriate variable type. The variable types can be found in the parameter type list ([Configuration parameter identifiers](#)).

**Example:**

```
double lightscale = *(double*)GetConfigParam (
    CFGPRM_SURFACLELIGHTBRT);
```

17.20.3.69 SURFHANDLE oapi::GraphicsClient::GetMFDSurface ( int *mfd* ) const

Returns the surface containing an [MFD](#) display.

## Parameters

<i>mfd</i>	MFD identifier (0 <= <i>mfd</i> < MAXMFD)
------------	---

## Returns

[MFD](#) display surface handle, or NULL if not available

17.20.3.70 DWORD oapi::GraphicsClient::GetPopupList ( const HWND \*\* *hPopupWnd* ) const

returns a list of popup windows owned by the render window.

## Parameters

out	<i>hPopupWnd</i>	on exit, points to a list of window handles
-----	------------------	---

## Returns

Number of entries in the list.

## Note

The list returned by this method contains the handles of popup windows that are to be rendered on top of the render viewport (e.g. dialog boxes).

A client can use this list if it requires a special method of displaying the popup windows. Typically, this is the case in fullscreen render modes, where the dialog contents may need to be blitted manually into the render surface.

17.20.3.71 DWORD oapi::GraphicsClient::GetSurfaceMarkers ( OBJHANDLE *hObj*, const LABELLIST \*\* *sm\_list* ) const

Returns an array of surface marker lists for a planet.

## Parameters

<i>hObj</i>	planet handle
<i>sm_list</i>	array of marker lists

## Returns

number of lists in the array

## Note

*hObj* must refer to a planet or moon. Other objects are not supported.

## See also

[LABELLIST](#)

17.20.3.72 SURFHANDLE oapi::GraphicsClient::GetVCHUDSurface ( const VCHUDSPEC \*\* *hudspec* ) const

Returns the surface containing the virtual cockpit HUD.

## Parameters

out	<i>hudspec</i>	pointer to structure containing mesh and group index, and size parameters of VC HUD object
-----	----------------	--

## Returns

HUD surface handle, or NULL if not available

17.20.3.73 **SURFHANDLE** oapi::GraphicsClient::GetVCMFDSurface ( *int mfd, const VCMFDSPEC \*\* mfdspec* ) const

Returns the surface containing a virtual cockpit [MFD](#) display.

## Parameters

in	<i>mfd</i>	<a href="#">MFD</a> identifier ( $0 \leq mfd < \text{MAXMFD}$ )
out	<i>mfdspec</i>	pointer to structure containing mesh and group index of the VC <a href="#">MFD</a> display object

## Returns

[MFD](#) display surface handle, or NULL if not available

17.20.3.74 **VIDEODATA\*** oapi::GraphicsClient::GetVideoData ( ) [inline]

Returns a pointer to the VideoData structure.

This structure contains the user selection for video parameters as stored in the Orbiter.cfg file. You can use this structure to retrieve and present video options to the user, or ignore it and define your own method (e.g. reading/writing to a separate config file)

## Returns

pointer to [VIDEODATA](#) structure containing default video settings

17.20.3.75 **HWND** oapi::GraphicsClient::LaunchpadVideoTab ( ) const [inline], [protected]

Returns the window handle of the 'video' tab of the Orbiter Launchpad dialog.

If clbkUseLaunchpadVideoTab() is overloaded to return false, this function will return NULL.

17.20.3.76 **virtual BOOL** oapi::GraphicsClient::LaunchpadVideoWndProc ( *HWND hWnd, UINT uMsg, WPARAM wParam, LPARAM lParam* ) [virtual]

Message handler for 'video' tab in Orbiter Launchpad dialog.

Overload this method to display and retrieve video parameters using the Launchpad video tab. This method acts like a standard Windows dialog message handler.

## Parameters

<i>hWnd</i>	window handle for video tab
<i>uMsg</i>	Windows message
<i>wParam</i>	WPARAM message value
<i>lParam</i>	LPARAM message value

## Returns

The return value depends on the message type and the action taken.

## Default action:

Do nothing, return FALSE.

17.20.3.77 DWORD oapi::GraphicsClient::LoadConstellationLines ( DWORD *n*, ConstRec \* *rec* )

Load constellation line data from Orbiter's data base file.

Load up to '*n*' constellation lines from the default constellation data base.

**Parameters**

<i>n</i>	Requested number of lines
<i>rec</i>	Pointer to an array receiving the data.

**Returns**

The actual number of lines loaded.

**Note**

*rec* must be allocated to size  $\geq n$  on call.

17.20.3.78 DWORD oapi::GraphicsClient::LoadStars ( DWORD *n*, StarRec \* *rec* )

Load star data from Orbiter's data base file.

Load up to '*n*' data records from the default data base (in decreasing order of apparent magnitude).

**Parameters**

<i>n</i>	Requested number of stars
<i>rec</i>	Pointer to an array receiving the data.

**Returns**

The actual number of loaded stars

**Note**

*rec* must be allocated to size  $\geq n$  on call.

17.20.3.79 HBITMAP oapi::GraphicsClient::ReadImageFromFile ( const char \* *fname*, UINT *w* = 0, UINT *h* = 0 )  
[protected]

Read an image from a file into a bitmap.

**Parameters**

<i>fname</i>	file name
<i>fmt</i>	image format
<i>w</i>	width of image after scaling (0 to keep original width)
<i>h</i>	height of image after scaling (0 to keep original height)

**Note**

This function can read different image formats (bmp, jpg, png, tif)

**See also**

[ReadImageFromMemory](#), [WriteImageToFile](#)

17.20.3.80 HBITMAP oapi::GraphicsClient::ReadImageFromMemory ( BYTE \* *pBuf*, DWORD *nBuf*, UINT *w*, UINT *h* )  
[protected]

Read an image from a memory buffer.

## Parameters

<i>pBuf</i>	pointer to memory buffer
<i>nBuf</i>	size of memory buffer
<i>w</i>	width of image after scaling (0 to keep original width)
<i>h</i>	height of image after scaling (0 to keep original height)

## Note

This function automatically recognises different image formats in the memory buffer (bmp, jpg, png, tif)

This function can be used to read in an image from a resource stored in the executable file (see Windows API functions LoadResource, LockResource, SizeofResource)

## See also

[ReadImageFromFile](#), [WriteImageDataToFile](#)

17.20.3.81 void oapi::GraphicsClient::RegisterVisObject ( **OBJHANDLE hObj**, **VISHANDLE vis** )

Register a new visual object with Orbiter.

## Parameters

<i>hObj</i>	handle of the object to register the visual with
<i>vis</i>	identifier for the visual (passed to the message callback function)

## Note

When the client creates a visual for an orbiter object (such as vessels and planets), it must register them with the core by calling RegisterVisObject. This will allow the visual to receive event notifications via clbkVisEvent. Visuals should not be persistent, but should be created when an object comes into visual range of an observer camera, and deleted when the object moves out of visual range.

If a client supports multiple views, it should not register visuals for an object in each view, but only once when the object is rendered in any of the views, and unregister when the object is no longer rendered in any of the views.

*vis* should be a nonzero handle that allows the client to uniquely identify the visual (e.g. a pointer to a client-specific visual object instance). The handle is passed to the clbkVisEvent method, and also to any [VESSEL](#) methods that use VISHANDLEs.

For vessel visuals, RegisterVisObject will trigger a [VESSEL2::clbkVisualCreated](#) notification to the vessel module, if it exists.

## See also

[UnregisterVisObject](#), [clbkVisEvent](#), [clbkVisualCreated](#)

## 17.20.3.82 void oapi::GraphicsClient::Render2DOverlay ( ) [protected]

Notifies Orbiter to to initiate rendering of the 2D scene overlay.

The 2D overlay is used to render 2D instrument panels, HUD, the info boxes at the top left and right of the screen, etc. This function should typically be called at the end of [clbkRenderScene](#), after the 3D scene has been rendered, but before the rendering environment is released. During the execution of this function, Orbiter will call the [clbkRender2DPanel](#) function several times to allow the client to build up the 2D layer.

## Note

Orbiter will *not* acquire a [Sketchpad](#) environment while executing this function, because the graphics driver may not allow to lock surfaces for drawing while in render mode. If a [Sketchpad](#) environment is required to draw on top of the render window (for example for displaying specific HUD elements), it is acquired after clbkRenderScene returns.

## See also

[clbkRenderScene](#), [clbkRender2DPanel](#)

**17.20.3.83 virtual LRESULT oapi::GraphicsClient::RenderWndProc ( HWND *hWnd*, UINT *uMsg*, WPARAM *wParam*, LPARAM *lParam* ) [virtual]**

Render window message handler.

Derived classes should also call the base class method to allow default message processing.

## Parameters

<i>hWnd</i>	render window handle
<i>uMsg</i>	Windows message identifier
<i>wParam</i>	WPARAM message parameter
<i>lParam</i>	LPARAM message parameter

## Returns

The return value depends on the message being processed.

## Note

This is the standard Windows message handler for the render window.

This method currently intercepts only the WM\_CLOSE and WM\_DESTROY messages, and passes everything else to the Orbiter core message handler.

**17.20.3.84 bool oapi::GraphicsClient::TexturePath ( const char \* *fname*, char \* *path* ) const**

Return the full path for a texture file.

Returns the fully qualified path for texture file 'fname' in 'path', relative to the orbiter root directory. The search method conforms to the standard orbiter convention (first search under Textures2, then under Textures directory) Example: for fname="mypath\\tex1.dds", this may return ".\Textures2\mypath\tex1.dds" or ".\Textures\mypath\tex1.dds" Return value is false if no file is found in either directory

## Parameters

<i>fname</i>	texture file name (with path relative to an Orbiter texture directory)
<i>path</i>	string into which the full path is copied

## Returns

true if file was found, false otherwise.

**17.20.3.85 void oapi::GraphicsClient::UnregisterVisObject ( OBJHANDLE *hObj* )**

Unregister a visual before deleting it.

## Parameters

<i>hObj</i>	handle of the object for which the visual is un-registered.
-------------	---

## Note

Before the client deletes a visual (e.g. when it runs out of the camera visual range) it must unregister it from the core.

Once the visual is un-registered, Orbiter will no longer generate visual events via clbkVisEvent for it.

For vessel visuals, UnregisterVisObject will trigger a [VESSEL2::clbkVisualDestroyed](#) notification to the vessel module, if it exists.

## See also

[RegisterVisObject](#), [clbkVisEvent](#)

**17.20.3.86** `bool oapi::GraphicsClient::WriteImageDataToFile ( const ImageData & data, const char * fname, ImageFileFormat fmt = IMAGE_JPG, float quality = 0.7f )` [protected]

Write a block of raw image data to a formatted image file.

## Parameters

<code>data</code>	image specification structure
<code>fname</code>	output file name (relative to orbiter root directory)
<code>fmt</code>	output format
<code>quality</code>	requested image quality, if supported by the format

## Returns

`true` on success, `false` if inconsistencies in the image specifications were detected (see notes)

## Note

The following limitations to the provided image data currently apply:

- `data.bpp` must be 24
- `data.stride` must be aligned to 4 bytes, i.e. `(data.width * data.bpp + 31) & ~31) >> 3`
- `data.bufsize` must be  $\geq$  `data.stride * data.height`

## See also

[ImageData](#), [ImageFileFormat](#)

The documentation for this class was generated from the following file:

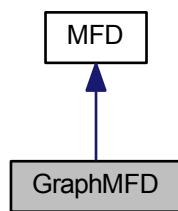
- OrbiterSDK/include/GraphicsAPI.h

## 17.21 GraphMFD Class Reference

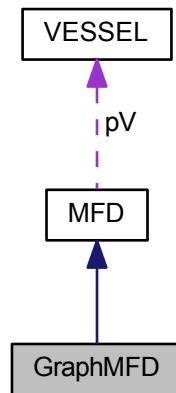
This class is derived from [MFD](#) and provides a template for [MFD](#) modes containing 2D graphs.

```
#include <MFD.h>
```

Inheritance diagram for GraphMFD:



Collaboration diagram for GraphMFD:



### Public Member Functions

- **GraphMFD** (DWORD w, DWORD h, **VESSEL** \*vessel)  
*Constructor. Creates a new **GraphMFD**.*
- int **AddGraph** (void)  
*Adds a new graph to the **MFD**.*
- void **AddPlot** (int g, float \*absc, float \*data, int ndata, int col, int \*ofs=0)  
*Adds a plot to an existing graph.*
- void **SetRange** (int g, int axis, float rmin, float rmax)  
*Sets a fixed range for the x or y axis of a graph.*
- void **SetAutoRange** (int g, int axis, int p=-1)  
*Allows the graph to set its range automatically according to the range of the plots.*
- void **SetAutoTicks** (int g, int axis)  
*Calculates tick intervals for a given graph and axis.*
- void **SetAxisTitle** (int g, int axis, char \*title)  
*Sets the title for a given graph and axis.*
- void **Plot** (HDC hDC, int g, int h0, int h1, const char \*title=0)  
*Displays a graph.*
- void **FindRange** (float \*d, int ndata, float &dmin, float &dmax) const  
*Determines the range of an array of data.*

### Protected Attributes

- int **ngraph**
- struct GraphMFD::GRAPH \* **graph**

#### 17.21.1 Detailed Description

This class is derived from **MFD** and provides a template for **MFD** modes containing 2D graphs.

This class is derived from **MFD** and provides a template for **MFD** modes containing 2D graphs. An example is the ascent profile recorder in the samples\CustomMFD folder.

## 17.21.2 Constructor & Destructor Documentation

### 17.21.2.1 GraphMFD::GraphMFD ( **DWORD** *w*, **DWORD** *h*, **VESSEL** \* *vessel* )

Constructor. Creates a new [GraphMFD](#).

#### Parameters

<i>w</i>	width of the <a href="#">MFD</a> display (pixel)
<i>h</i>	height of the <a href="#">MFD</a> display (pixel)
<i>vessel</i>	pointer to <a href="#">VESSEL</a> interface associated with the <a href="#">MFD</a>

## 17.21.3 Member Function Documentation

### 17.21.3.1 int GraphMFD::AddGraph ( void )

Adds a new graph to the [MFD](#).

#### Returns

graph identifier

#### Note

This function allocates data for a new graph. To display plots in the new graph, one or more calls to [AddPlot](#) are required.

### 17.21.3.2 void GraphMFD::AddPlot ( int *g*, float \* *absc*, float \* *data*, int *ndata*, int *col*, int \* *ofs* = 0 )

Adds a plot to an existing graph.

#### Parameters

<i>g</i>	graph identifier
<i>absc</i>	pointer to array containing the abscissa (x-axis) values.
<i>data</i>	pointer to array containing the data (y-axis) values.
<i>ndata</i>	number of data points
<i>col</i>	plot colour index
<i>ofs</i>	pointer to data offset (optional)

#### Note

Data arrays are not copied, so they should not be deleted after the call to [AddPlot\(\)](#).

*col* is used as an index to select a pen for the plot using the [SelectDefaultPen](#) function. Valid range is the same as for [SelectDefaultPen\(\)](#).

If defined, *ofs* is the index of the first plot value in the data array. The plot is drawn using the points *ofs* to *ndata*-1, followed by points 0 to *ofs*-1. This allows to define continuously updated plots without having to copy blocks of data within the arrays.

### 17.21.3.3 void GraphMFD::FindRange ( float \* *d*, int *ndata*, float & *dmin*, float & *dmax* ) const

Determines the range of an array of data.

#### Parameters

<i>d</i>	data array
<i>ndata</i>	number of data
<i>dmin</i>	minimum value on return
<i>dmax</i>	maximum value on return

17.21.3.4 void GraphMFD::Plot ( *HDC hDC*, *int g*, *int h0*, *int h1*, *const char \* title* = 0 )

Displays a graph.

**Parameters**

<i>hDC</i>	Windows device context
<i>g</i>	graph identifier
<i>h0</i>	upper boundary of plot area (pixel)
<i>h1</i>	lower boundary of plot area (pixel)
<i>title</i>	graph title

**Note**

This function should be called from Update to paint the graph(s) into the provided device context.

17.21.3.5 void GraphMFD::SetAutoRange ( *int g*, *int axis*, *int p* = -1 )

Allows the graph to set its range automatically according to the range of the plots.

**Parameters**

<i>g</i>	graph identifier
<i>axis</i>	axis identifier (0=x, 1=y)
<i>p</i>	plot identifier (-1=all)

**Note**

If *p* >= 0, then *p* specifies the plot used for determining the graph range. If *p* = -1, then all of the graph's plots are used to determine the range.

17.21.3.6 void GraphMFD::SetAutoTicks ( *int g*, *int axis* )

Calculates tick intervals for a given graph and axis.

**Parameters**

<i>g</i>	graph identifier
<i>axis</i>	axis identifier (0=x, 1=y)

**Note**

This function is called from within SetRange and normally doesn't need to be called explicitly by derived classes.

17.21.3.7 void GraphMFD::SetTitle ( *int g*, *int axis*, *char \* title* )

Sets the title for a given graph and axis.

**Parameters**

<i>g</i>	graph identifier
<i>axis</i>	axis identifier (0=x, 1=y)
<i>title</i>	axis title

#### Note

The [MFD](#) may append an extension of the form "x \<scale\>" to the title, where <scale> is a scaling factor applied to the tick labels of the axis. It is therefore a good idea to finish the title with the units applicable to the data of this axis, so that for example a title "Altitude: km" may become "Altitude: km x 1000".

#### 17.21.3.8 void GraphMFD::SetRange ( int *g*, int *axis*, float *rmin*, float *rmax* )

Sets a fixed range for the x or y axis of a graph.

#### Parameters

<i>g</i>	graph identifier
<i>axis</i>	axis identifier (0=x, 1=y)
<i>rmin</i>	minimum value
<i>rmax</i>	maximum value

#### Note

The range applies to all plots in the graph.

The documentation for this class was generated from the following file:

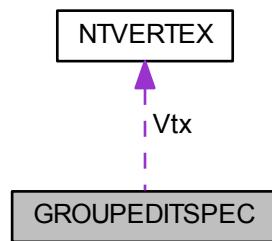
- Orbitersdk/include/[MFDAPI.h](#)

## 17.22 GROUPEDITSPEC Struct Reference

Structure used by [oapiEditMeshGroup](#) to define the group elements to be replaced or modified.

```
#include <OrbiterAPI.h>
```

Collaboration diagram for GROUPEDITSPEC:



#### Public Attributes

- DWORD [flags](#)  
*flags* (see [Mesh group editing flags](#))

- DWORD [UsrFlag](#)  
*Replacement for group UsrFlag entry.*
- [NTVERTEX \\* Vtx](#)  
*Replacement for group vertices.*
- DWORD [nVtx](#)  
*Number of vertices to be replaced.*
- WORD \* [vIdx](#)  
*Index list for vertices to be replaced.*

#### 17.22.1 Detailed Description

Structure used by [oapiEditMeshGroup](#) to define the group elements to be replaced or modified.

##### Note

Only the group elements specified in the *flags* entry will be replaced or modified. The elements that are to remain unchanged can be left undefined in the [GROUPEDITSPEC](#) structure. For example, if only GRPEDI←T\_VTXCRDX is specified, only the 'X' fields in the Vtx array need to be assigned. To replace individual vertices in the group, the nVtx entry should contain the number of vertices to be replaced, the vIdx array should contain the indices ( $\geq 0$ ) of the vertices to be replaced, and Vtx should contain the new vertex values of those vertices. If vIdx==NULL, vertices are replaced in sequence from the beginning of the group's vertex list. nVtx must be less or equal the number of vertices in the group.

##### See also

[oapiEditMeshGroup](#), Mesh group editing flags

The documentation for this struct was generated from the following file:

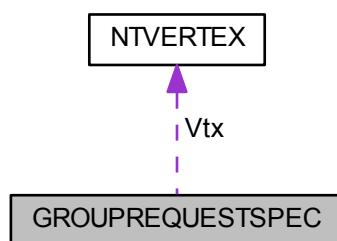
- Orbitersdk/include/OrbiterAPI.h

## 17.23 GROUPREQUESTSPEC Struct Reference

Structure used by [oapiGetMeshGroup](#) containing data buffers to be filled with vertex and index data.

```
#include <OrbiterAPI.h>
```

Collaboration diagram for GROUPREQUESTSPEC:



## Public Attributes

- **NTVERTEX \* Vtx**  
*Vertex buffer.*
- **DWORD nVtx**  
*Number of vertices to return.*
- **WORD \* VtxPerm**  
*Vertex permutation index list.*
- **WORD \* Idx**  
*Triangle index buffer.*
- **DWORD nIdx**  
*Number of indices to return.*
- **WORD \* IdxPerm**  
*Triangle permutation index list.*
- **DWORD MtrlIdx**  
*Material index.*
- **DWORD TexIdx**  
*Texture index.*

### 17.23.1 Detailed Description

Structure used by [oapiGetMeshGroup](#) containing data buffers to be filled with vertex and index data.

The documentation for this struct was generated from the following file:

- Orbitersdk/include/[OrbiterAPI.h](#)

## 17.24 HELPCONTEXT Struct Reference

Context information for an Orbiter ingame help page.

```
#include <OrbiterAPI.h>
```

## Public Attributes

- **char \* helpfile**
- **char \* topic**
- **char \* toc**
- **char \* index**

### 17.24.1 Detailed Description

Context information for an Orbiter ingame help page.

See also

[oapiOpenHelp](#)

The documentation for this struct was generated from the following file:

- Orbitersdk/include/[OrbiterAPI.h](#)

## 17.25 HUDPARAM Union Reference

Mode-specific parameters for HUD mode settings.

```
#include <OrbiterAPI.h>
```

### Public Attributes

- struct {  
    OBJHANDLE hRef  
    *orbit HUD reference object (NULL for auto)*  
} **HUDorbit**
- struct {  
    DWORD NavIdx  
    *docking HUD nav receiver index (>= 0)*  
} **HUDdocking**

### 17.25.1 Detailed Description

Mode-specific parameters for HUD mode settings.

#### See also

[oapiSetHUDMode\(int,const HUDPARAM\\*\)](#)

The documentation for this union was generated from the following file:

- Orbitersdk/include/OrbiterAPI.h

## 17.26 oapi::ImageData Struct Reference

Structure for defining a raw image.

```
#include <GraphicsAPI.h>
```

### Public Attributes

- BYTE \* **data**  
    *pointer to image data*
- UINT **bufsize**  
    *allocated size of data*
- UINT **width**  
    *image width [pixel]*
- UINT **height**  
    *image height [pixel]*
- UINT **bpp**  
    *bits per pixel*
- UINT **stride**  
    *number of bytes per scan line*

### 17.26.1 Detailed Description

Structure for defining a raw image.

The documentation for this struct was generated from the following file:

- Orbitersdk/include/GraphicsAPI.h

## 17.27 oapi::IVECTOR2 Union Reference

Integer-valued 2-D vector type.

```
#include <DrawAPI.h>
```

### Public Attributes

- long **data** [2]  
*vector data array*
- struct {
 long **x**  
*vector x coordinate*
 long **y**  
*vector y coordinate*
};

### 17.27.1 Detailed Description

Integer-valued 2-D vector type.

#### Note

This structure is designed to be compatible with the Windows POINT type.

The documentation for this union was generated from the following file:

- Orbitersdk/include/DrawAPI.h

## 17.28 oapi::GraphicsClient::LABELLIST Struct Reference

Label list description for celestial and surface markers.

```
#include <GraphicsAPI.h>
```

### Public Attributes

- char **name** [64]  
*list name*
- LABELSPEC \* **list**  
*marker array*
- int **length**  
*length of the marker array*
- int **colour**  
*marker colour index (0-5)*

- int **shape**  
*marker shape index (0-4)*
- float **size**  
*marker size factor*
- float **distfac**  
*marker distance cutout factor*
- DWORD **flag**  
*reserved*
- bool **active**  
*active list flag*

#### 17.28.1 Detailed Description

Label list description for celestial and surface markers.

The documentation for this struct was generated from the following file:

- Orbitersdk/include/GraphicsAPI.h

## 17.29 LaunchpadItem Class Reference

Base class to define launchpad items.

```
#include <OrbiterAPI.h>
```

### Public Member Functions

- **LaunchpadItem ()**  
*Constructor. Creates a new launchpad item.*
- virtual **~LaunchpadItem ()**  
*Destructor. Destroys the launchpad item.*
- virtual char \* **Name ()**  
*Derived classes should return a pointer to the string to appear in the Launchpad "Extra" list.*
- virtual char \* **Description ()**  
*Derived classes should return a pointer to the the string containing a description of the item. The description is shown next to the Launchpad list whenever the item is selected.*
- virtual bool **OpenDialog (HINSTANCE hInst, HWND hLaunchpad, int resId, DLGPROC pDlg)**  
*Opens a dialog box associated with the launchpad item.*
- virtual bool **clbkOpen (HWND hLaunchpad)**  
*This method is called whenever the user opens the item by double-clicking on the list or clicking the "Edit" button below the list.*
- virtual int **clbkWriteConfig ()**  
*This method is called whenever the item should write its current state to a file.*

### Public Attributes

- **LAUNCHPADITEM\_HANDLE hItem**

### 17.29.1 Detailed Description

Base class to define launchpad items.

[LaunchpadItem](#) is the base class for objects that can be inserted into the parameter list of the Extra tab of the Orbiter Launchpad dialog. The Extra tab provides a mechanism for plugin modules to allow users to set global parameters specific to an addon. [LaunchpadItem](#) is notified whenever the user selects the item from the list, and when parameters need to be read from or written to disk.

#### See also

[oapiRegisterLaunchpadItem](#), [oapiUnregisterLaunchpadItem](#)

### 17.29.2 Member Function Documentation

#### 17.29.2.1 virtual bool LaunchpadItem::clbkOpen ( HWND *hLaunchpad* ) [virtual]

This method is called whenever the user opens the item by double-clicking on the list or clicking the "Edit" button below the list.

##### Parameters

<i>hLaunchpad</i>	The window handle of the Launchpad dialog
-------------------	---

##### Returns

Currently ignored. Should be *true* if the derived class processes this callback function.

**Default action:** Nothing; returns false.

##### Note

The derived class can use this function to open a dialog box or some other means of allowing the user to set addon-specific parameters.

#### 17.29.2.2 virtual int LaunchpadItem::clbkWriteConfig ( ) [virtual]

This method is called whenever the item should write its current state to a file.

##### Returns

Currently ignored. Should be 0.

**Default action:** Nothing; returns 0.

##### Note

This function is called before a simulation session is launched, before Orbiter shuts down, and before the module is deactivated. It allows the module to write its current state to a file, so it can re-load its settings the next time Orbiter is launched.

You can either use default C or C++ methods to open a file for output, or you can use the [oapiOpenFile\(\)](#) method.

Modules should never write to the global Orbiter.cfg configuration file. Any addons that are not active when Orbiter overwrites Orbiter.cfg will lose their settings, since their [clbkWriteConfig\(\)](#) method cannot be called.

The best place to read the settings stored during a previous session is in the overloaded [LaunchpadItem](#) constructor. Use [oapiOpenFile](#) or another file access method compatible with the way the file was written. The parameter settings should then be stored in class member variables, and modified by user interaction.

## 17.29.2.3 virtual char\* LaunchpadItem::Description( ) [virtual]

Derived classes should return a pointer to the string containing a description of the item. The description is shown next to the Launchpad list whenever the item is selected.

## Returns

Pointer to the descriptive string, or NULL if there is none.

**Default action:** Returns NULL (no description).

## Note

Line breaks can be inserted into the description with a carriage return/newline sequence (\r\n).

## 17.29.2.4 virtual char\* LaunchpadItem::Name( ) [virtual]

Derived classes should return a pointer to the string to appear in the Launchpad "Extra" list.

## Returns

Pointer to the item label in the list.

**Default action:** Returns NULL (no entry in the list).

## 17.29.2.5 virtual bool LaunchpadItem::OpenDialog( HINSTANCE hInst, HWND hLaunchpad, int resId, DLGPROC pDlg ) [virtual]

Opens a dialog box associated with the launchpad item.

## Parameters

<i>hInst</i>	module instance handle
<i>hLaunchpad</i>	launchpad window handle
<i>resId</i>	integer resource ID of the dialog box
<i>pDlg</i>	dialog box message handler

## Returns

Currently this function always returns *true*.

## Note

This function is usually called in the body of [LaunchpadItem::clbkOpen\(\)](#).

It is an alternative to the standard Windows DialogBox function. It has the advantage that a pointer to the [LaunchpadItem](#) instance is passed as IParam to the message handler with the WM\_INITDIALOG message. In all subsequent calls to the handler, the [LaunchpadItem](#) instance pointer can be obtained with a call to *GetWindowLong (hWnd, DWL\_USER)*, where hWnd is the dialog box handle passed to the message handler.

The documentation for this class was generated from the following file:

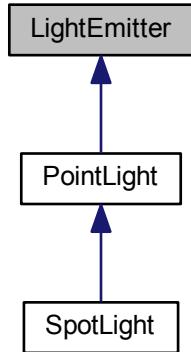
- Orbitersdk/include/[OrbiterAPI.h](#)

## 17.30 LightEmitter Class Reference

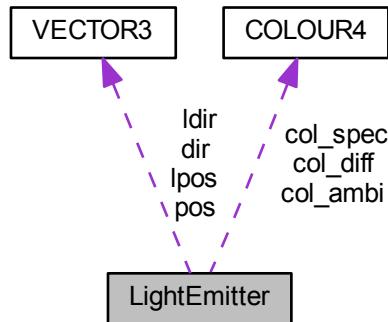
Base class for defining a light source that can illuminate other objects.

```
#include <OrbiterAPI.h>
```

Inheritance diagram for LightEmitter:



Collaboration diagram for LightEmitter:



## Public Types

- enum **TYPE** { **LT\_NONE**, **LT\_POINT**, **LT\_SPOT**, **LT\_DIRECTIONAL** }
- enum **VISIBILITY** { **VIS\_EXTERNAL** =1, **VIS\_COCKPIT** =2, **VIS\_ALWAYS** =3 }

## Public Member Functions

- [LightEmitter \(\)](#)  
*Create a light source with default parameters.*
- [LightEmitter \(COLOUR4 diffuse, COLOUR4 specular, COLOUR4 ambient\)](#)  
*Create a light source with specific colour parameters.*
- [TYPE GetType \(\) const](#)  
*Returns the light source type.*

- **VISIBILITY GetVisibility () const**  
*Returns the light visibility mode.*
- **void SetVisibility (VISIBILITY vis)**  
*Set the light visibility mode.*
- **const COLOUR4 & GetDiffuseColour () const**
- **const COLOUR4 & GetSpecularColour () const**
- **const COLOUR4 & GetAmbientColour () const**
- **void Activate (bool act)**  
*Activate or deactivate the light source.*
- **bool IsActive () const**  
*Returns activation status of light source.*
- **void SetPosition (const VECTOR3 &p)**  
*Set light source position.*
- **VECTOR3 GetPosition () const**  
*Returns the current source position.*
- **void SetPositionRef (const VECTOR3 \*p)**  
*Set the reference pointer to the light source position.*
- **const VECTOR3 \* GetPositionRef () const**  
*Returns a pointer to the position reference variable.*
- **void ShiftExplicitPosition (const VECTOR3 &ofs)**  
*Adds an offset to the explicit position definition of the source.*
- **void SetDirection (const VECTOR3 &d)**  
*Set light source direction.*
- **VECTOR3 GetDirection () const**  
*Returns the current source direction.*
- **void SetDirectionRef (const VECTOR3 \*d)**  
*Set the reference pointer to the light source direction.*
- **const VECTOR3 \* GetDirectionRef () const**  
*Returns a pointer to the direction reference variable.*
- **const OBJHANDLE GetObjectHandle () const**  
*Returns the handle of the object the light source is attached to.*
- **void SetIntensity (double in)**
- **double GetIntensity () const**
- **void SetIntensityRef (double \*pin)**
- **const double \* GetIntensityRef () const**

#### Protected Member Functions

- **OBJHANDLE Attach (OBJHANDLE hObj)**
- **OBJHANDLE Detach ()**

#### Protected Attributes

- **TYPE ltype**
- **VISIBILITY visibility**
- **OBJHANDLE hRef**
- **bool active**
- **COLOUR4 col\_diff**
- **COLOUR4 col\_spec**
- **COLOUR4 col\_ambi**
- **const double \* intens**
- **double lintens**

- const **VECTOR3** \* **pos**
- const **VECTOR3** \* **dir**
- **VECTOR3** **lpos**
- **VECTOR3** **ldir**

### 17.30.1 Detailed Description

Base class for defining a light source that can illuminate other objects.

### 17.30.2 Constructor & Destructor Documentation

#### 17.30.2.1 **LightEmitter::LightEmitter ( )**

Create a light source with default parameters.

##### Note

Creates a light source with white spectrum for diffuse, specular and emissive colour components. Intensity is set to 1, position (for point source objects) is set to (0,0,0) and direction (for spot and directional lights) is set to (0,0,1). To change these, use [SetPosition](#), [SetPositionRef](#), [SetDirection](#), [SetDirectionRef](#), [SetIntensity](#), [SetIntensityRef](#)

#### 17.30.2.2 **LightEmitter::LightEmitter ( COLOUR4 *diffuse*, COLOUR4 *specular*, COLOUR4 *ambient* )**

Create a light source with specific colour parameters.

##### Parameters

<i>diffuse</i>	light source's contribution to lit objects' diffuse colour component
<i>specular</i>	light source's contribution to lit objects' specular colour component
<i>ambient</i>	light source's contribution to lit objects' ambient colour component

##### Note

Intensity is set to 1, position (for point source objects) is set to (0,0,0) and direction (for spot and directional lights) is set to (0,0,1). To change these, use [SetPosition](#), [SetPositionRef](#), [SetIntensity](#), [SetIntensityRef](#)

### 17.30.3 Member Function Documentation

#### 17.30.3.1 **void LightEmitter::Activate ( bool *act* )**

Activate or deactivate the light source.

##### Parameters

<i>act</i>	if <i>true</i> , activates the light source. Otherwise, deactivates the light source
------------	--

##### See also

[IsActive](#)

#### 17.30.3.2 **VECTOR3 LightEmitter::GetDirection ( ) const**

Returns the current source direction.

##### Returns

Current source direction.

**Note**

The source direction is only relevant for spot and directional lights. It is ignored for point lights.

If the source is attached to an object (see [Attach](#)) the returned vector is the source direction in local object coordinates. Otherwise, the returned vector is the global source direction.

**See also**

[SetDirection](#), [SetDirectionRef](#), [GetDirectionRef](#)

**17.30.3.3 const VECTOR3\* LightEmitter::GetDirectionRef ( ) const**

Returns a pointer to the direction reference variable.

**Returns**

Pointer to the variable defining the light source direction

**Note**

If the direction is defined explicitly (see [SetDirection](#)), this method simply returns a pointer to the `ldir` member variable. Otherwise, it returns the pointer specified in [SetDirectionRef](#).

**See also**

[SetDirection](#), [SetDirectionRef](#), [GetDirection](#)

**17.30.3.4 const OBJHANDLE LightEmitter::GetObjectHandle ( ) const [inline]**

Returns the handle of the object the light source is attached to.

**Returns**

Object handle, or `NULL` if not attached

**17.30.3.5 VECTOR3 LightEmitter::GetPosition ( ) const [inline]**

Returns the current source position.

**Returns**

Current source position [**m**]

**Note**

The source position is only relevant for point and spot lights. It is ignored for directional lights

If the source is attached to an object (see [Attach](#)) the returned vector is the source position in local object coordinates. Otherwise, the returned vector is the global source position.

**See also**

[SetPosition](#), [SetPositionRef](#), [GetPositionRef](#)

### 17.30.3.6 const VECTOR3\* LightEmitter::GetPositionRef ( ) const

Returns a pointer to the position reference variable.

#### Returns

Pointer to the variable defining the light source position

#### Note

If the position is defined explicitly (see [GetPosition](#)), this method simply returns a pointer to the `lpos` member variable. Otherwise, it returns the pointer specified in [GetPositionRef](#).

#### See also

[GetPosition](#), [GetPositionRef](#), [GetPosition](#)

### 17.30.3.7 VISIBILITY LightEmitter::GetVisibility ( ) const [inline]

Returns the light visibility mode.

#### Returns

visibility mode

### 17.30.3.8 bool LightEmitter::IsActive ( ) const

Returns activation status of light source.

#### Returns

*true* if source is active, *false* otherwise.

#### See also

[Activate](#)

### 17.30.3.9 void LightEmitter::SetDirection ( const VECTOR3 & d )

Set light source direction.

#### Parameters

<i>p</i>	new direction (in object or global coordinates)
----------	---

#### Note

The vector argument should be normalised to length 1.

The source direction is only relevant for spot and directional lights. It is ignored for point lights.

If the source is attached to an object (see [Attach](#)) the direction is interpreted in the local object coordinates. Otherwise, the direction is taken to be in global coordinates.

#### See also

[GetDirection](#), [SetDirectionRef](#), [GetDirectionRef](#)

### 17.30.3.10 void LightEmitter::SetDirectionRef ( const VECTOR3 \* d )

Set the reference pointer to the light source direction.

**Parameters**

<i>d</i>	pointer to vector defining the source direction
----------	---

**Note**

This method links the direction of the light source to an externally defined vector. By modifying the vector elements, the light source can be re-directed instantly.

The vector variable pointed to by *d* must remain valid for the lifetime of the light source.

The source direction is only relevant for spot and directional lights. It is ignored for point lights

**See also**

[SetDirection](#), [GetDirection](#), [GetDirectionRef](#)

**17.30.3.11 void LightEmitter::SetPosition ( const VECTOR3 & *p* )**

Set light source position.

**Parameters**

<i>p</i>	new position [ <b>m</b> ] (in object or global coordinates)
----------	---

**Note**

The source position is only relevant for point and spot lights. It is ignored for directional lights

If the source is attached to an object (see [Attach](#)) the position is interpreted in the local object coordinates. Otherwise, the position is taken to be in global coordinates.

After a displacement of the vessel's centre of mass (see [VESSEL::ShiftCG](#)), all light sources that define their position explicitly (via [SetPosition](#)) are updated automatically. Light sources with implicit position definition (via [SetPositionRef](#)) must update their positions themselves.

**See also**

[GetPosition](#), [SetPositionRef](#), [GetPositionRef](#)

**17.30.3.12 void LightEmitter::SetPositionRef ( const VECTOR3 \* *p* )**

Set the reference pointer to the light source position.

**Parameters**

<i>p</i>	pointer to vector defining the source position
----------	--

**Note**

This method links the position of the light source to an externally defined vector. By modifying the vector elements, the light source can be re-positioned instantly.

The vector variable pointed to by *p* must remain valid for the lifetime of the light source.

The source position is only relevant for point and spot lights. It is ignored for directional lights

**See also**

[GetPosition](#), [GetPositionRef](#)

**17.30.3.13 void LightEmitter::SetVisibility ( VISIBILITY *vis* ) [inline]**

Set the light visibility mode.

**Parameters**

<i>vis</i>	visibility mode
------------	-----------------

**17.30.3.14 void LightEmitter::ShiftExplicitPosition ( const VECTOR3 & *ofs* )**

Adds an offset to the explicit position definition of the source.

**Parameters**

<i>ofs</i>	offset vector in local vessel coordinates
------------	---

**Note**

This method has only an effect for light sources whose positions are defined explicitly (via [SetPosition](#)). If the source position is defined implicitly (via [SetPositionRef](#)), this method has no effect. Modules that define their light source positions via implicit references must keep the positions up to date themselves (e.g. reacting to shifts in the centre of gravity).

**See also**

[SetPosition](#), [SetPositionRef](#), [VESSEL::ShiftCG](#)

The documentation for this class was generated from the following file:

- OrbiterSDK/include/OrbiterAPI.h

**17.31 LISTENTRY Struct Reference**

Entry specification for selection list entry.

```
#include <OrbiterAPI.h>
```

**Public Attributes**

- char **name** [64]  
*entry string*
- DWORD **flag**  
*entry flags*

**17.31.1 Detailed Description**

Entry specification for selection list entry.

The documentation for this struct was generated from the following file:

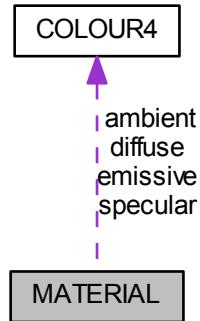
- OrbiterSDK/include/OrbiterAPI.h

**17.32 MATERIAL Struct Reference**

material definition

```
#include <OrbiterAPI.h>
```

Collaboration diagram for MATERIAL:



#### Public Attributes

- COLOUR4 diffuse  
*diffuse component*
- COLOUR4 ambient  
*ambient component*
- COLOUR4 specular  
*specular component*
- COLOUR4 emissive  
*emissive component*
- float power  
*specular power*

#### 17.32.1 Detailed Description

material definition

The documentation for this struct was generated from the following file:

- Orbitersdk/include/OrbiterAPI.h

## 17.33 MATRIX3 Union Reference

3x3-element matrix

```
#include <OrbiterAPI.h>
```

#### Public Attributes

- double data [9]  
*array data interface (row-sorted)*

```

• struct {
    double m11
    double m12
    double m13
    double m21
    double m22
        double m23
        double m31
        double m32
        double m33
    };

```

*named data interface*

### 17.33.1 Detailed Description

3x3-element matrix

The documentation for this union was generated from the following file:

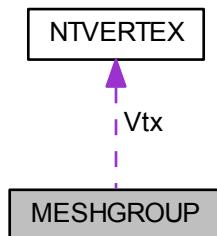
- Orbitersdk/include/OrbiterAPI.h

## 17.34 MESHGROUP Struct Reference

Defines a mesh group (subset of a mesh).

```
#include <OrbiterAPI.h>
```

Collaboration diagram for MESHGROUP:



### Public Attributes

- **NTVERTEX** \* **Vtx**  
*vertex list*
- **WORD** \* **Idx**  
*index list*
- **DWORD** **nVtx**  
*vertex count*
- **DWORD** **nIdx**  
*index count*

- DWORD [MtrlIdx](#)  
*material index (>= 1, 0=none)*
- DWORD [TexIdx](#)  
*texture index (>= 1, 0=none)*
- DWORD [UsrFlag](#)  
*user-defined flag*
- WORD [zBias](#)  
*z bias*
- WORD [Flags](#)  
*internal flags*

#### 17.34.1 Detailed Description

Defines a mesh group (subset of a mesh).

A mesh group contains a vertex list, an index list, a material and texture index, and a set of flags.

The documentation for this struct was generated from the following file:

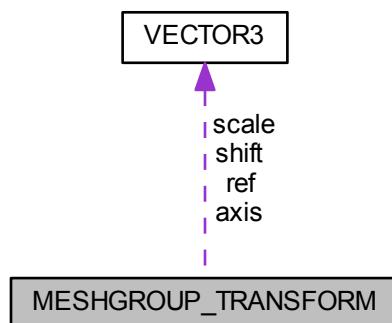
- Orbitersdk/include/[OrbiterAPI.h](#)

## 17.35 MESHGROUP\_TRANSFORM Struct Reference

This structure defines an affine mesh group transform (translation, rotation or scaling).

```
#include <OrbiterAPI.h>
```

Collaboration diagram for MESHGROUP\_TRANSFORM:



#### Public Types

- enum { **TRANSLATE**, **ROTATE**, **SCALE** }

#### Public Attributes

- union {
   
 struct {

```

VECTOR3 ref
  rotation reference point
VECTOR3 axis
  rotation axis direction
  float angle
  rotation angle [rad]
} rotparam
struct {
  VECTOR3 shift
  translation vector
} transparam
struct {
  VECTOR3 scale
  scaling factor
} scaleparam
} P

```

- int **nmesh**

*mesh index (>= 0)*

- int **ngrp**

*group index (>= 0, or < 0 to indicate entire mesh)*

- enum MESHGROUP\_TRANSFORM:: { ... } **transform**

*transformation flag*

### 17.35.1 Detailed Description

This structure defines an affine mesh group transform (translation, rotation or scaling).

#### See also

[VESSEL::MeshgroupTransform](#)

The documentation for this struct was generated from the following file:

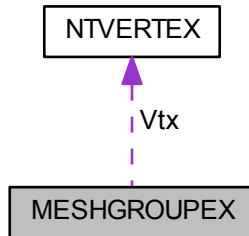
- Orbitersdk/include/OrbiterAPI.h

## 17.36 MESHGROUPEX Struct Reference

extended mesh group definition

```
#include <OrbiterAPI.h>
```

Collaboration diagram for MESHGROUPEX:



### Public Attributes

- **NTVERTEX \* Vtx**  
*vertex list*
- **WORD \* Idx**  
*index list*
- **DWORD nVtx**  
*vertex count*
- **DWORD nIdx**  
*index count*
- **DWORD MtrlIdx**  
*material index (>= 1, 0=none)*
- **DWORD TexIdx**  
*texture index (>= 1, 0=none)*
- **DWORD UsrFlag**  
*user-defined flag*
- **WORD zBias**  
*z bias*
- **WORD Flags**  
*internal flags*
- **DWORD TexIdxEx [MAXTEX]**  
*additional texture indices*
- **float TexMixEx [MAXTEX]**  
*texture mix values*

#### 17.36.1 Detailed Description

extended mesh group definition

The documentation for this struct was generated from the following file:

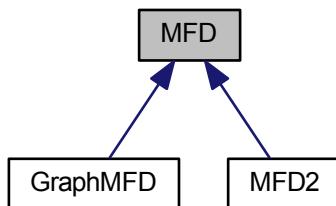
- Orbitersdk/include/OrbiterAPI.h

### 17.37 MFD Class Reference

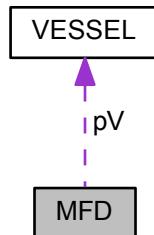
This class acts as an interface for user defined MFD (multi functional display) modes.

```
#include <MFDAPI.h>
```

Inheritance diagram for MFD:



Collaboration diagram for MFD:



#### Public Member Functions

- **MFD** (DWORD w, DWORD h, [VESSEL](#) \*vessel)  
*Constructor. Creates a new [MFD](#).*
- virtual [~MFD](#) ()  
*[MFD](#) destructor.*
- virtual void [Update](#) (HDC hDC)=0  
*Callback function: Orbiter calls this method when the [MFD](#) needs to update its display.*
- void [InvalidateDisplay](#) ()  
*Force a display update in the next frame.*
- void [InvalidateButtons](#) ()  
*Force the [MFD](#) buttons to be redrawn.*
- void [Title](#) (HDC hDC, const char \*title) const  
*Displays a title string in the upper left corner of the [MFD](#) display.*
- HPEN [SelectDefaultPen](#) (HDC hDC, DWORD i) const

- **HFONT SelectDefaultFont (HDC hDC, DWORD i) const**

*Selects a predefined MFD font into the device context.*
- **virtual bool ConsumeKeyBuffered (DWORD key)**

*MFD keyboard handler for buffered keys.*
- **virtual bool ConsumeKeyImmediate (char \*kstate)**

*MFD keyboard handler for immediate (unbuffered) keys.*
- **virtual bool ConsumeButton (int bt, int event)**

*MFD button handler.*
- **virtual char \* ButtonLabel (int bt)**

*Return the label for the specified MFD button.*
- **virtual int ButtonMenu (const MFDBUTTONMENU \*\*menu) const**

*Defines a list of short descriptions for the various MFD mode button/key functions.*
- **virtual void WriteStatus (FILEHANDLE scn) const**

*Called when the MFD should write its status to a scenario file.*
- **virtual void ReadStatus (FILEHANDLE scn)**

*Called when the MFD should read its status from a scenario file.*
- **virtual void StoreStatus () const**
- **virtual void RecallStatus ()**

#### Protected Attributes

- **DWORD W**
- **DWORD H**

*width and height of MFD display area (pixel)*
- **DWORD cw**
- **DWORD ch**

*character width, height of standard MFD font 0 (pixel)*
- **VESSEL \* pV**

*pointer to vessel interface*

#### Friends

- class **MFD2**
- class **Instrument\_User**

#### 17.37.1 Detailed Description

This class acts as an interface for user defined MFD (multi functional display) modes.

This class acts as an interface for user defined MFD (multi functional display) modes. It provides control over keyboard and mouse functions to manipulate the MFD mode, and allows the module to draw the MFD display. The MFD class is a pure virtual class. Each userdefined MFD mode requires the definition of a specialised class derived from MFD. An example for a generic MFD mode implemented as a plugin module can be found in orbitersdk\samples\CustomMFD.

#### 17.37.2 Constructor & Destructor Documentation

##### 17.37.2.1 MFD::MFD ( DWORD w, DWORD h, VESSEL \* vessel )

Constructor. Creates a new MFD.

## Parameters

<i>w</i>	width of the <a href="#">MFD</a> display (pixel)
<i>h</i>	height of the <a href="#">MFD</a> display (pixel)
<i>vessel</i>	pointer to <a href="#">VESSEL</a> interface associated with the <a href="#">MFD</a> .

## Note

[MFD](#) is a pure virtual function, so it can't be instantiated directly. It is used as a base class for specialised [MFD](#) modes.

New [MFD](#) modes are registered by a call to [oapiRegisterMFDMode\(\)](#). Whenever the new mode is selected by the user, Orbiter sends a [OAPI\\_MSG\\_MFD\\_OPENED](#) signal to the message handler, to which the module should respond by creating the [MFD](#) mode and returning a pointer to it. Orbiter will automatically destroy the [MFD](#) mode when it is turned off.

## 17.37.3 Member Function Documentation

17.37.3.1 `virtual char* MFD::ButtonLabel( int bt ) [inline], [virtual]`

Return the label for the specified [MFD](#) button.

## Parameters

<i>bt</i>	button identifier
-----------	-------------------

## Returns

The function should return a 0-terminated character string of up to 3 characters, or NULL if the button is unlabelled.

**Bug** This function should really return a const char\*

17.37.3.2 `virtual int MFD::ButtonMenu( const MFDBUTTONMENU ** menu ) const [inline], [virtual]`

Defines a list of short descriptions for the various [MFD](#) mode button/key functions.

## Parameters

<i>menu</i>	on return this should point to an array of button menu items. (see notes)
-------------	---

## Returns

number of items in the list

## Note

The definition of the MFDBUTTONMENU struct is:

```
typedef struct {
const char *line1, *line2;
char selchar;
} MFDBUTTONMENU;
```

containing up to 2 lines of short description, and the keyboard key to trigger the function.

Each line should contain no more than 16 characters, to fit into the [MFD](#) display.

If the menu item only uses one line, then line2 should be set to NULL.

menu==0 is valid and indicates that the caller only requires the number of items, not the actual list.

A typical implementation would be

```

int MyMFD::ButtonMenu (const MFDBUTTONMENU **menu) const
{
    static const MFDBUTTONMENU mnu[2] = {
        {"Select target", 0, 'T'},
        {"Select orbit", "reference", 'R'}
    };
    if (*menu) *menu = mnu;
    return 2;
}

```

### 17.37.3.3 virtual bool MFD::ConsumeButton( int *bt*, int *event* ) [inline], [virtual]

**MFD** button handler.

**MFD** button handler. This function is called when the user performs a mouse click on a panel button associated with the **MFD**.

Parameters

<i>bt</i>	button identifier.
<i>event</i>	mouse event ( <i>see PANEL_MOUSE_xxx constants in orbitersdk.h</i> )

Returns

The function should return true if it processes the button event, false otherwise.

Note

This function is invoked as a response to a call to `oapiProcessMFDButton()` in a vessel module.

Typically, `ConsumeButton()` will call `ConsumeKeyBuffered()` or `ConsumeKeyImmediate()` to emulate a key-board event.

### 17.37.3.4 virtual bool MFD::ConsumeKeyBuffered( DWORD *key* ) [inline], [virtual]

**MFD** keyboard handler for buffered keys.

Parameters

<i>key</i>	key code ( <i>see OAPI_KEY_xxx constants in orbitersdk.h</i> )
------------	--

Returns

The function should return true if it recognises and processes the key, false otherwise.

### 17.37.3.5 virtual bool MFD::ConsumeKeyImmediate( char \* *kstate* ) [inline], [virtual]

**MFD** keyboard handler for immediate (unbuffered) keys.

Parameters

<i>kstate</i>	keyboard state.
---------------	-----------------

Returns

The function should return true only if it wants to inhibit Orbiter's default immediate key handler for this time step completely.

Note

The state of single keys can be queried by the KEYDOWN macro.

The immediate key handler is useful where an action should take place while a key is pressed.

### 17.37.3.6 void MFD::InvalidateButtons( )

Force the **MFD** buttons to be redrawn.

Force the **MFD** buttons to be redrawn. This is useful to alert Orbiter that the **MFD** mode has dynamically modified its button labels.

#### Note

Orbiter will call the **MFD::ButtonLabel** method to retrieve the new button labels. Therefore this must have been updated to return the new labels before calling **InvalidateButtons()**.

If the **MFD** is part of a 2-D panel view or 3-D virtual cockpit view, Orbiter calls the **VESSEL2::clbkMFDMode()** method to allow the vessel to update its button labels. If the **MFD** is one of the two glass cockpit **MFD** displays, the buttons are updated internally.

If the **MFD** is displayed in an external window, Orbiter calls the **ExternMFD::clbkRefreshButtons()** method to refresh the buttons.

### 17.37.3.7 void MFD::InvalidateDisplay( )

Force a display update in the next frame.

Force a display update in the next frame. This function causes Orbiter to call the **MFD**'s **Update** method in the next frame.

### 17.37.3.8 virtual void MFD::ReadStatus( FILEHANDLE *scn* ) [inline], [virtual]

Called when the **MFD** should read its status from a scenario file.

#### Parameters

<i>scn</i>	scenario file handle (read only)
------------	----------------------------------

#### Note

Use a loop with **oapiReadScenario\_nextline()** to read **MFD** status parameters from the scenario.

The default behaviour is to do nothing. **MFD** modes which need to read status parameters should overwrite this function.

### 17.37.3.9 virtual void MFD::RecallStatus( ) [inline], [virtual]

Called after creation of the **MFD** mode, to allow the mode to restore its status from the last save.

#### Note

This is the counterpart to the **StoreStatus()** function. It should be implemented if and only if **StoreStatus()** is implemented.

### 17.37.3.10 HFONT MFD::SelectDefaultFont( HDC *hDC*, DWORD *i* ) const

Selects a predefined **MFD** font into the device context.

#### Parameters

<i>hDC</i>	Windows device context
<i>i</i>	font index

#### Returns

Handle of font being replaced.

**Note**

Currently supported are font indices 0-3, where

- 0 = standard [MFD](#) font (Courier, fixed pitch)
- 1 = small font (Arial, variable pitch)
- 2 = small font, rotated 90 degrees (Arial, variable pitch)
- 3 = medium font, (Arial, variable pitch)

In principle, an [MFD](#) mode may create its own fonts using the standard Windows CreateFont function, but using the predefined fonts is preferred to provide a consistent [MFD](#) look.

Default fonts are scaled automatically according to the [MFD](#) display size.

**Deprecated** This method is deprecated. MFD implementations should derive from [MFD2](#) and use the device-independent [MFD2::GetDefaultFont](#) method instead.

**17.37.3.11 HOPEN MFD::SelectDefaultPen ( HDC *hDC*, DWORD *i* ) const**

Selects a predefined pen into the device context.

**Parameters**

<i>hDC</i>	Windows device context
<i>i</i>	pen index

**Returns**

Handle of pen being replaced.

**Note**

Currently supported are pen indices 0-5, where

- 0 = solid, HUD display colour
- 1 = solid, light green
- 2 = solid, medium green
- 3 = solid, medium yellow
- 4 = solid, dark yellow
- 5 = solid, medium grey

In principle, an [MFD](#) mode may create its own pen resources using the standard Windows CreatePen function, but using predefined pens is preferred to provide a consistent [MFD](#) look.

**Deprecated** This method is deprecated. MFD implementations should derive from [MFD2](#) and use the device-independent [MFD2::GetDefaultPen](#) method instead.

**17.37.3.12 virtual void MFD::StoreStatus ( ) const [inline], [virtual]**

Called before destruction of the [MFD](#) mode, to allow the mode to save its status to static memory.

**Note**

This function is called before an [MFD](#) mode is destroyed (either because the [MFD](#) switches to a different mode, or because the [MFD](#) itself is destroyed). It allows the [MFD](#) to back up its status parameters, so it can restore its last status when it is created next time.

Since the [MFD](#) mode instance is about to be destroyed, status parameters should be backed up either in static data members, or outside the class instance.

In principle this function could be implemented by opening a file and calling [WriteStatus\(\)](#) with the file handle. However for performance reasons file I/O should be avoided in this function. The default behaviour is to do nothing. [MFD](#) modes which need to save status parameters should overwrite this function.

#### 17.37.3.13 void MFD::Title ( [HDC](#) *hDC*, const char \* *title* ) const

Displays a title string in the upper left corner of the [MFD](#) display.

##### Parameters

<i>hDC</i>	device context
<i>title</i>	title string (null-terminated)

##### Note

This method should be called from within [Update\(\)](#)

The title string can contain up to approx. 35 characters when displayed in the default Courier [MFD](#) font. This method switches the text colour of the GDI context to white.

**Deprecated** This method is deprecated. MFD implementations should derive from [MFD2](#) and use the device-independent [MFD2::Title](#) method instead.

#### 17.37.3.14 virtual void MFD::Update ( [HDC](#) *hDC* ) [pure virtual]

Callback function: Orbiter calls this method when the [MFD](#) needs to update its display.

##### Parameters

<i>hDC</i>	Windows device context for drawing on the <a href="#">MFD</a> display surface.
------------	--

##### Note

The frequency at which this function is called corresponds to the "MFD refresh rate" setting in Orbiter's parameter settings, unless a redraw is forced by [InvalidateDisplay\(\)](#).

**Deprecated** This method is deprecated. MFD implementations should derive from [MFD2](#) and use the device-independent [MFD2::Update\(oapi::Sketchpad\\*\)](#) method instead.

Implemented in [MFD2](#).

#### 17.37.3.15 virtual void MFD::WriteStatus ( [FILEHANDLE](#) *scn* ) const [inline], [virtual]

Called when the [MFD](#) should write its status to a scenario file.

##### Parameters

<i>scn</i>	scenario file handle (write only)
------------	-----------------------------------

##### Note

Use the oapiWriteScenario\_xxx functions to write [MFD](#) status parameters to the scenario.

The default behaviour is to do nothing. [MFD](#) modes which need to save status parameters should overwrite this function.

The documentation for this class was generated from the following file:

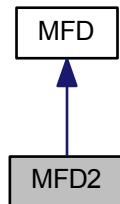
- Orbitersdk/include/[MFDAPi.h](#)

## 17.38 MFD2 Class Reference

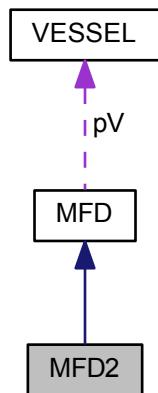
Extended [MFD](#) class.

```
#include <MFDAPi.h>
```

Inheritance diagram for MFD2:



Collaboration diagram for MFD2:



### Public Member Functions

- [MFD2](#) (DWORD w, DWORD h, [VESSEL](#) \*vessel)  
*Constructor. Creates a new [MFD](#).*
- [~MFD2](#) ()  
*[MFD](#) destructor.*
- DWORD [GetWidth](#) () const  
*Returns the [MFD](#) display width.*
- DWORD [GetHeight](#) () const  
*Returns the [MFD](#) display height.*
- void [Update](#) (HDC hDC)

*Dummy implementation of GDI-specific base class method.*

- `virtual bool Update (oapi::Sketchpad *skp)`  
*Callback function: Orbiter calls this method when the [MFD](#) needs to update its display.*
- `void Title (oapi::Sketchpad *skp, const char *title) const`  
*Displays a title string in the upper left corner of the [MFD](#) display.*
- `oapi::Pen * GetDefaultPen (DWORD colidx, DWORD intens=0, DWORD style=1) const`  
*Returns a predefined [MFD](#) pen resource.*
- `oapi::Font * GetDefaultFont (DWORD fontidx) const`  
*Returns a predefined [MFD](#) font resource.*
- `DWORD GetDefaultColour (DWORD colidx, DWORD intens=0) const`  
*Returns the colour value for a specified colour index and intensity.*

## Additional Inherited Members

### 17.38.1 Detailed Description

Extended [MFD](#) class.

[MFD2](#) replaces GDI-specific functions with versions that use the generic Sketchpad class. [MFD](#) addons should derive from [MFD2](#) instead of [MFD](#), to ensure compatibility with non-GDI graphics clients.

### 17.38.2 Constructor & Destructor Documentation

#### 17.38.2.1 [MFD2::MFD2 \( DWORD w, DWORD h, VESSEL \\* vessel \)](#) [inline]

Constructor. Creates a new [MFD](#).

##### Parameters

<code>w</code>	width of the <a href="#">MFD</a> display (pixel)
<code>h</code>	height of the <a href="#">MFD</a> display (pixel)
<code>vessel</code>	pointer to <a href="#">VESSEL</a> interface associated with the <a href="#">MFD</a> .

##### Note

[MFD](#) is a pure virtual function, so it can't be instantiated directly. It is used as a base class for specialised [MFD](#) modes.

New [MFD](#) modes are registered by a call to [oapiRegisterMFDMode\(\)](#). Whenever the new mode is selected by the user, Orbiter sends a `OAPI_MSG_MFD_OPENED` signal to the message handler, to which the module should respond by creating the [MFD](#) mode and returning a pointer to it. Orbiter will automatically destroy the [MFD](#) mode when it is turned off.

### 17.38.3 Member Function Documentation

#### 17.38.3.1 [DWORD MFD2::GetDefaultColour \( DWORD colidx, DWORD intens = 0 \)](#) const

Returns the colour value for a specified colour index and intensity.

##### Parameters

<code>colidx</code>	colour index (see notes)
<code>intens</code>	colour brightness (0=bright, 1=dark)

##### Returns

Colour value in 0xBBGGRR format.

**Note**

Valid colour indices are 0 to 4, where

Index	Function	default colour
0	Main <a href="#">MFD</a> colour	green
1	Auxiliary colour 1	yellow
2	Auxiliary colour 2	white
3	Auxiliary colour 3	red
4	Auxiliary colour 4	blue

The returned colour values can be used to set standard text, pen or brush colours for particular display elements.

**See also**

[oapi::Sketchpad::SetTextColor](#)

**17.38.3.2 oapi::Font\* MFD2::GetDefaultFont ( DWORD *fontidx* ) const**

Returns a predefined [MFD](#) font resource.

**Parameters**

<i>fontidx</i>	font index
----------------	------------

**Returns**

font resource

**Note**

Currently supported are font indices 0-2, where

0 = standard [MFD](#) font (Courier, fixed pitch)  
 1 = small font (Arial, variable pitch)  
 2 = small font, rotated 90 degrees (Arial, variable pitch)

To select the font for drawing in the [MFD](#) display, call the [MFD](#) drawing context's [oapi::Sketchpad::SetFont](#) method.

In principle, an [MFD](#) mode may create its own fonts using the standard Windows CreateFont function, but using the predefined fonts is preferred to provide a consistent [MFD](#) look.

Default fonts are scaled automatically according to the [MFD](#) display size.

**17.38.3.3 oapi::Pen\* MFD2::GetDefaultPen ( DWORD *colidx*, DWORD *intens* = 0, DWORD *style* = 1 ) const**

Returns a predefined [MFD](#) pen resource.

**Parameters**

<i>colidx</i>	pen colour index (see notes)
<i>intens</i>	pen brightness (0=bright, 1=dark)
<i>style</i>	pen style (1=solid, 2=dashed)

**Returns**

pen resource

**Note**

Valid colour indices are 0 to 4, where

Index	Function	default colour
0	Main <a href="#">MFD</a> colour	green
1	Auxiliary colour 1	yellow
2	Auxiliary colour 2	white
3	Auxiliary colour 3	red
4	Auxiliary colour 4	blue

To select the pen for drawing in the [MFD](#) display, call the [MFD](#) drawing context's [oapi::Sketchpad::SetPen](#) method.

The default colours can be overridden by editing [Config/MFD/default.cfg](#).

In principle, an [MFD](#) mode may create its own pen resources using the [oapi::GraphicsClient::clbkCreatePen](#) function, but using predefined pens is preferred to provide a consistent [MFD](#) look, and to avoid excessive allocation of drawing resources.

#### See also

[oapi::Sketchpad::SetPen](#)

#### 17.38.3.4 DWORD [MFD2::GetHeight](#)( ) const [inline]

Returns the [MFD](#) display height.

#### Returns

[MFD](#) display height [pixel]

#### See also

[GetWidth](#)

#### 17.38.3.5 DWORD [MFD2::GetWidth](#)( ) const [inline]

Returns the [MFD](#) display width.

#### Returns

[MFD](#) display width [pixel]

#### See also

[GetHeight](#)

#### 17.38.3.6 void [MFD2::Title](#)( [oapi::Sketchpad](#) \* *skp*, const char \* *title* ) const

Displays a title string in the upper left corner of the [MFD](#) display.

#### Parameters

<i>skp</i>	Drawing context
<i>title</i>	title string (null-terminated)

#### Note

This method should be called from within [Update\(\)](#)

The title string can contain up to approx. 35 characters when displayed in the default Courier [MFD](#) font.

This method switches the text colour of the drawing context to white.

17.38.3.7 void MFD2::Update ( *HDC hDC* ) [inline], [virtual]

Dummy implementation of GDI-specific base class method.

**Note**

Derived classes should overload the [Update\(oapi::Sketchpad\\*\)](#) method instead.

Implements [MFD](#).

17.38.3.8 virtual bool MFD2::Update ( *oapi::Sketchpad \* skp* ) [virtual]

Callback function: Orbiter calls this method when the [MFD](#) needs to update its display.

**Parameters**

<i>skp</i>	Drawing context for drawing on the <a href="#">MFD</a> display surface.
------------	---

**Note**

The frequency at which this function is called corresponds to the "MFD refresh rate" setting in Orbiter's parameter settings, unless a redraw is forced by [InvalidateDisplay\(\)](#).

This function must be overwritten by derived classes.

The documentation for this class was generated from the following file:

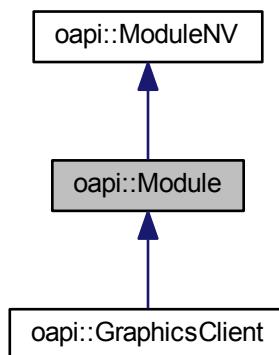
- Orbitersdk/include/[MFD API.h](#)

## 17.39 oapi::Module Class Reference

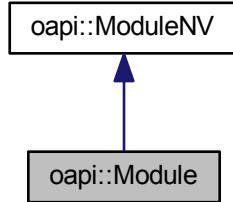
Generic Orbiter plugin interface class.

```
#include <ModuleAPI.h>
```

Inheritance diagram for oapi::Module:



Collaboration diagram for oapi::Module:



## Public Types

- enum `RenderMode` { `RENDER_NONE`, `RENDER_FULLSCREEN`, `RENDER_WINDOW` }  
*Simulation graphics support type.*

## Public Member Functions

- `Module` (HINSTANCE hDLL)  
*Creates a new `Module` instance.*
- `virtual void clbkSimulationStart (RenderMode mode)`  
*Simulation start notification.*
- `virtual void clbkSimulationEnd ()`  
*Simulation end notification.*
- `virtual void clbkPreStep (double simt, double simdt, double mjd)`  
*Time step notification before state update.*
- `virtual void clbkPostStep (double simt, double simdt, double mjd)`  
*Time step notification after state update.*
- `virtual void clbkTimeJump (double simt, double simdt, double mjd)`  
*Discontinuous simulation time jump notification.*
- `virtual void clbkFocusChanged (OBJHANDLE new_focus, OBJHANDLE old_focus)`  
*Change of input focus notification.*
- `virtual void clbkTimeAccChanged (double new_warp, double old_warp)`  
*Change of time acceleration notification.*
- `virtual void clbkNewVessel (OBJHANDLE hVessel)`  
*Vessel creation notification.*
- `virtual void clbkDeleteVessel (OBJHANDLE hVessel)`  
*Vessel destruction notification.*
- `virtual void clbkVesselJump (OBJHANDLE hVessel)`  
*Discontinuous vessel repositioning notification.*
- `virtual void clbkPause (bool pause)`  
*Simulation pause/resume notification.*
- `virtual bool clbkProcessMouse (UINT event, DWORD state, DWORD x, DWORD y)`  
*Process mouse events.*
- `virtual bool clbkProcessKeyboardImmediate (char kstate[256], bool simRunning)`  
*Process immediate keyboard events.*
- `virtual bool clbkProcessKeyboardBuffered (DWORD key, char kstate[256], bool simRunning)`  
*Process buffered keyboard events.*

## Additional Inherited Members

### 17.39.1 Detailed Description

Generic Orbiter plugin interface class.

Defines generic base class which can be used by plugins to provide a set of interface functions to the Orbiter core, and callback functions which can be overloaded by derived classes to react to specific types of events.

### 17.39.2 Member Enumeration Documentation

#### 17.39.2.1 enum oapi::Module::RenderMode

Simulation graphics support type.

##### See also

[clbkSimulationStarted](#)

##### Enumerator

**RENDER\_NONE** no graphics support

**RENDER\_FULLSCREEN** fullscreen mode

**RENDER\_WINDOW** windowed mode

### 17.39.3 Constructor & Destructor Documentation

#### 17.39.3.1 oapi::Module::Module ( *HINSTANCE hDLL* )

Creates a new [Module](#) instance.

##### Parameters

<i>hDLL</i>	DLL library instance handle (see <a href="#">InitModule</a> )
-------------	---

### 17.39.4 Member Function Documentation

#### 17.39.4.1 virtual void oapi::Module::clbkDeleteVessel ( *OBJHANDLE hVessel* ) [virtual]

Vessel destruction notification.

Sent to modules immediately before a vessel is destroyed. After this callback method returns, the object handle (*hVessel*) and will no longer be valid. Modules should make sure that they don't access the vessel in any form after this point.

##### Parameters

<i>hVessel</i>	object handle for the vessel being destroyed.
----------------	---

##### Default action:

Calls [opcDeleteVessel](#), if defined in the module.

#### 17.39.4.2 virtual void oapi::Module::clbkFocusChanged ( *OBJHANDLE new\_focus, OBJHANDLE old\_focus* ) [virtual]

Change of input focus notification.

Called when input focus (keyboard and joystick control) is switched to a new vessel (for example as a result of a call to [oapiSetFocus](#)).

## Parameters

<i>new_focus</i>	handle of vessel receiving the input focus
<i>old_focus</i>	handle of vessel losing focus

## Default action:

Calls [opcFocusChanged](#), if defined in the module.

## Note

Currently only objects of type "vessel" can receive the input focus. This may change in future versions. This callback function is also called at the beginning of the simulation, where *new\_focus* is the vessel receiving the initial focus, and *old\_focus* is NULL. *clbkFocusChanged* is sent to non-vessel modules after the vessels receiving and losing focus have been notified via [VESSEL2::clbkFocusChanged](#).

17.39.4.3 virtual void oapi::Module::clbkNewVessel ( **OBJHANDLE hVessel** ) [inline], [virtual]

Vessel creation notification.

Sent to modules after a new vessel has been created during the simulation run. Not sent for vessels created from the scenario script at the start of a session.

## Parameters

<i>hVessel</i>	object handle for the new vessel
----------------	----------------------------------

## Default action:

None.

17.39.4.4 virtual void oapi::Module::clbkPause ( **bool pause** ) [virtual]

Simulation pause/resume notification.

Called when the pause/resume state of the simulation has changed.

## Parameters

<i>pause</i>	pause/resume state: true if simulation has been paused, false if simulation has been resumed.
--------------	---

## Default action:

Calls [opcPause](#), if defined in the module.

17.39.4.5 virtual void oapi::Module::clbkPostStep ( **double simt, double simdt, double mjd** ) [virtual]

Time step notification after state update.

Called at each time step of the simulation, after the state has been updated to the current simulation time.

## Parameters

<i>simt</i>	current simulation time [s]
<i>simdt</i>	length of the last time step [s]

<i>mjd</i>	simulation time in Modified Julian Date format [days]
------------	---

Default action:

Calls [opcPostStep](#), if defined in the module.

See also

[clbkPreStep](#)

**17.39.4.6 virtual void oapi::Module::clbkPreStep ( double *simt*, double *simdt*, double *mjd* ) [virtual]**

Time step notification before state update.

Called at each time step of the simulation, before the state is updated to the current simulation time. This function is only called when the "physical" state of the simulation is propagated in time. clbkPreStep is not called while the simulation is paused, even if the user moves the camera.

Parameters

<i>simt</i>	simulation time after the currently processed step [s]
<i>simdt</i>	length of the currently processed step [s]
<i>mjd</i>	simulation time after the currently processed step in Modified Julian Date format [days]

Default action:

Calls [opcPreStep](#), if defined in the module.

Note

This function is called by Orbiter after the new time step length (simdt) and simulation time (simt) have been calculated, but before the simulation state is integrated to simt. The parameters passed to clbkPreStep therefore are the values that will be applied in the current simulation step.

See also

[clbkPostStep](#)

**17.39.4.7 virtual bool oapi::Module::clbkProcessKeyboardBuffered ( DWORD *key*, char *kstate*[256], bool *simRunning* ) [inline], [virtual]**

Process buffered keyboard events.

Called to offer buffered keyboard events to the module.

Parameters

<i>key</i>	Key identifier. Corresponds to the OAPI_KEY_xxx constants defined in <a href="#">OrbiterAPI.h</a> .
<i>kstate</i>	State flags for all keyboard keys. This allows to check for modifier keys pressed when the key event was generated. The indices into the kstate list correspond to the OAPI_KEY_xxx constants defined in <a href="#">OrbiterAPI.h</a> . A pressed key is indicated by a set bit 0x80.
<i>simRunning</i>	Indicates that the simulation is running (not paused). This allows a module to differentiate between key processing in running/paused simulation states.

Returns

Returning true prevents the keyboard event from entering the standard Orbiter processing queue (blocking event). Returning false allows Orbiter to also process the event.

Default action:

Nothing, returns false.

**Note**

Even if an overloaded function returns true, the event will still be offered to the other plugin modules through their `clbkProcessKeyboardImmediate` method. It only prevents the standard Orbiter processing of the event. This avoids one module blocking all subsequent modules from receiving the event notification.

**See also**

[clbkProcessKeyboardImmediate](#), [clbkProcessMouse](#)

**17.39.4.8** `virtual bool oapi::Module::clbkProcessKeyboardImmediate ( char kstate[256], bool simRunning ) [inline], [virtual]`

Process immediate keyboard events.

Called to offer immediate keyboard events to the module.

**Parameters**

<i>kstate</i>	State flags for all keyboard keys. The indices into the <i>kstate</i> list correspond to the OAPI_K←EY_xxx constants defined in <a href="#">OrbiterAPI.h</a> . A pressed key is indicated by a set bit 0x80.
<i>simRunning</i>	Indicates that the simulation is running (not paused). This allows a module to differentiate between key processing in running/paused simulation states.

**Returns**

Returning true prevents the keyboard event from entering the standard Orbiter processing queue (blocking event). Returning false allows Orbiter to also process the event.

**Default action:**

Nothing, returns false.

**Note**

Even if an overloaded function returns true, the event will still be offered to the other plugin modules through their `clbkProcessKeyboardBuffered` method. It only prevents the standard Orbiter processing of the event. This avoids one module blocking all subsequent modules from receiving the event notification.

**See also**

[clbkProcessKeyboardBuffered](#), [clbkProcessMouse](#)

**17.39.4.9** `virtual bool oapi::Module::clbkProcessMouse ( UINT event, DWORD state, DWORD x, DWORD y ) [inline], [virtual]`

Process mouse events.

Called to offer a mouse event to the module.

**Parameters**

<i>event</i>	Event type. This is a Windows message identifier (WM_xxx) such as WM_LBUTTONDOWN.
<i>state</i>	Keyboard state during mouse event. This corresponds to the WPARAM value passed to the window message handler for mouse events (e.g. MK_CONTROL).

x	Mouse x position in render window at event
y	Mouse y position in render window at event

**Returns**

Returning true prevents the event from entering the standard Orbiter processing queue (blocking event). Returning false allows Orbiter to also process this event.

**Default action:**

Nothing, returns false.

**Note**

Even if an overloaded function returns true, the event will still be offered to the other plugin modules through their clbkProcessMouse method. It only prevents the standard Orbiter processing of the event. This avoids one module blocking all subsequent modules from receiving the event notification.

Mouse-processing of the Orbiter main menu cannot be blocked.

**See also**

[clbkProcessKeyboardImmediate](#), [clbkProcessKeyboardBuffered](#)

**17.39.4.10 virtual void oapi::Module::clbkSimulationEnd( ) [virtual]**

Simulation end notification.

This method is called immediately before a simulation session is terminated, and before the render window is closed.

**Default action:**

Calls [opcCloseRenderViewport](#), if defined in the module.

**17.39.4.11 virtual void oapi::Module::clbkSimulationStart( RenderMode mode ) [virtual]**

Simulation start notification.

This method is called immediately after a simulation session has been set up (i.e. all objects created and their states set according to the scenario data) and the render window has been opened (if applicable).

**Parameters**

<i>mode</i>	defines the graphics support (none, fullscreen or windowed)
-------------	---

**Default action:**

Calls [opcOpenRenderViewport](#), if defined in the module.

**17.39.4.12 virtual void oapi::Module::clbkTimeAccChanged( double new\_warp, double old\_warp ) [virtual]**

Change of time acceleration notification.

Called when the simulation time acceleration factor changes.

**Parameters**

<i>new_warp</i>	new time acceleration factor
<i>old_warp</i>	old time acceleration factor

Default action:

Calls [opcTimeAccChanged](#), if defined in the module.

#### 17.39.4.13 virtual void oapi::Module::clbkTimeJump ( double *simt*, double *simdt*, double *mjd* ) [inline], [virtual]

Discontinuous simulation time jump notification.

Called after a discontinuous explicit reset of the simulation time (e.g. using the scenario editor).

Parameters

<i>simt</i>	new simulation time relative to session start [s]
<i>simdt</i>	jump interval [s]
<i>mjd</i>	new absolute simulation time in MJD format [days]

Default action:

None.

Note

*simdt* can be negative if a jump to an earlier time was performed.

*simt* can become negative if a jump prior to the session start time was performed.

#### 17.39.4.14 virtual void oapi::Module::clbkVesselJump ( OBJHANDLE *hVessel* ) [inline], [virtual]

Discontinuous vessel repositioning notification.

Sent to modules after a vessel position has been set explicitly (rather than via continuous state propagation. This callback can be used to force a refresh of parameters that depend on vessel position.

Parameters

<i>hVessel</i>	vessel object handle
----------------	----------------------

Default action:

None.

Note

This method is called after a [VESSEL::ShiftCentreOfMass\(\)](#)

The documentation for this class was generated from the following file:

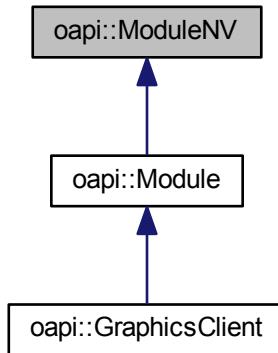
- Orbitersdk/include/ModuleAPI.h

## 17.40 oapi::ModuleNV Class Reference

Generic Orbiter plugin interface class.

```
#include <ModuleAPI.h>
```

Inheritance diagram for oapi::ModuleNV:



### Public Member Functions

- [ModuleNV \(HINSTANCE hDLL\)](#)  
*Creates a new [ModuleNV](#) instance.*
- int [Version \(\) const](#)  
*[Module](#) interface version.*
- HINSTANCE [GetModule \(\) const](#)  
*Returns the module instance handle.*
- double [GetSimTime \(\) const](#)  
*Returns simulation time since session start.*
- double [GetSimStep \(\) const](#)  
*Returns the length of the last time step.*
- double [GetSimMJD \(\) const](#)  
*Returns the absolute simulation time in Modified Julian Date format.*

### Protected Attributes

- int **version**
- HINSTANCE **hModule**

#### 17.40.1 Detailed Description

Generic Orbiter plugin interface class.

Defines generic base class which can be used by plugins to provide a set of interface functions to the Orbiter core. This class contains only the non-virtual set of methods (excluding callback functions). Plugin implementations should normally not derive their interface classes from [oapi::ModuleNV](#), but instead from class [oapi::Module](#) which includes the virtual callback methods.

#### 17.40.2 Constructor & Destructor Documentation

##### 17.40.2.1 oapi::ModuleNV::ModuleNV ( HINSTANCE hDLL )

Creates a new [ModuleNV](#) instance.

**Parameters**

<i>hDLL</i>	DLL library instance handle (see <a href="#">InitModule</a> )
-------------	---

**17.40.3 Member Function Documentation****17.40.3.1 HINSTANCE oapi::ModuleNV::GetModule ( ) const [inline]**

Returns the module instance handle.

**Returns**

[Module](#) instance handle.

**17.40.3.2 double oapi::ModuleNV::GetSimMJD ( ) const**

Returns the absolute simulation time in Modified Julian Date format.

**Returns**

Current Modified Julian Date [days]

**Note**

Orbiter defines the Modified Julian Date (MJD) as JD - 2 400 000.5, where JD is the Julian Date. JD is the interval of time in mean solar days elapsed since 4713 BC January 1 at Greenwich mean noon.

**See also**

[GetSimTime](#)

**17.40.3.3 double oapi::ModuleNV::GetSimStep ( ) const**

Returns the length of the last time step.

**Returns**

Step length [s]

**Note**

This method returns the time difference between the current and previous time frame.  
This parameter is useful for numerical (finite difference) calculation of time derivatives.

**See also**

[GetSimTime](#)

**17.40.3.4 double oapi::ModuleNV::GetSimTime ( ) const**

Returns simulation time since session start.

**Returns**

Simulation session time [s]

**Note**

The simulation session time is useful mainly for time differences. To get an absolute time parameter, use `GetSimMJD`.

**See also**

[GetSimMJD](#), [GetSimStep](#)

**17.40.3.5 int oapi::ModuleNV::Version ( ) const [inline]**

`Module` interface version.

**Returns**

version number

The documentation for this class was generated from the following file:

- `Orbitersdk/include/ModuleAPI.h`

**17.41 NAVDATA Struct Reference**

Navigation transmitter data.

```
#include <OrbiterAPI.h>
```

**Public Attributes**

- `DWORD type`  
*transmitter type id*
- `DWORD ch`  
*transmitter channel (0..639)*
- `double power`  
*transmitter power [arbitrary units]*
- `const char * descr`  
*pointer to transmitter description string*
- `union {`  
  `struct {`  
    `OBJHANDLE hPlanet`  
    *associated planet*  
    `double lng`  
    `double lat`  
    *transmitter location [rad]*  
  `} vor`  
  `struct {`  
    `OBJHANDLE hBase`  
    *associated base*  
    `int npad`  
    *pad number (>= 0)*  
  `} vtol`  
  `struct {`  
    `OBJHANDLE hBase`  
    *associated base*  
    `double appdir`  
    *ILS approach direction [rad].*

```

} ils
struct {
    OBJHANDLE hVessel
    associated vessel
    DOCKHANDLE hDock
    associated docking port
} ids
struct {
    OBJHANDLE hVessel
    associated vessel
} xpdr
};

```

#### 17.41.1 Detailed Description

Navigation transmitter data.

This structure contains both general data (transmitter type, channel, output power and description string) and type-specific data. To query type-specific data, first check the transmitter type, for example

```

NAVDATA ndata;
oapiGetNavData (hNav, &ndata);
if (ndata.type == TRANSMITTER_ILS)
    approach_dir = ndata.ils.appdir;

```

#### Note

The power  $S_0$  of a transmitter is defined in arbitrary units such that the signal  $S(r) = S_0/r^2$  drops to 1 at the maximum range  $r_{\max}$ , given a default receiver, i.e.  $S_0 = r_{\max}^2$ .

#### See also

[oapiGetNavData](#)

The documentation for this struct was generated from the following file:

- Orbitersdk/include/[OrbiterAPI.h](#)

## 17.42 NTVERTEX Struct Reference

vertex definition including normals and texture coordinates

```
#include <OrbiterAPI.h>
```

#### Public Attributes

- float **x**  
*vertex x position*
- float **y**  
*vertex y position*
- float **z**  
*vertex z position*
- float **nx**  
*vertex x normal*
- float **ny**

- float **nz**  
*vertex z normal*
- float **tu**  
*vertex u texture coordinate*
- float **tv**  
*vertex v texture coordinate*

#### 17.42.1 Detailed Description

vertex definition including normals and texture coordinates

The documentation for this struct was generated from the following file:

- Orbitersdk/include/OrbiterAPI.h

## 17.43 ORBITPARAM Struct Reference

Secondary orbital parameters derived from the primary [ELEMENTS](#).

```
#include <OrbiterAPI.h>
```

Inherits orbit.

#### Public Attributes

- double **SMi**  
*semi-minor axis [m]*
- double **PeD**  
*periapsis distance [m]*
- double **ApD**  
*apoapsis distance [m]*
- double **MnA**  
*mean anomaly [rad]*
- double **TrA**  
*true anomaly [rad]*
- double **MnL**  
*mean longitude [rad]*
- double **TrL**  
*true longitude [rad]*
- double **EcA**  
*eccentric anomaly [rad]*
- double **Lec**  
*linear eccentricity [m]*
- double **T**  
*orbit period [s]*
- double **PeT**  
*time to next periapsis passage [s]*
- double **ApT**  
*time to next apoapsis passage [s]*

### 17.43.1 Detailed Description

Secondary orbital parameters derived from the primary [ELEMENTS](#).

This members of this structure provide additional parameters to the primary elements of contained in the [ELEMENTS](#) structure.

#### Note

SMi: for open orbits, this represents the imaginary semi-axis

PeD: distance to lowest point of the orbit from focal point

ApD: distance of highest point of the orbit from focal point. Only defined for closed orbits.

T: orbit period only defined for closed orbits.

PeT: For open orbits, this is negative after periapsis passage

ApT: Only defined for closed orbits.

#### See also

[ELEMENTS](#), [Basics of orbital mechanics](#)

The documentation for this struct was generated from the following file:

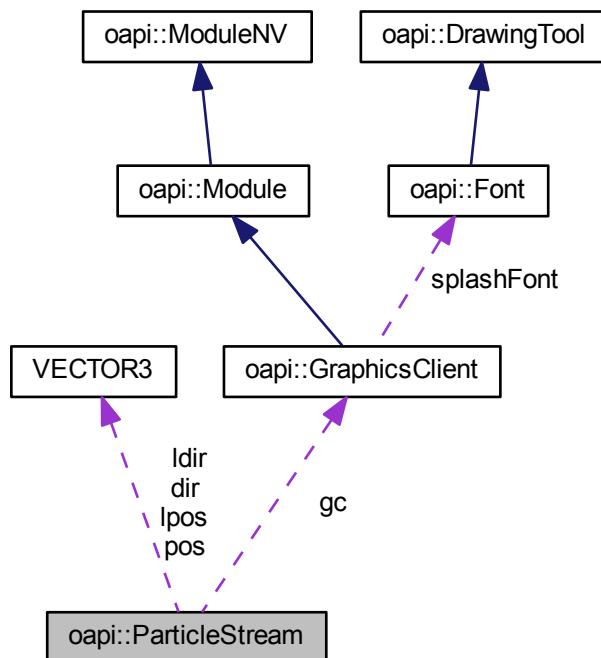
- `Orbitersdk/include/OrbiterAPI.h`

## 17.44 oapi::ParticleStream Class Reference

Defines an array of "particles" (e.g. for exhaust and reentry effects, gas venting, condensation, etc.)

```
#include <GraphicsAPI.h>
```

Collaboration diagram for oapi::ParticleStream:



## Public Member Functions

- **ParticleStream** (`GraphicsClient * _gc, PARTICLESTREAMSPEC * pss`)  
*Constructs a new particle stream.*
- **~ParticleStream** ()  
*Destructor.*
- **void Attach** (`OBJHANDLE hObj, const VECTOR3 * ppos, const VECTOR3 * pdir, const double * srclvl`)  
*Attach the stream to an object.*
- **void Attach** (`OBJHANDLE hObj, const VECTOR3 & _pos, const VECTOR3 & _dir, const double * srclvl`)  
*Attach the stream to an object.*
- **void Detach** ()  
*Detach the stream from its object.*
- **void SetFixedPos** (`const VECTOR3 & _pos`)  
*Reset the particle source point to a constant value.*
- **void SetFixedDir** (`const VECTOR3 & _dir`)  
*Reset the particle source direction to a constant value.*
- **void SetVariablePos** (`const VECTOR3 * ppos`)  
*Reset the particle source point reference.*
- **void SetVariableDir** (`const VECTOR3 * pdir`)  
*Reset the particle source direction reference.*
- **void SetLevelPtr** (`const double * srclvl`)  
*Reset the particle generator strength reference.*
- **const double \* Level** () const  
*Returns the particle generator level.*

## Protected Attributes

- **GraphicsClient \* gc**
- **const double \* level**
- **OBJHANDLE hRef**
- **const VECTOR3 \* pos**
- **const VECTOR3 \* dir**
- **VECTOR3 lpos**
- **VECTOR3 ldir**

## Friends

- class **GraphicsClient**

### 17.44.1 Detailed Description

Defines an array of "particles" (e.g. for exhaust and reentry effects, gas venting, condensation, etc.)

Each particle is represented by a "billboard" object facing the camera and rendered with a semi-transparent texture.

Particle streams experience drag in atmosphere. They also can cast shadows on the ground.

### 17.44.2 Constructor & Destructor Documentation

#### 17.44.2.1 oapi::ParticleStream::ParticleStream ( `GraphicsClient * _gc, PARTICLESTREAMSPEC * pss` )

Constructs a new particle stream.

## Parameters

<i>_gc</i>	pointer to graphics client
<i>pss</i>	particle parameter set

## Note

The particle stream will only start to generate particles once it has been attached to an object with [Attach\(\)](#).

## 17.44.3 Member Function Documentation

**17.44.3.1 void oapi::ParticleStream::Attach ( OBJHANDLE *hObj*, const VECTOR3 \* *ppos*, const VECTOR3 \* *pdir*, const double \* *srclvl* )**

Attach the stream to an object.

## Parameters

<i>hObj</i>	object handle
<i>ppos</i>	pointer to particle source point (object frame)
<i>pdir</i>	pointer to particle direction (object frame)
<i>srclvl</i>	pointer to particle generator level

## Note

This method uses pointers to externally defined position and direction variables which may be modified by orbiter during the lifetime of the particle stream.

**17.44.3.2 void oapi::ParticleStream::Attach ( OBJHANDLE *hObj*, const VECTOR3 & *\_pos*, const VECTOR3 & *\_dir*, const double \* *srclvl* )**

Attach the stream to an object.

## Parameters

<i>hObj</i>	object handle
<i>_pos</i>	particle source point (object frame)
<i>_dir</i>	particle direction (object frame)
<i>srclvl</i>	pointer to particle generator level

## Note

This method uses fixed position and direction variables.

**17.44.3.3 void oapi::ParticleStream::Detach ( )**

Detach the stream from its object.

## Note

After detaching the stream, no new particles will be generated, but the existing particle will persist to the end of their lifetime.

**17.44.3.4 const double\* oapi::ParticleStream::Level ( ) const [inline]**

Returns the particle generator level.

## Returns

pointer to particle generator level (0...1)

17.44.3.5 void oapi::ParticleStream::SetFixedDir ( const VECTOR3 & *dir* )

Reset the particle source direction to a constant value.

## Parameters

<i>_dir</i>	particle direction (reference object frame)
-------------	---

## Note

This method overrides any previous fixed or variable source direction.

17.44.3.6 void oapi::ParticleStream::SetFixedPos ( const VECTOR3 & *\_pos* )

Reset the particle source point to a constant value.

## Parameters

<i>_pos</i>	particle source point (reference object frame)
-------------	--

## Note

This method overrides any previous fixed or variable source position.

17.44.3.7 void oapi::ParticleStream::SetLevelPtr ( const double \* *srclvl* )

Reset the particle generator strength reference.

## Parameters

<i>srclvl</i>	pointer to particle generator strength (0...1)
---------------	--

## Note

The generator strength affects the initial opacity of generated particles.

This method overrides the previous strength reference.

17.44.3.8 void oapi::ParticleStream::SetVariableDir ( const VECTOR3 \* *pdir* )

Reset the particle source direction reference.

## Parameters

<i>pdir</i>	pointer to particle source direction
-------------	--------------------------------------

## Note

This method overrides the previous direction reference and any constant direction value.

17.44.3.9 void oapi::ParticleStream::SetVariablePos ( const VECTOR3 \* *ppos* )

Reset the particle source point reference.

## Parameters

<i>ppos</i>	pointer to particle source point
-------------	----------------------------------

## Note

This method overrides the previous position reference and any constant position value.

The documentation for this class was generated from the following file:

- Orbitersdk/include/GraphicsAPI.h

## 17.45 PARTICLESTREAMSPEC Struct Reference

Particle stream parameters.

```
#include <OrbiterAPI.h>
```

### Public Types

- enum **LTYPE** { **EMISSIVE**, **DIFFUSE** }  
*Particle lighting method.*
- enum **LEVELMAP** {  
  **LVL\_FLAT**, **LVL\_LIN**, **LVL\_SQRT**, **LVL\_PLIN**,  
  **LVL\_PSQLT** }  
*Mapping from level to alpha value (particle opacity)*
- enum **ATMSMAP** { **ATM\_FLAT**, **ATM\_PLIN**, **ATM\_PLOG** }

### Public Attributes

- DWORD **flags**  
*streamspec bitflags*
- double **srcsize**  
*particle size at creation [m]*
- double **srcrate**  
*average particle creation rate [Hz]*
- double **v0**  
*emission velocity [m/s]*
- double **srcspread**  
*velocity spread during creation*
- double **lifetime**  
*average particle lifetime [s]*
- double **growthrate**  
*particle growth rate [m/s]*
- double **atmslowdown**  
*slowdown rate in atmosphere*
- enum **PARTICLESTREAMSPEC::LTYPE** **ltype**  
*render lighting method*
- enum **PARTICLESTREAMSPEC::LEVELMAP** **levelmap**  
*mapping from level to alpha*
- double **lmin**
- double **lmax**  
*min and max levels for level PLIN and PSQRT mapping types*
- enum **PARTICLESTREAMSPEC::ATMSMAP** **atmsmap**  
*mapping from atmospheric params to alpha*
- double **amin**
- double **amax**  
*min and max densities for atms PLIN mapping*
- **SURFHANDLE** **tex**  
*particle texture handle (NULL for default)*

### 17.45.1 Detailed Description

Particle stream parameters.

#### Note

The following mapping methods (LEVELMAP) between stream level L and opacity a are supported:

- **LVL\_FLAT**:  $\alpha = \text{const}$
- **LVL\_LIN**:  $\alpha = L$
- **LVL\_SQRT**:  $\alpha = \sqrt{L}$
- **LVL\_PLIN**:  $\alpha = \begin{cases} 0 & \text{if } L < L_{\min} \\ \frac{L - L_{\min}}{L_{\max} - L_{\min}} & \text{if } L_{\min} \leq L \leq L_{\max} \\ 1 & \text{if } L > L_{\max} \end{cases}$
- **LVL\_PSQRT**:  $\alpha = \begin{cases} 0 & \text{if } L < L_{\min} \\ \sqrt{\frac{L - L_{\min}}{L_{\max} - L_{\min}}} & \text{if } L_{\min} \leq L \leq L_{\max} \\ 1 & \text{if } L > L_{\max} \end{cases}$

### 17.45.2 Member Enumeration Documentation

#### 17.45.2.1 enum PARTICLESTREAMSPEC::LEVELMAP

Mapping from level to alpha value (particle opacity)

##### Enumerator

- LVL\_FLAT** constant (alpha independent of level)
- LVL\_LIN** linear mapping (alpha = level)
- LVL\_SQRT** square root mapping (alpha = sqrt(level))
- LVL\_PLIN** linear mapping in sub-range
- LVL\_PSQRT** square-root mapping in sub-range

#### 17.45.2.2 enum PARTICLESTREAMSPEC::LTYPE

Particle lighting method.

##### Enumerator

- EMISSIVE** emissive lighting (example: plasma stream)
- DIFFUSE** diffuse lighting (example: vapour stream)

The documentation for this struct was generated from the following file:

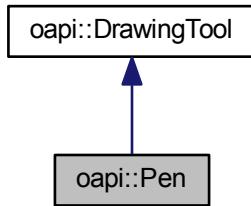
- OrbiterSDK/include/OrbiterAPI.h

## 17.46 oapi::Pen Class Reference

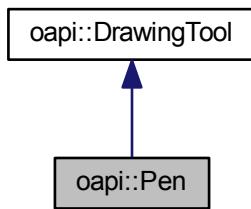
A pen is a resource used for drawing lines and the outlines of closed figures such as rectangles, ellipses and polygons.

```
#include <DrawAPI.h>
```

Inheritance diagram for oapi::Pen:



Collaboration diagram for oapi::Pen:



#### Public Member Functions

- virtual [~Pen \(\)](#)  
*Pen destructor.*

#### Protected Member Functions

- [Pen \(int style, int width, DWORD col\)](#)  
*Pen constructor.*

#### 17.46.1 Detailed Description

A pen is a resource used for drawing lines and the outlines of closed figures such as rectangles, ellipses and polygons.

#### 17.46.2 Constructor & Destructor Documentation

##### 17.46.2.1 oapi::Pen::Pen ( int *style*, int *width*, DWORD *col* ) [inline], [protected]

[Pen constructor.](#)

**Parameters**

<i>style</i>	line style (0=invisible, 1=solid, 2=dashed)
<i>width</i>	line width [pixel]
<i>col</i>	line colour (format: 0xBBGGRR)

The documentation for this class was generated from the following file:

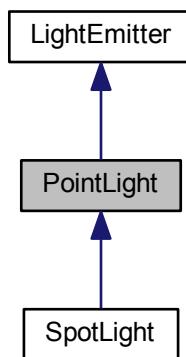
- OrbiterSDK/include/DrawAPI.h

## 17.47 PointLight Class Reference

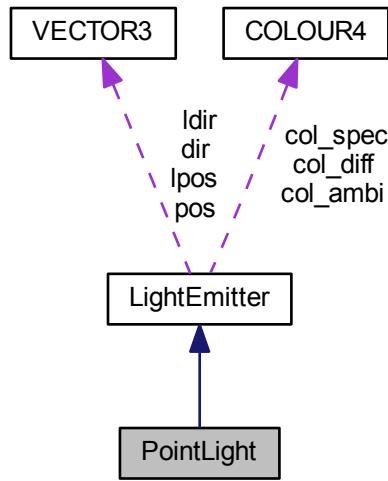
Class for isotropic point light source.

```
#include <OrbiterAPI.h>
```

Inheritance diagram for PointLight:



Collaboration diagram for PointLight:



### Public Member Functions

- `PointLight (OBJHANDLE hObj, const VECTOR3 &_pos, double _range, double att0, double att1, double att2)`  
*Creates a white isotropic point light.*
- `PointLight (OBJHANDLE hObj, const VECTOR3 &_pos, double _range, double att0, double att1, double att2, COLOUR4 diffuse, COLOUR4 specular, COLOUR4 ambient)`  
*Creates a coloured isotropic point light.*
- `double GetRange () const`  
*Returns the light source range.*
- `void SetRange (double _range)`  
*Set the light source range.*
- `const double * GetAttenuation () const`  
*Returns a pointer to attenuation coefficients.*
- `void SetAttenuation (double att0, double att1, double att2)`  
*Set the attenuation coefficients.*

### Protected Attributes

- `double range`
- `double att [3]`

### Additional Inherited Members

#### 17.47.1 Detailed Description

Class for isotropic point light source.

## 17.47.2 Constructor & Destructor Documentation

17.47.2.1 `PointLight::PointLight ( OBJHANDLE hObj, const VECTOR3 & _pos, double _range, double att0, double att1, double att2 )`

Creates a white isotropic point light.

## Parameters

<i>hObj</i>	handle of object the point light is attached to
<i>_pos</i>	light position in local object coordinates [m]
<i>_range</i>	point light range [m]
<i>att0</i>	light attenuation parameters
<i>att1</i>	light attenuation parameters
<i>att2</i>	light attenuation parameters

17.47.2.2 `PointLight::PointLight ( OBJHANDLE hObj, const VECTOR3 & _pos, double _range, double att0, double att1, double att2, COLOUR4 diffuse, COLOUR4 specular, COLOUR4 ambient )`

Creates a coloured isotropic point light.

## Parameters

<i>hObj</i>	handle of object the point light is attached to
<i>_pos</i>	point light position in local object coordinates [m]
<i>_range</i>	spotlight range [m]
<i>att0</i>	light attenuation parameters
<i>att1</i>	light attenuation parameters
<i>att2</i>	light attenuation parameters
<i>diffuse</i>	light source's contribution to lit objects' diffuse colour component
<i>specular</i>	light source's contribution to lit objects' specular colour component
<i>ambient</i>	light source's contribution to lit objects' ambient colour component

## 17.47.3 Member Function Documentation

17.47.3.1 `const double* PointLight::GetAttenuation ( ) const [inline]`

Returns a pointer to attenuation coefficients.

## Returns

Pointer to array of 3 attenuation coefficients.

## Note

The attenuation coefficients define the fractional light intensity  $I/I_0$  as a function of distance  $d$ :

$$\frac{I}{I_0} = \frac{1}{att_0 + datt_1 + d^2att_2}$$

17.47.3.2 `double PointLight::GetRange ( ) const [inline]`

Returns the light source range.

## Returns

Light source range [m]

17.47.3.3 `void PointLight::SetAttenuation ( double att0, double att1, double att2 )`

Set the attenuation coefficients.

## Parameters

<i>att0</i>	attenuation coefficient
<i>att1</i>	attenuation coefficient
<i>att2</i>	attenuation coefficient

## Note

The attenuation coefficients define the fractional light intensity  $I/I_0$  as a function of distance  $d$ :

$$\frac{I}{I_0} = \frac{1}{att_0 + datt_1 + d^2att_2}$$

17.47.3.4 void PointLight::SetRange ( double *\_range* )

Set the light source range.

## Parameters

<i>_range</i>	new light source range [m]
---------------	----------------------------

## Note

When changing the range, the attenuation factors usually should be adjusted accordingly, to avoid sharp cutoff edges or large areas of negligible intensity.

The documentation for this class was generated from the following file:

- Orbitersdk/include/OrbiterAPI.h

## 17.48 ATMOSPHERE::PRM\_IN Struct Reference

Input parameters for atmospheric data calculation.

```
#include <CelBodyAPI.h>
```

## Public Attributes

- double **alt**  
*altitude [m]*
- double **lng**  
*longitude [rad]*
- double **lat**  
*latitude [rad]*
- double **f107bar**  
*average F10.7 flux over recent period*
- double **f107**  
*current F10.7 flux*
- double **ap**  
*magnetic index*
- DWORD **flag**  
*parameter flags (see PRM\_IN\_FLAG)*

#### 17.48.1 Detailed Description

Input parameters for atmospheric data calculation.

##### See also

`clbkAtmParam`

The documentation for this struct was generated from the following file:

- Orbitersdk/include/[CelBodyAPI.h](#)

## 17.49 ATMOSPHERE::PRM\_OUT Struct Reference

Output parameters for atmospheric data calculation.

```
#include <CelBodyAPI.h>
```

#### Public Attributes

- `double T`  
*temperature [K]*
- `double p`  
*pressure [Pa]*
- `double rho`  
*density [kg/m^3]*

#### 17.49.1 Detailed Description

Output parameters for atmospheric data calculation.

##### See also

`clbkAtmParam`

The documentation for this struct was generated from the following file:

- Orbitersdk/include/[CelBodyAPI.h](#)

## 17.50 oapi::ScreenAnnotation Class Reference

Defines a block of text displayed on top of the simulation render window.

```
#include <GraphicsAPI.h>
```

#### Public Member Functions

- `ScreenAnnotation (GraphicsClient *_gc)`  
*Constructs a new annotation object.*
- `virtual ~ScreenAnnotation ()`  
*Destroys the annotation object.*
- `virtual void Reset ()`  
*Resets annotation parameters to their default values.*
- `virtual void SetText (char *str)`

*Set the text to be displayed by the annotation object.*

- **virtual void `ClearText ()`**  
*Clear the text display.*
- **virtual void `SetPosition (double x1, double y1, double x2, double y2)`**  
*Set the bounding box of the annotation block.*
- **virtual void `SetSize (double scale)`**  
*Set the font size.*
- **virtual void `SetColour (const VECTOR3 &col)`**  
*Set the font colour.*
- **virtual void `Render ()`**  
*Render the annotation text into the simulation window.*

#### 17.50.1 Detailed Description

Defines a block of text displayed on top of the simulation render window.

#### 17.50.2 Constructor & Destructor Documentation

##### 17.50.2.1 `oapi::ScreenAnnotation::ScreenAnnotation ( GraphicsClient * _gc )`

Constructs a new annotation object.

###### Parameters

<code>_gc</code>	pointer to graphics client
------------------	----------------------------

#### 17.50.3 Member Function Documentation

##### 17.50.3.1 `virtual void oapi::ScreenAnnotation::SetColour ( const VECTOR3 & col ) [virtual]`

Set the font colour.

###### Parameters

<code>col</code>	RGB values of the font colour (0..1 in each component)
------------------	--

##### 17.50.3.2 `virtual void oapi::ScreenAnnotation::SetPosition ( double x1, double y1, double x2, double y2 ) [virtual]`

Set the bounding box of the annotation block.

###### Parameters

<code>x1</code>	left edge
<code>y1</code>	top edge
<code>x2</code>	right edge
<code>y2</code>	bottom edge

###### Note

The positions are relative to the boundaries of the render window, in the range 0 to 1, where (0,0) is the top left edge, and (1,1) is the bottom right edge of the render window.

##### 17.50.3.3 `virtual void oapi::ScreenAnnotation::SetSize ( double scale ) [virtual]`

Set the font size.

## Parameters

<code>scale</code>	font size parameter (>0)
--------------------	--------------------------

## Note

`scale=1` defines the default font size, `scale<1` is a smaller font, and `scale>1` a larger font.  
The default font size is automatically scaled with the size of the render window.

17.50.3.4 virtual void oapi::ScreenAnnotation::SetText ( `char * str` ) [virtual]

Set the text to be displayed by the annotation object.

## Parameters

<code>str</code>	character string
------------------	------------------

The documentation for this class was generated from the following file:

- Orbitersdk/include/GraphicsAPI.h

## 17.51 oapi::Sketchpad Class Reference

A Sketchpad object defines an environment for drawing onto 2-D surfaces.

```
#include <DrawAPI.h>
```

## Public Types

- enum `TAlign_horizontal` { `LEFT`, `CENTER`, `RIGHT` }  
*Horizontal text alignment modes.*
- enum `TAlign_vertical` { `TOP`, `BASELINE`, `BOTTOM` }  
*Vertical text alignment modes.*
- enum `BkgMode` { `BK_TRANSPARENT`, `BK_OPAQUE` }  
*Background modes for text output.*

## Public Member Functions

- `Sketchpad (SURFHANDLE s)`  
*Constructs a drawing object for a given surface.*
- virtual `~Sketchpad ()`  
*Destructor. Destroys a drawing object.*
- virtual `Font * SetFont (Font *font) const`  
*Selects a new font to use.*
- virtual `Pen * SetPen (Pen *pen) const`  
*Selects a new pen to use.*
- virtual `Brush * SetBrush (Brush *brush) const`  
*Selects a new brush to use.*
- virtual void `SetTextAlign (TAlign_horizontal tah=LEFT, TAlign_vertical tav=TOP)`  
*Set horizontal and vertical text alignment.*
- virtual `DWORD SetTextColor (DWORD col)`  
*Set the foreground colour for text output.*
- virtual `DWORD SetBackgroundColor (DWORD col)`  
*Set the background colour for text output.*

- virtual void `SetBackgroundMode (BkgMode mode)`  
*Set the background mode for text and drawing operations.*
- virtual DWORD `GetCharSize ()`  
*Return height and (average) width of a character in the currently selected font.*
- virtual DWORD `GetTextWidth (const char *str, int len=0)`  
*Return the width of a text string in the currently selected font.*
- virtual void `SetOrigin (int x, int y)`  
*Set the position in the surface bitmap which is mapped to the origin of the coordinate system for all drawing functions.*
- virtual void `GetOrigin (int *x, int *y) const`  
*Returns the position in the surface bitmap which is mapped to the origin of the coordinate system for all drawing functions.*
- virtual bool `Text (int x, int y, const char *str, int len)`  
*Draw a text string.*
- virtual bool `TextBox (int x1, int y1, int x2, int y2, const char *str, int len)`  
*Draw a text string into a rectangle.*
- virtual void `Pixel (int x, int y, DWORD col)`  
*Draw a single pixel in a specified colour.*
- virtual void `MoveTo (int x, int y)`  
*Move the drawing reference to a new point.*
- virtual void `LineTo (int x, int y)`  
*Draw a line to a specified point.*
- virtual void `Line (int x0, int y0, int x1, int y1)`  
*Draw a line between two points.*
- virtual void `Rectangle (int x0, int y0, int x1, int y1)`  
*Draw a rectangle (filled or outline).*
- virtual void `Ellipse (int x0, int y0, int x1, int y1)`  
*Draw an ellipse from its bounding box.*
- virtual void `Polygon (const IVECTOR2 *pt, int npt)`  
*Draw a closed polygon given by vertex points.*
- virtual void `Polyline (const IVECTOR2 *pt, int npt)`  
*Draw a line of piecewise straight segments.*
- virtual void `PolyPolygon (const IVECTOR2 *pt, const int *npt, const int nline)`  
*Draw a set of polygons.*
- virtual void `PolyPolyline (const IVECTOR2 *pt, const int *npt, const int nline)`  
*Draw a set of polylines.*
- SURFHANDLE `GetSurface () const`  
*Returns the surface associated with the drawing object.*
- virtual HDC `GetDC ()`  
*Return the Windows device context handle, if applicable.*

### 17.51.1 Detailed Description

A Sketchpad object defines an environment for drawing onto 2-D surfaces.

It defines drawing primitives (lines, text, etc.) that can be used for preparing MFD surfaces, panel elements or vessel markings.

The drawing object is an abstract class which must be implemented by derived graphics clients. An example for a DrawingObject implementation is via the Windows GDI (graphics device interface).

## 17.51.2 Member Enumeration Documentation

## 17.51.2.1 enum oapi::Sketchpad::BkgMode

Background modes for text output.

## See also

[SetBackgroundMode](#)

## Enumerator

***BK\_TRANSPARENT*** transparent background

***BK\_OPAQUE*** opaque background

## 17.51.2.2 enum oapi::Sketchpad::TAlign\_horizontal

Horizontal text alignment modes.

## See also

[SetTextAlign](#)

## Enumerator

***LEFT*** align left

***CENTER*** align center

***RIGHT*** align right

## 17.51.2.3 enum oapi::Sketchpad::TAlign\_vertical

Vertical text alignment modes.

## See also

[SetTextAlign](#)

## Enumerator

***TOP*** align top of text line

***BASELINE*** align base line of text line

***BOTTOM*** align bottom of text line

## 17.51.3 Constructor &amp; Destructor Documentation

17.51.3.1 oapi::Sketchpad::Sketchpad ( ***SURFHANDLE s*** )

Constructs a drawing object for a given surface.

## Parameters

<b><i>s</i></b>	surface handle
-----------------	----------------

## 17.51.4 Member Function Documentation

17.51.4.1 virtual void oapi::Sketchpad::Ellipse ( ***int x0, int y0, int x1, int y1*** ) [inline], [virtual]

Draw an ellipse from its bounding box.

**Parameters**

<i>x0</i>	left edge of bounding box [pixel]
<i>y0</i>	top edge of bounding box [pixel]
<i>x1</i>	right edge of bounding box [pixel]
<i>y1</i>	bottom edge of bounding box [pixel]

**Default action:**

None.

**Note**

Implementations should fill the ellipse with the currently selected brush resource.

**See also**

[Rectangle](#), [Polygon](#)

**17.51.4.2 virtual DWORD oapi::Sketchpad::GetCharSize( ) [inline], [virtual]**

Return height and (average) width of a character in the currently selected font.

**Returns**

Height of character cell [pixel] in the lower 16 bit of the return value, and (average) width of character cell [pixel] in the upper 16 bit.

**Default action:**

None, returns 0.

**Note**

The height value should describe the height of the character cell (i.e. the smallest box circumscribing all characters in the font), but without any "internal leading", i.e. the gap between characters in two consecutive lines.

For proportional fonts, the width value should be an approximate average character width.

**17.51.4.3 virtual HDC oapi::Sketchpad::GetDC( ) [inline], [virtual]**

Return the Windows device context handle, if applicable.

**Returns**

device context handle

**Default action:**

None, returns NULL.

**Note**

[Sketchpad](#) implementations based on the Windows GDI system should overload this function to return the device context handle here. All other implementations should not overload this function.

The device context returned by this function should not be released (e.g. with `ReleaseDC`). The device context is released automatically when the [Sketchpad](#) instance is destroyed.

This method should be regarded as temporary. Ultimately, the device-dependent drawing mechanism should be hidden outside the sketchpad implementation.

**17.51.4.4 virtual void oapi::Sketchpad::GetOrigin( int \* x, int \* y ) const [inline], [virtual]**

Returns the position in the surface bitmap which is mapped to the origin of the coordinate system for all drawing functions.

**Parameters**

out	x	pointer to integer receiving horizontal position of the origin [pixel]
out	y	pointer to integer receiving vertical position of the origin [pixel]

**Default action:**

Returns (0,0)

**See also**

[SetOrigin](#)

**17.51.4.5 SURFHANDLE oapi::Sketchpad::GetSurface ( ) const [inline]**

Returns the surface associated with the drawing object.

**Returns**

Surface handle

**17.51.4.6 virtual DWORD oapi::Sketchpad::GetTextWidth ( const char \* str, int len = 0 ) [inline], [virtual]**

Return the width of a text string in the currently selected font.

**Parameters**

str	text string
len	string length, or 0 for auto (0-terminated string)

**Returns**

width of the string, drawn in the currently selected font [pixel]

**Default action:**

None, returns 0.

**See also**

[SetFont](#)

**17.51.4.7 virtual void oapi::Sketchpad::Line ( int x0, int y0, int x1, int y1 ) [inline], [virtual]**

Draw a line between two points.

**Parameters**

x0	x-coordinate of first point [pixel]
y0	y-coordinate of first point [pixel]
x1	x-coordinate of second point [pixel]
y1	y-coordinate of second point [pixel]

**Default action:**

None.

**Note**

The line is drawn with the currently selected pen.

**See also**

[SetPen](#)

17.51.4.8 `virtual void oapi::Sketchpad::LineTo( int x, int y ) [inline], [virtual]`

Draw a line to a specified point.

**Parameters**

<i>x</i>	x-coordinate of line end point [pixel]
<i>y</i>	y-coordinate of line end point [pixel]

**Default action:**

None.

**Note**

The line starts at the current drawing reference point.

**See also**

[MoveTo](#)

**17.51.4.9 virtual void oapi::Sketchpad::MoveTo( int *x*, int *y* ) [inline], [virtual]**

Move the drawing reference to a new point.

**Parameters**

<i>x</i>	x-coordinate of new reference point [pixel]
<i>y</i>	y-coordinate of new reference point [pixel]

**Note**

Some methods use the drawing reference point for drawing operations, e.g. [LineTo](#).

**Default action:**

None.

**See also**

[LineTo](#)

**17.51.4.10 virtual void oapi::Sketchpad::Pixel( int *x*, int *y*, DWORD *col* ) [inline], [virtual]**

Draw a single pixel in a specified colour.

**Parameters**

<i>x</i>	x-coordinate of point [pixel]
<i>y</i>	y-coordinate of point [pixel]
<i>col</i>	pixel colour (format: 0xBBGGRR)

**17.51.4.11 virtual void oapi::Sketchpad::Polygon( const IVECTOR2 \* *pt*, int *npt* ) [inline], [virtual]**

Draw a closed polygon given by vertex points.

**Parameters**

<i>pt</i>	list of vertex points
-----------	-----------------------

<i>npt</i>	number of points in the list
------------	------------------------------

Default action:

None.

Note

Implementations should draw the outline of the polygon with the current pen, and fill it with the current brush. The polygon should be closed, i.e. the last point joined with the first one.

See also

[Polyline](#), [PolyPolygon](#), [Rectangle](#), [Ellipse](#)

**17.51.4.12** `virtual void oapi::Sketchpad::Polyline ( const IVECTOR2 * pt, int npt ) [inline], [virtual]`

Draw a line of piecewise straight segments.

Parameters

<i>pt</i>	list of vertex points
<i>npt</i>	number of points in the list

Default action:

None

Note

Implementations should draw the line with the currently selected pen.

Polylines are open figures: the end points are not connected, and no fill operation is performed.

See also

[Polygon](#), [PolyPolyline](#), [Rectangle](#), [Ellipse](#)

**17.51.4.13** `virtual void oapi::Sketchpad::PolyPolygon ( const IVECTOR2 * pt, const int * npt, const int nline ) [virtual]`

Draw a set of polygons.

Parameters

<i>pt</i>	list of vertex points for all polygons
<i>npt</i>	list of number of points for each polygon
<i>nline</i>	number of polygons

Default action:

Calls `Polygon` for each line in the list.

Note

The number of entries in *npt* must be  $\geq$  *nline*, and the number of points in *pt* must be at least the sum of the values in *npt*.

Implementations should overload this function if they can provide efficient direct support for it. Otherwise, the base class implementation should be sufficient.

See also

[Polygon](#), [Polyline](#), [PolyPolyline](#)

```
17.51.4.14 virtual void oapi::Sketchpad::PolyPolyline ( const IVECTOR2 * pt, const int * npt, const int nline )  
[virtual]
```

Draw a set of polylines.

**Parameters**

<i>pt</i>	list of vertex points for all lines
<i>npt</i>	list of number of points for each line
<i>nline</i>	number of lines

**Default action:**

Calls Polyline for each line in the list.

**Note**

The number of entries in *npt* must be  $\geq$  *nline*, and the number of points in *pt* must be at least the sum of the values in *npt*.

Implementations should overload this function if they can provide efficient direct support for it. Otherwise, the base class implementation should be sufficient.

**See also**

[Polyline](#), [Polygon](#), [PolyPolygon](#)

**17.51.4.15 virtual void oapi::Sketchpad::Rectangle ( int *x0*, int *y0*, int *x1*, int *y1* ) [virtual]**

Draw a rectangle (filled or outline).

**Parameters**

<i>x0</i>	left edge of rectangle [pixel]
<i>y0</i>	top edge of rectangle [pixel]
<i>x1</i>	right edge of rectangle [pixel]
<i>y1</i>	bottom edge of rectangle [pixel]

**Default action:**

Draws the rectangle from 4 line segments by calling [MoveTo](#) and [LineTo](#).

**Note**

Derived classes should overload this method if possible, because the default method does not allow to draw filled rectangles, and may be less efficient than a dedicated implementation.

Implementations should fill the rectangle with the currently selected brush resource.

**See also**

[MoveTo](#), [LineTo](#), [Ellipse](#), [Polygon](#)

**17.51.4.16 virtual DWORD oapi::Sketchpad::SetBackgroundColor ( DWORD *col* ) [inline], [virtual]**

Set the background colour for text output.

**Parameters**

<i>col</i>	background colour description (format: 0xBBGGRR)
------------	--

**Returns**

Previous colour setting

**Default action:**

None, returns 0.

**Note**

The background colour is only used if the background mode is set to BK\_OPAQUE.

**See also**

[SetBackgroundMode](#)

**17.51.4.17** `virtual void oapi::Sketchpad::SetBackgroundMode ( BkgMode mode )` [inline], [virtual]

Set the background mode for text and drawing operations.

**Parameters**

<i>mode</i>	background mode (see <a href="#">BkgMode</a> )
-------------	--

**Default action:**

None.

**Note**

This function affects text output and dashed line drawing.

In opaque background mode, text background and the gaps between dashed lines are drawn in the current background colour (see [SetBackgroundColor](#)). In transparent mode, text background and line gaps are not modified.

The default background mode (before the first call of [SetBackgroundMode](#)) should be transparent.

**See also**

[SetBackgroundColor](#), [SetTextColor](#)

**17.51.4.18** `virtual Brush* oapi::Sketchpad::SetBrush ( Brush * brush ) const` [inline], [virtual]

Selects a new brush to use.

**Parameters**

<i>brush</i>	pointer to brush resource, or NULL to disable fill mode
--------------	---

**Returns**

Previously selected brush.

**Default action:**

None, returns NULL.

**See also**

[oapi::Brush](#), [oapi::GraphicsClient::clbkCreateBrush](#)

**17.51.4.19** `virtual Font* oapi::Sketchpad::SetFont ( Font * font ) const` [inline], [virtual]

Selects a new font to use.

**Parameters**

<i>font</i>	pointer to font resource
-------------	--------------------------

**Returns**

Previously selected font.

**Default action:**

None, returns NULL.

**See also**

[oapi::Font](#), [oapi::GraphicsClient::clbkCreateFont](#)

**17.51.4.20 virtual void oapi::Sketchpad::SetOrigin ( int *x*, int *y* ) [inline], [virtual]**

Set the position in the surface bitmap which is mapped to the origin of the coordinate system for all drawing functions.

**Parameters**

<i>x</i>	horizontal position of the origin [pixel]
<i>y</i>	vertical position of the origin [pixel]

**Default action:**

None.

**Note**

By default, the reference point for drawing function coordinates is the top left corner of the bitmap, with positive x-axis to the right, and positive y-axis down.

`SetOrigin` can be used to shift the logical reference point to a different position in the surface bitmap (but not to change the orientation of the axes).

If the drawing system used by an implementation does not support this function directly, the derived class should itself account for the shift in origin, by subtracting the offset from all coordinate values.

**See also**

[GetOrigin](#)

**17.51.4.21 virtual Pen\* oapi::Sketchpad::SetPen ( Pen \* *pen* ) const [inline], [virtual]**

Selects a new pen to use.

**Parameters**

<i>pen</i>	pointer to pen resource, or NULL to disable outlines
------------	--

**Returns**

Previously selected pen.

**Default action:**

None, returns NULL.

**See also**

[oapi::Pen](#), [oapi::GraphicsClient::clbkCreatePen](#)

```
17.51.4.22 virtual void oapi::Sketchpad::SetTextAlign ( TAlign_horizontal tah = LEFT, TAlign_vertical tav = TOP )
    [inline], [virtual]
```

Set horizontal and vertical text alignment.

## Parameters

<i>tah</i>	horizontal alignment
<i>tav</i>	vertical alignment

## Default action:

None.

17.51.4.23 virtual DWORD oapi::Sketchpad::SetTextColor ( DWORD *col* ) [inline], [virtual]

Set the foreground colour for text output.

## Parameters

<i>col</i>	colour description (format: 0xBBGGR)
------------	--------------------------------------

## Returns

Previous colour setting.

## Default action:

None, returns 0.

17.51.4.24 virtual bool oapi::Sketchpad::Text ( int *x*, int *y*, const char \* *str*, int *len* ) [inline], [virtual]

Draw a text string.

## Parameters

<i>x</i>	reference x position [pixel]
<i>y</i>	reference y position [pixel]
<i>str</i>	text string
<i>len</i>	string length for output

## Returns

*true* on success, *false* on failure.

## Default action:

None, returns false.

17.51.4.25 virtual bool oapi::Sketchpad::TextBox ( int *x1*, int *y1*, int *x2*, int *y2*, const char \* *str*, int *len* ) [virtual]

Draw a text string into a rectangle.

## Parameters

<i>x1</i>	left edge [pixel]
<i>y1</i>	top edge [pixel]
<i>x2</i>	right edge [pixel]
<i>y2</i>	bottom edge [pixel]
<i>str</i>	text string
<i>len</i>	string length for output

**Returns**

*true* on success, *false* on failure.

**Default action:**

Implementation via [Text](#) calls.

**Note**

This method should write the text string into the specified rectangle, using the current font. Line breaks should automatically be applied as required to fit the text in the box.

The bottom edge (*y2*) should probably be ignored, so text isn't truncated if it doesn't fit the box.

The documentation for this class was generated from the following file:

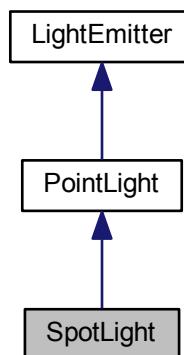
- [Orbitersdk/include/DrawAPI.h](#)

## 17.52 SpotLight Class Reference

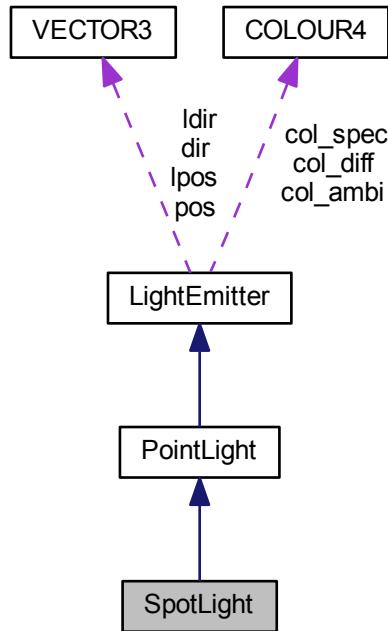
Class for directed spot light sources.

```
#include <OrbiterAPI.h>
```

Inheritance diagram for SpotLight:



Collaboration diagram for SpotLight:



#### Public Member Functions

- `SpotLight (OBJHANDLE hObj, const VECTOR3 &_pos, const VECTOR3 &_dir, double _range, double att0, double att1, double att2, double _umbra, double _penumbra)`

*Creates a white spotlight.*
- `SpotLight (OBJHANDLE hObj, const VECTOR3 &_pos, const VECTOR3 &_dir, double _range, double att0, double att1, double att2, double _umbra, double _penumbra, COLOUR4 diffuse, COLOUR4 specular, COLOUR4 ambient)`

*Creates a coloured spotlight.*
- `double GetUmbra () const`

*Returns the angular aperture of inner (maximum intensity) cone.*
- `double GetPenumbra () const`

*Returns the angular aperture of outer (zero intensity) cone.*
- `void SetAperture (double _umbra, double _penumbra)`

*Set the spotlight cone geometry.*

#### Protected Attributes

- `double umbra`
- `double penumbra`

#### Additional Inherited Members

## 17.52.1 Detailed Description

Class for directed spot light sources.

## 17.52.2 Constructor &amp; Destructor Documentation

17.52.2.1 `SpotLight::SpotLight ( OBJHANDLE hObj, const VECTOR3 & _pos, const VECTOR3 & _dir, double _range, double att0, double att1, double att2, double _umbra, double _penumbra )`

Creates a white spotlight.

## Parameters

<i>hObj</i>	handle of object the spotlight is attached to
<i>_pos</i>	spotlight position in local object coordinates [m]
<i>_dir</i>	spotlight direction in local object coordinates
<i>_range</i>	spotlight range [m]
<i>att0</i>	light attenuation parameters
<i>att1</i>	light attenuation parameters
<i>att2</i>	light attenuation parameters
<i>_umbra</i>	angular aperture of inner (maximum intensity) cone [rad]
<i>_penumbra</i>	angular aperture of outer (zero intensity) cone [rad]

## Note

Direction vector *\_dir* must be normalised to length 1.

$0 < \text{_umbra} \leq \text{penumbra} \leq \pi$  is required.

The intensity falloff between *\_umbra* and *\_penumbra* is linear from maximum intensity to zero.

17.52.2.2 `SpotLight::SpotLight ( OBJHANDLE hObj, const VECTOR3 & _pos, const VECTOR3 & _dir, double _range, double att0, double att1, double att2, double _umbra, double _penumbra, COLOUR4 diffuse, COLOUR4 specular, COLOUR4 ambient )`

Creates a coloured spotlight.

## Parameters

<i>hObj</i>	handle of object the spotlight is attached to
<i>_pos</i>	spotlight position in local object coordinates [m]
<i>_dir</i>	spotlight direction in local object coordinates
<i>_range</i>	spotlight range [m]
<i>att0</i>	light attenuation parameters
<i>att1</i>	light attenuation parameters
<i>att2</i>	light attenuation parameters
<i>_umbra</i>	angular aperture of inner (maximum intensity) cone [rad]
<i>_penumbra</i>	angular aperture of outer (zero intensity) cone [rad]
<i>diffuse</i>	light source's contribution to lit objects' diffuse colour component
<i>specular</i>	light source's contribution to lit objects' specular colour component
<i>ambient</i>	light source's contribution to lit objects' ambient colour component

## Note

Direction vector *\_dir* must be normalised to length 1.

$0 < \text{_umbra} \leq \text{penumbra} \leq \pi$  is required.

The intensity falloff between *\_umbra* and *\_penumbra* is linear from maximum intensity to zero.

## 17.52.3 Member Function Documentation

### 17.52.3.1 double SpotLight::GetPenumbra ( ) const [inline]

Returns the angular aperture of outer (zero intensity) cone.

#### Returns

Aperture of outer spotlight cone [rad]

#### See also

[GetUmbra](#)

### 17.52.3.2 double SpotLight::GetUmbra ( ) const [inline]

Returns the angular aperture of inner (maximum intensity) cone.

#### Returns

Aperture of inner spotlight cone [rad]

#### See also

[GetPenumbra](#)

### 17.52.3.3 void SpotLight::SetAperture ( double *umbra*, double *penumbra* )

Set the spotlight cone geometry.

#### Parameters

<i>umbra</i>	angular aperture of inner (maximum intensity) cone [rad]
<i>penumbra</i>	angular aperture of outer (zero intensity) cone [rad]

The documentation for this class was generated from the following file:

- Orbitersdk/include/OrbiterAPI.h

## 17.53 VESSELSTATUS2::THRUSTSPEC Struct Reference

thruster definition list

```
#include <OrbiterAPI.h>
```

#### Public Attributes

- DWORD *idx*  
*thruster index*
- double *level*  
*thruster level*

### 17.53.1 Detailed Description

thruster definition list

The documentation for this struct was generated from the following file:

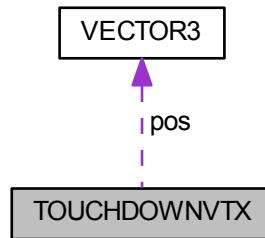
- Orbitersdk/include/OrbiterAPI.h

## 17.54 TOUCHDOWNVTX Struct Reference

Collision vertex definition.

```
#include <VesselAPI.h>
```

Collaboration diagram for TOUCHDOWNVTX:



### Public Attributes

- **VECTOR3 pos**  
*collision point position (vessel frame)*
- **double stiffness**  
*suspension stiffness coefficient*
- **double damping**  
*suspension damping coefficient*
- **double mu**  
*isotropic/lateral friction coefficient*
- **double mu\_lng**  
*longitudinal friction coefficient (only used for first 3 points)*

### 17.54.1 Detailed Description

Collision vertex definition.

The documentation for this struct was generated from the following file:

- Orbitersdk/include/VesselAPI.h

## 17.55 VECTOR3 Union Reference

3-element vector

```
#include <OrbiterAPI.h>
```

### Public Attributes

- **double data [3]**  
*array data interface*

- struct {  
    double **x**  
    double **y**  
    double **z**  
};

*named data interface*

#### 17.55.1 Detailed Description

3-element vector

The documentation for this union was generated from the following file:

- Orbitersdk/include/OrbiterAPI.h

### 17.56 VECTOR4 Union Reference

4-element vector

```
#include <OrbiterAPI.h>
```

#### Public Attributes

- double **data** [4]

*array data interface*

- struct {  
    double **x**  
    double **y**  
    double **z**  
    double **w**  
};

*named data interface*

#### 17.56.1 Detailed Description

4-element vector

The documentation for this union was generated from the following file:

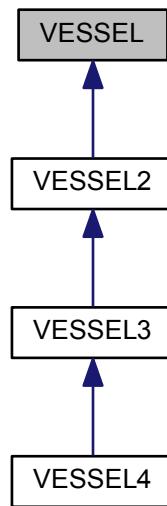
- Orbitersdk/include/OrbiterAPI.h

### 17.57 VESSEL Class Reference

Base class for objects of vessel type (spacecraft and similar)

```
#include <VesselAPI.h>
```

Inheritance diagram for VESSEL:



#### Protected Attributes

- `Vessel * vessel`  
*Orbiter internal vessel class.*
- `short flightmodel`  
*realism level*
- `short version`  
*interface version*

#### Construction/creation, handles and interfaces

- `VESSEL (OBJHANDLE hVessel, int fmodel=1)`  
*Creates a VESSEL interface instance from a vessel handle.*
- `int Version () const`  
*Returns the version number of the vessel interface class.*
- `const OBJHANDLE GetHandle () const`  
*Returns a handle to the vessel object.*
- `bool GetEditorModule (char *fname) const`  
*Returns the file name of the DLL containing the vessel's scenario editor extensions.*

#### General vessel properties

- `char * GetName () const`  
*Returns the vessel's name.*
- `char * GetClassName () const`  
*Returns the vessel's class name.*
- `int GetFlightModel () const`

- **int GetDamageModel () const**

*Returns the requested realism level for the flight model.*
- **bool GetEnableFocus () const**

*Returns the current user setting for damage and systems failure simulation.*
- **void SetEnableFocus (bool enable) const**

*Enable or disable the vessel's ability to receive the input focus.*
- **double GetSize () const**

*Returns the vessel's mean radius.*
- **void SetSize (double size) const**

*Set the vessel's mean radius.*
- **void SetVisibilityLimit (double vislimit, double spotlimit=-1) const**

*Defines the vessel's range of visibility.*
- **double GetClipRadius () const**

*Returns the radius of the vessel's circumscribing sphere.*
- **void SetAlbedoRGB (const VECTOR3 &albedo) const**

*Set the average colour distribution reflected by the vessel.*
- **void SetClipRadius (double rad) const**

*Set the radius of the vessel's circumscribing sphere.*
- **double GetEmptyMass () const**

*Returns the vessel's empty mass (excluding propellants).*
- **void SetEmptyMass (double m) const**

*Set the vessel's empty mass (excluding propellants).*
- **double GetCOG\_elev () const**

*Elevation of the vessel's centre of gravity (COG) above ground.*
- **bool GetTouchdownPoint (TOUCHDOWNVTX &tdvtx, DWORD idx) const**

*Returns one of the touchdown vertex definitions for the vessel.*
- **void SetTouchdownPoints (const TOUCHDOWNVTX \*tdvtx, DWORD ntdvtx) const**

*Defines an arbitrary number of vessel surface contact points.*
- **DWORD GetTouchdownPointCount () const**

*Returns the number of touchdown points defining the impact hull of the vessel.;*
- **void SetSurfaceFrictionCoeff (double mu\_lng, double mu\_lat) const**

*Set friction coefficients for ground contact.*
- **void GetCrossSections (VECTOR3 &cs) const**

*Returns the vessel's cross sections projected in the direction of the vessel's principal axes.*
- **void SetCrossSections (const VECTOR3 &cs) const**

*Defines the vessel's cross-sectional areas, projected in the directions of the vessel's principal axes.*
- **void GetPMI (VECTOR3 &pmi) const**

*Returns the vessel's mass-normalised principal moments of inertia (PMI)*
- **void SetPMI (const VECTOR3 &pmi) const**

*Set the vessel's mass-normalised principal moments of inertia (PMI).*
- **double GetGravityGradientDamping () const**

*Returns the vessel's damping coefficient for gravity field gradient-induced torque.*
- **bool SetGravityGradientDamping (double damp) const**

*Sets the vessel's damping coefficient for gravity field gradient-induced torque.*

## Vessel state

- void **GetStatus** (VESSELSTATUS &status) const
  - Returns the vessel's current status parameters in a VESSELSTATUS structure.*
- void **GetStatusEx** (void \*status) const
  - Returns the vessel's current status parameters in a VESSELSTATUSx structure (version x >= 2).*
- void **DefSetState** (const VESSELSTATUS \*status) const
  - Set default vessel status parameters.*
- void **DefSetStateEx** (const void \*status) const
  - Set default vessel status parameters.*
- DWORD **GetFlightStatus** () const
  - Returns a bit flag defining the vessel's current flight status.*
- double **GetMass** () const
  - Returns current (total) vessel mass.*
- void **GetGlobalPos** (VECTOR3 &pos) const
  - Returns the vessel's current position in the global reference frame.*
- void **GetGlobalVel** (VECTOR3 &vel) const
  - Returns the vessel's current velocity in the global reference frame.*
- void **GetRelativePos** (OBJHANDLE hRef, VECTOR3 &pos) const
  - Returns the vessel's current position with respect to another object.*
- void **GetRelativeVel** (OBJHANDLE hRef, VECTOR3 &vel) const
  - Returns the vessel's current velocity relative to another object.*
- void **GetAngularVel** (VECTOR3 &avel) const
  - Returns the vessel's current angular velocity components around its principal axes.*
- void **GetAngularAcc** (VECTOR3 &aacc) const
  - Returns the vessel's current angular acceleration components around its principal axes.*
- void **GetLinearMoment** (VECTOR3 &F) const
  - Returns the linear force vector currently acting on the vessel.*
- void **GetAngularMoment** (VECTOR3 &amom) const
  - Returns the sum of angular moments currently acting on the vessel.*
- void **SetAngularVel** (const VECTOR3 &avel) const
  - Applies new angular velocity to the vessel.*
- void **GetGlobalOrientation** (VECTOR3 &arot) const
  - Returns the Euler angles defining the vessel's orientation.*
- void **SetGlobalOrientation** (const VECTOR3 &arot) const
  - Sets the vessel's orientation via Euler angles.*
- bool **GroundContact** () const
  - Returns a flag indicating contact with a planetary surface.*
- bool **OrbitStabilised** () const
  - Flag indicating whether orbit stabilisation is used for the vessel at the current time step.*
- bool **NonsphericalGravityEnabled** () const
  - Flag for nonspherical gravity perturbations.*
- DWORD **GetADCctrlMode** () const
  - Returns aerodynamic control surfaces currently under manual control.*
- void **SetADCctrlMode** (DWORD mode) const
  - Configure manual input mode for aerodynamic control surfaces.*
- bool **ActivateNavmode** (int mode)
  - Activates one of the automated orbital navigation modes.*
- bool **DeactivateNavmode** (int mode)
  - Deactivates an automated orbital navigation mode.*
- bool **ToggleNavmode** (int mode)

- **bool GetNavmodeState (int mode)**

*Toggles a navigation mode on/off.*
- **bool GetHoverHoldAltitude (double &alt, bool &terrainalt)**

*Returns the current active/inactive state of a navigation mode.*
- **void SetHoverHoldAltitude (double alt, bool terrainalt)**

*Returns the altitude that the hover hold altitude program tries to maintain.*
- **Set the target altitude for the hover hold altitude program and activate the program.**

## Orbital elements

See also: [Basics of orbital mechanics](#)

- **const OBJHANDLE GetGravityRef () const**

*Returns a handle to the main contributor of the gravity field at the vessel's current position.*
- **OBJHANDLE GetElements (ELEMENTS &el, double &mjd\_ref) const**

*Returns osculating orbital elements.*
- **bool GetElements (OBJHANDLE hRef, ELEMENTS &el, ORBITPARAM \*prm=0, double mjd\_ref=0, int frame=FRAME\_ECL) const**

*Returns osculating elements and additional orbit parameters.*
- **bool SetElements (OBJHANDLE hRef, const ELEMENTS &el, ORBITPARAM \*prm=0, double mjd\_ref=0, int frame=FRAME\_ECL) const**

*Set vessel state (position and velocity) by means of a set of osculating orbital elements.*
- **OBJHANDLE GetSmi (double &smi) const**

*Returns the magnitude of the semi-minor axis of the current osculating orbit.*
- **OBJHANDLE GetArgPer (double &arg) const**

*Returns argument of periaxis of the current osculating orbit.*
- **OBJHANDLE GetPeDist (double &pedist) const**

*Returns the periaxis distance of the current osculating orbit.*
- **OBJHANDLE GetApDist (double &apdist) const**

*Returns the apoaixis distance of the current osculating orbit.*

## Surface-relative parameters

- **const OBJHANDLE GetSurfaceRef () const**

*Returns a handle to the surface reference object (planet or moon).*
- **double GetAltitude () const**

*Returns the altitude above the mean radius of the current surface reference body.*
- **double GetAltitude (AltitudeMode mode, int \*reslvl=0)**

*Returns the vessel altitude.*
- **double GetPitch () const**

*Returns the current pitch angle with respect to the local horizon.*
- **double GetBank () const**

*Returns the current bank (roll) angle with respect to the local horizon.*
- **double GetYaw () const**

*Returns the current yaw angle with respect to the local horizon.*
- **double GetSurfaceElevation () const**

*Returns the elevation of the surface at the vessel's current longitude/latitude above the reference radius.*
- **VECTOR3 GetSurfaceNormal () const**

*Returns the normal (in local horizon frame) of the surface below the vessel's current position.*
- **OBJHANDLE GetEquPos (double &longitude, double &latitude, double &radius) const**

*Returns vessel's current equatorial position with respect to the closest planet or moon.*

### Atmospheric parameters

- const **OBJHANDLE** **GetAtmRef** () const  
*Returns a handle to the reference body for atmospheric calculations.*
- double **GetAtmTemperature** () const  
*Returns ambient atmospheric temperature at current vessel position.*
- double **GetAtmDensity** () const  
*Returns atmospheric density at current vessel position.*
- double **GetAtmPressure** () const  
*Returns static atmospheric pressure at current vessel position.*

### Aerodynamic state parameters

- double **GetDynPressure** () const  
*Returns the current dynamic pressure for the vessel.*
- double **GetMachNumber** () const  
*Returns the vessel's current Mach number.*
- double **GetGroundspeed** () const  
*Returns magnitude of the ground speed vector.*
- bool **GetGroundspeedVector** (**REFFRAME** frame, **VECTOR3** &v) const  
*Returns the vessel's ground speed vector.*
- double **GetAirspeed** () const  
*Returns magnitude of the true airspeed vector.*
- bool **GetAirspeedVector** (**REFFRAME** frame, **VECTOR3** &v) const  
*Returns the vessel's true airspeed vector.*
- bool **GetHorizonAirspeedVector** (**VECTOR3** &v) const  
*Returns the airspeed vector in local horizon coordinates.*
- bool **GetShipAirspeedVector** (**VECTOR3** &v) const  
*Returns the airspeed vector in vessel coordinates.*
- double **GetAOA** () const  
*Returns the current angle of attack.*
- double **GetSlipAngle** () const  
*Returns the lateral (yaw) angle between the velocity vector and the vessel's longitudinal axis.*

### Airfoils and control surfaces

- void **CreateAirfoil** (**AIRFOIL\_ORIENTATION** align, const **VECTOR3** &ref, **AirfoilCoeffFunc** cf, double c, double S, double A) const  
*Creates a new airfoil and defines its aerodynamic properties.*
- **AIRFOILHANDLE** **CreateAirfoil2** (**AIRFOIL\_ORIENTATION** align, const **VECTOR3** &ref, **AirfoilCoeffFunc** cf, double c, double S, double A) const  
*Creates a new airfoil and defines its aerodynamic properties.*
- **AIRFOILHANDLE** **CreateAirfoil3** (**AIRFOIL\_ORIENTATION** align, const **VECTOR3** &ref, **AirfoilCoeffFuncEx** cf, void \*context, double c, double S, double A) const  
*Creates a new airfoil and defines its aerodynamic properties.*
- bool **GetAirfoilParam** (**AIRFOILHANDLE** hAirfoil, **VECTOR3** \*ref, **AirfoilCoeffFunc** \*cf, void \*\*context, double \*c, double \*S, double \*A) const  
*Returns the parameters of an existing airfoil.*
- void **EditAirfoil** (**AIRFOILHANDLE** hAirfoil, **DWORD** flag, const **VECTOR3** &ref, **AirfoilCoeffFunc** cf, double c, double S, double A) const  
*Resets the parameters of an existing airfoil definition.*

- bool `DelAirfoil (AIRFOILHANDLE hAirfoil) const`  
*Deletes a previously defined airfoil.*
- void `ClearAirfoilDefinitions () const`  
*Removes all airfoils currently defined for the vessel.*
- void `CreateControlSurface (AIRCTRL_TYPE type, double area, double dCI, const VECTOR3 &ref, int axis=AIRCTRL_AXIS_AUTO, UINT anim=(UINT)-1) const`  
*Creates an aerodynamic control surface.*
- `CTRLSURFHANDLE CreateControlSurface2 (AIRCTRL_TYPE type, double area, double dCI, const VEC→TOR3 &ref, int axis=AIRCTRL_AXIS_AUTO, UINT anim=(UINT)-1) const`  
*Creates an aerodynamic control surface and returns a handle.*
- `CTRLSURFHANDLE CreateControlSurface3 (AIRCTRL_TYPE type, double area, double dCI, const VEC→TOR3 &ref, int axis=AIRCTRL_AXIS_AUTO, double delay=1.0, UINT anim=(UINT)-1) const`  
*Creates an aerodynamic control surface and returns a handle.*
- bool `DelControlSurface (CTRLSURFHANDLE hCtrlSurf) const`  
*Deletes a previously defined aerodynamic control surface.*
- void `ClearControlSurfaceDefinitions () const`  
*Removes all aerodynamic control surfaces.*
- void `SetControlSurfaceLevel (AIRCTRL_TYPE type, double level) const`  
*Updates the position of an aerodynamic control surface.*
- void `SetControlSurfaceLevel (AIRCTRL_TYPE type, double level, bool direct) const`  
*Updates the position of an aerodynamic control surface.*
- double `GetControlSurfaceLevel (AIRCTRL_TYPE type) const`  
*Returns the current position of a control surface.*
- void `CreateVariableDragElement (const double *drag, double factor, const VECTOR3 &ref) const`  
*Attaches a modifiable drag component to the vessel.*
- void `ClearVariableDragElements () const`  
*Removes all drag elements defined with CreateVariableDragElement.*

#### Aerodynamic vessel properties (legacy model)

The methods in this group are used only if the vessel does not define any airfoils.

- void `GetCW (double &cw_z_pos, double &cw_z_neg, double &cw_x, double &cw_y) const`  
*Returns the vessel's wind resistance coefficients (legacy flight model only).*
- void `SetCW (double cw_z_pos, double cw_z_neg, double cw_x, double cw_y) const`  
*Set the vessel's wind resistance coefficients along its axis directions.*
- double `GetWingAspect () const`  
*Returns the vessel's wing aspect ratio (wingspan<sup>2</sup> / wing area)*
- void `SetWingAspect (double aspect) const`  
*Set the wing aspect ratio (wingspan<sup>2</sup> / wing area)*
- double `GetWingEffectiveness () const`  
*Returns the wing form factor used in aerodynamic calculations.*
- void `SetWingEffectiveness (double eff) const`  
*Set the wing form factor for aerodynamic lift and drag calculations.*
- void `GetRotDrag (VECTOR3 &rd) const`  
*Returns the vessel's atmospheric rotation resistance coefficients.*
- void `SetRotDrag (const VECTOR3 &rd) const`  
*Set the vessel's atmospheric rotation resistance coefficients.*
- double `GetPitchMomentScale () const`  
*Returns the scaling factor for the pitch moment.*
- void `SetPitchMomentScale (double scale) const`

- **double GetYawMomentScale () const**

*Sets the scaling factor for the pitch moment.*
- **void SetYawMomentScale (double scale) const**

*Returns the scaling factor for the yaw moment.*
- **double GetTrimScale () const**

*Sets the scaling factor for the yaw moment.*
- **void SetTrimScale (double scale) const**

*Returns the scaling factor for the pitch trim control.*
- **void SetLiftCoeffFunc (LiftCoeffFunc lcf) const**

*Sets the scaling factor for the pitch trim control.*
- **void SetLiftCoeffFunc (LiftCoeffFunc lcf) const**

*Defines the callback function for aerodynamic lift calculation.*

## Forces

- **double GetLift () const**

*Returns magnitude of aerodynamic lift force vector.*
- **double GetDrag () const**

*Returns magnitude of aerodynamic drag force vector.*
- **bool GetWeightVector (VECTOR3 &G) const**

*Returns gravitational force vector in local vessel coordinates.*
- **bool GetThrustVector (VECTOR3 &T) const**

*Returns thrust force vector in local vessel coordinates.*
- **bool GetLiftVector (VECTOR3 &L) const**

*Returns aerodynamic lift force vector in local vessel coordinates.*
- **bool GetDragVector (VECTOR3 &D) const**

*Returns aerodynamic drag force vector in local vessel coordinates.*
- **bool GetForceVector (VECTOR3 &F) const**

*Returns total force vector acting on the vessel in local vessel coordinates.*
- **bool GetTorqueVector (VECTOR3 &M) const**

*Returns the total torque vector acting on the vessel in local vessel coordinates.*
- **void AddForce (const VECTOR3 &F, const VECTOR3 &r) const**

*Add a custom body force.*

## Fuel management

- **PROPELLANT\_HANDLE CreatePropellantResource (double maxmass, double mass=-1.0, double efficiency=1.0) const**

*Create a new propellant resource ("fuel tank")*
- **void DelPropellantResource (PROPELLANT\_HANDLE &ph) const**

*Remove a propellant resource.*
- **void ClearPropellantResources () const**

*Remove all propellant resources for the vessel.*
- **DWORD GetPropellantCount () const**

*Returns the current number of vessel propellant resources.*
- **PROPELLANT\_HANDLE GetPropellantHandleByIndex (DWORD idx) const**

*Returns the handle of a propellant resource for a given index.*
- **double GetPropellantMaxMass (PROPELLANT\_HANDLE ph) const**

*Returns the maximum capacity of a propellant resource.*
- **void SetPropellantMaxMass (PROPELLANT\_HANDLE ph, double maxmass) const**

*Reset the maximum capacity of a fuel resource.*
- **double GetPropellantMass (PROPELLANT\_HANDLE ph) const**

- **Returns the current mass of a propellant resource.**
- void **SetPropellantMass** (PROPELLANT\_HANDLE ph, double mass) const
  - Reset the current mass of a propellant resource.*
- double **GetTotalPropellantMass** () const
  - Returns the vessel's current total propellant mass.*
- double **GetPropellantEfficiency** (PROPELLANT\_HANDLE ph) const
  - Returns the efficiency factor of a propellant resource.*
- void **SetPropellantEfficiency** (PROPELLANT\_HANDLE ph, double efficiency) const
  - Reset the efficiency factor of a fuel resource.*
- double **GetPropellantFlowrate** (PROPELLANT\_HANDLE ph) const
  - Returns the current mass flow rate from a propellant resource.*
- double **GetTotalPropellantFlowrate** () const
  - Returns the current total mass flow rate, summed over all propellant resources.*
- void **SetDefaultPropellantResource** (PROPELLANT\_HANDLE ph) const
  - Define a "default" propellant resource.*
- PROPELLANT\_HANDLE **GetDefaultPropellantResource** () const
  - Returns the handle for the vessel's default propellant resource.*
- double **GetMaxFuelMass** () const
  - Returns the maximum capacity of the vessel's default propellant resource.*
- void **SetMaxFuelMass** (double mass) const
  - Set the maximum fuel capacity of the vessel's default propellant resource.*
- double **GetFuelMass** () const
  - Returns the current mass of the vessel's default propellant resource.*
- void **SetFuelMass** (double mass) const
  - Reset the current mass of the vessel's default propellant resource.*
- double **GetFuelRate** () const
  - Returns the current mass flow rate from the default propellant resource.*

## Thruster management

- THRUSTER\_HANDLE **CreateThruster** (const VECTOR3 &pos, const VECTOR3 &dir, double maxth0, PROPELLANT\_HANDLE hp=NULL, double isp0=0.0, double isp\_ref=0.0, double p\_ref=101.4e3) const
  - Add a logical thruster definition for the vessel.*
- bool **DelThruster** (THRUSTER\_HANDLE &th) const
  - Delete a logical thruster definition.*
- void **ClearThrusterDefinitions** () const
  - Delete all thruster and thruster group definitions.*
- DWORD **GetThrusterCount** () const
  - Returns the number of thrusters currently defined.*
- THRUSTER\_HANDLE **GetThrusterHandleByIndex** (DWORD idx) const
  - Returns the handle of a thruster specified by its index.*
- PROPELLANT\_HANDLE **GetThrusterResource** (THRUSTER\_HANDLE th) const
  - Returns a handle for the propellant resource feeding the thruster.*
- void **SetThrusterResource** (THRUSTER\_HANDLE th, PROPELLANT\_HANDLE ph) const
  - Connect a thruster to a propellant resource.*
- void **GetThrusterRef** (THRUSTER\_HANDLE th, VECTOR3 &pos) const
  - Returns the thrust force attack point of a thruster.*
- void **SetThrusterRef** (THRUSTER\_HANDLE th, const VECTOR3 &pos) const
  - Reset the thrust force attack point of a thruster.*
- void **GetThrusterDir** (THRUSTER\_HANDLE th, VECTOR3 &dir) const
  - Returns the force direction of a thruster.*

- void [SetThrusterDir \(THRUSTER\\_HANDLE th, const VECTOR3 &dir\) const](#)  
*Reset the force direction of a thruster.*
- double [GetThrusterMax0 \(THRUSTER\\_HANDLE th\) const](#)  
*Returns the maximum vacuum thrust rating of a thruster.*
- void [SetThrusterMax0 \(THRUSTER\\_HANDLE th, double maxth0\) const](#)  
*Reset the maximum vacuum thrust rating of a thruster.*
- double [GetThrusterMax \(THRUSTER\\_HANDLE th\) const](#)  
*Returns the current maximum thrust rating of a thruster.*
- double [GetThrusterMax \(THRUSTER\\_HANDLE th, double p\\_ref\) const](#)  
*Returns the maximum thrust rating of a thruster at a specific ambient pressure.*
- double [GetThrusterIsp0 \(THRUSTER\\_HANDLE th\) const](#)  
*Returns the vacuum fuel-specific impulse (Isp) rating for a thruster.*
- double [GetThrusterIsp \(THRUSTER\\_HANDLE th\) const](#)  
*Returns the current fuel-specific impulse (Isp) rating of a thruster.*
- double [GetThrusterIsp \(THRUSTER\\_HANDLE th, double p\\_ref\) const](#)  
*Returns the fuel-specific impulse (Isp) rating of a thruster at a specific ambient atmospheric pressure.*
- void [SetThrusterIsp \(THRUSTER\\_HANDLE th, double isp\) const](#)  
*Reset the fuel-specific impulse (Isp) rating of a thruster, assuming no pressure dependence.*
- void [SetThrusterIsp \(THRUSTER\\_HANDLE th, double isp0, double isp\\_ref, double p\\_ref=101.4e3\) const](#)  
*Reset the fuel-specific impulse (Isp) rating of a thruster including a pressure dependency.*
- double [GetThrusterLevel \(THRUSTER\\_HANDLE th\) const](#)  
*Returns the current thrust level setting of a thruster.*
- void [SetThrusterLevel \(THRUSTER\\_HANDLE th, double level\) const](#)  
*Set thrust level for a thruster.*
- void [IncThrusterLevel \(THRUSTER\\_HANDLE th, double dlevel\) const](#)  
*Apply a change to the thrust level of a thruster.*
- void [SetThrusterLevel\\_SingleStep \(THRUSTER\\_HANDLE th, double level\) const](#)  
*Set the thrust level of a thruster for the current time step only.*
- void [IncThrusterLevel\\_SingleStep \(THRUSTER\\_HANDLE th, double dlevel\) const](#)  
*Apply a thrust level change to a thruster for the current time step only.*
- void [GetThrusterMoment \(THRUSTER\\_HANDLE th, VECTOR3 &F, VECTOR3 &T\) const](#)  
*Returns the linear moment (force) and angular moment (torque) currently generated by a thruster.*
- double [GetISP \(\) const](#)  
*Returns the vessel's current default fuel-specific impulse.*
- void [SetISP \(double isp\) const](#)  
*Sets the default Isp value for subsequently created thrusters.*

#### Thruster group management

- [THGROUP\\_HANDLE CreateThrusterGroup \(THRUSTER\\_HANDLE \\*th, int nth, THGROUP\\_TYPE thgt\) const](#)  
*Combine thrusters into a logical group.*
- bool [DelThrusterGroup \(THGROUP\\_HANDLE thg, bool delth=false\) const](#)  
*Delete a thruster group and (optionally) all associated thrusters.*
- bool [DelThrusterGroup \(THGROUP\\_TYPE thgt, bool delth=false\) const](#)  
*Delete a default thruster group and (optionally) all associated thrusters.*
- [THGROUP\\_HANDLE GetThrusterGroupHandle \(THGROUP\\_TYPE thgt\) const](#)  
*Returns the handle of a default thruster group.*
- [THGROUP\\_HANDLE GetUserThrusterGroupHandleByIndex \(DWORD idx\) const](#)  
*Returns the handle of a user-defined (nonstandard) thruster group.*
- [DWORD GetGroupThrusterCount \(THGROUP\\_HANDLE thg\) const](#)

- **DWORD GetGroupThrusterCount (THGROUP\_TYPE thgt) const**

Returns the number of thrusters assigned to a logical thruster group.
- **THRUSTER\_HANDLE GetGroupThruster (THGROUP\_HANDLE thg, DWORD idx) const**

Returns the number of thrusters assigned to a standard logical thruster group.
- **THRUSTER\_HANDLE GetGroupThruster (THGROUP\_TYPE thgt, DWORD idx) const**

Returns a handle for a thruster that belongs to a specified thruster group.
- **THRUSTER\_HANDLE GetUserThrusterGroupCount () const**

Returns a handle for a thruster that belongs to a standard thruster group.
- **DWORD GetUserThrusterGroupCount () const**

Returns the number of user-defined (nonstandard) thruster groups.
- **bool ThrusterGroupDefined (THGROUP\_TYPE thgt) const**

Indicates if a default thruster group is defined by the vessel.
- **void SetThrusterGroupLevel (THGROUP\_HANDLE thg, double level) const**

Sets the thrust level for all thrusters in a group.
- **void SetThrusterGroupLevel (THGROUP\_TYPE thgt, double level) const**

Sets the thrust level for all thrusters in a standard group.
- **void IncThrusterGroupLevel (THGROUP\_HANDLE thg, double dlevel) const**

Increments the thrust level for all thrusters in a group.
- **void IncThrusterGroupLevel (THGROUP\_TYPE thgt, double dlevel) const**

Increments the thrust level for all thrusters in a standard group.
- **void IncThrusterGroupLevel\_SingleStep (THGROUP\_HANDLE thg, double dlevel) const**

Increments the thrust level of a group for a single time step.
- **void IncThrusterGroupLevel\_SingleStep (THGROUP\_TYPE thgt, double dlevel) const**

Increments the thrust level of a standard group for a single time step.
- **double GetThrusterGroupLevel (THGROUP\_HANDLE thg) const**

Returns the mean thrust level for a thruster group.
- **double GetThrusterGroupLevel (THGROUP\_TYPE thgt) const**

Returns the mean thrust level for a default thruster group.
- **double GetManualControlLevel (THGROUP\_TYPE thgt, DWORD mode=MANCTRL\_ATTMODE, DWORD device=MANCTRL\_ANYDEVICE) const**

Returns the thrust level of an attitude thruster group set via keyboard or mouse input.

## Reaction control system

- **int GetAttitudeMode () const**

Returns the current RCS (reaction control system) thruster mode.
- **bool SetAttitudeMode (int mode) const**

Sets the vessel's RCS (reaction control system) thruster mode.
- **int ToggleAttitudeMode () const**

Switch between linear and rotational RCS mode.
- **void GetAttitudeRotLevel (VECTOR3 &th) const**

Returns the current combined thrust levels for the reaction control system thruster groups in rotational mode.
- **void SetAttitudeRotLevel (const VECTOR3 &th) const**

Set RCS thruster levels for rotation in all 3 vessel axes.
- **void SetAttitudeRotLevel (int axis, double th) const**

Set RCS thruster level for rotation around a single axis.
- **void GetAttitudeLinLevel (VECTOR3 &th) const**

Returns the current combined thrust levels for the reaction control system thruster groups in linear (translational) mode.
- **void SetAttitudeLinLevel (const VECTOR3 &th) const**

Set RCS thruster levels for linear translation in all 3 vessel axes.
- **void SetAttitudeLinLevel (int axis, double th) const**

Set RCS thruster level for linear translation along a single axis.

### Communication interface

- int [SendBufferedKey](#) (DWORD key, bool down=true, char \*kstate=0)  
*Send a simulated buffered key event to the vessel.*

### Navigation radio interface

- void [InitNavRadios](#) (DWORD nnav) const  
*Defines the number of navigation (NAV) radio receivers supported by the vessel.*
- DWORD [GetNavCount](#) () const  
*Returns the number of NAV radio receivers.*
- bool [SetNavChannel](#) (DWORD n, DWORD ch) const  
*Sets the channel of a NAV radio receiver.*
- DWORD [GetNavChannel](#) (DWORD n) const  
*Returns the current channel setting of a NAV radio receiver.*
- float [GetNavRecvFreq](#) (DWORD n) const  
*Returns the current radio frequency of a NAV radio receiver.*
- void [EnableTransponder](#) (bool enable) const  
*Enable/disable transmission of transponder signal.*
- bool [SetTransponderChannel](#) (DWORD ch) const  
*Switch the channel number of the vessel's transponder.*
- void [EnableIDS](#) (DOCKHANDLE hDock, bool bEnable) const  
*Enable/disable one of the vessel's IDS (Instrument Docking System) transmitters.*
- bool [SetIDSChannel](#) (DOCKHANDLE hDock, DWORD ch) const  
*Switch the channel number of one of the vessel's IDS (Instrument Docking System) transmitters.*
- NAVHANDLE [GetTransponder](#) () const  
*Return handle of vessel transponder if available.*
- NAVHANDLE [GetIDS](#) (DOCKHANDLE hDock) const  
*Return handle of one of the vessel's instrument docking system (IDS) radio transmitters.*
- NAVHANDLE [GetNavSource](#) (DWORD n) const  
*Return handle of transmitter source currently received by one of the vessel's NAV receivers.*

### Cockpit camera methods

- void [SetCameraOffset](#) (const VECTOR3 &co) const  
*Set the camera position for internal (cockpit) view.*
- void [GetCameraOffset](#) (VECTOR3 &co) const  
*Returns the current camera position for internal (cockpit) view.*
- void [SetCameraDefaultDirection](#) (const VECTOR3 &cd) const  
*Set the default camera direction for internal (cockpit) view.*
- void [SetCameraDefaultDirection](#) (const VECTOR3 &cd, double tilt) const  
*Set the default camera direction and tilt angle for internal (cockpit) view.*
- void [GetCameraDefaultDirection](#) (VECTOR3 &cd) const  
*Returns the default camera direction for internal (cockpit) view.*
- void [SetCameraCatchAngle](#) (double cangle) const  
*Set the angle over which the cockpit camera auto-centers to default direction.*
- void [SetCameraRotationRange](#) (double left, double right, double up, double down) const  
*Sets the range over which the cockpit camera can be rotated from its default direction.*
- void [SetCameraShiftRange](#) (const VECTOR3 &fpos, const VECTOR3 &lpos, const VECTOR3 &rpos) const  
*Set the linear movement range for the cockpit camera.*
- void [SetCameraMovement](#) (const VECTOR3 &fpos, double fphi, double ftht, const VECTOR3 &lpos, double lphi, double ltht, const VECTOR3 &rpos, double rphi, double rtht) const  
*Set both linear movement range and orientation of the cockpit camera when "leaning" forward, left and right.*

## Instrument panel and virtual cockpit methods

- void [TriggerPanelRedrawArea](#) (int panel\_id, int area\_id)  
*Triggers a redraw notification for a panel area.*
- void [TriggerRedrawArea](#) (int panel\_id, int vc\_id, int area\_id)  
*Triggers a redraw notification to either a 2D panel or a virtual cockpit.*

## Mesh methods

- void [ClearMeshes](#) (bool retain\_anim) const  
*Remove all mesh definitions for the vessel.*
- UINT [AddMesh](#) (const char \*meshname, const [VECTOR3](#) \*ofs=0) const  
*Load a mesh definition for the vessel from a file.*
- UINT [AddMesh](#) ([MESHHANDLE](#) hMesh, const [VECTOR3](#) \*ofs=0) const  
*Add a pre-loaded mesh definition to the vessel.*
- UINT [InsertMesh](#) (const char \*meshname, UINT idx, const [VECTOR3](#) \*ofs=0) const  
*Insert or replace a mesh at a specific index location of the vessel's mesh list.*
- UINT [InsertMesh](#) ([MESHHANDLE](#) hMesh, UINT idx, const [VECTOR3](#) \*ofs=0) const  
*Insert or replace a mesh at a specific index location of the vessel's mesh list.*
- bool [DelMesh](#) (UINT idx, bool retain\_anim=false) const  
*Remove a mesh from the vessel's mesh list.*
- bool [ShiftMesh](#) (UINT idx, const [VECTOR3](#) &ofs) const  
*Shift the position of a mesh relative to the vessel's local coordinate system.*
- void [ShiftMeshes](#) (const [VECTOR3](#) &ofs) const  
*Shift the position of all meshes relative to the vessel's local coordinate system.*
- bool [GetMeshOffset](#) (UINT idx, [VECTOR3](#) &ofs) const  
*Returns the mesh offset in the vessel frame.*
- UINT [GetMeshCount](#) () const  
*Number of meshes.*
- [MESHHANDLE](#) [GetMesh](#) ([VISHANDLE](#) vis, UINT idx) const  
*Obtain mesh handle for a vessel mesh.*
- [DEVMESHHANDLE](#) [GetDevMesh](#) ([VISHANDLE](#) vis, UINT idx) const  
*Returns a handle for a device-specific mesh instance.*
- const [MESHHANDLE](#) [GetMeshTemplate](#) (UINT idx) const  
*Obtain a handle for a vessel mesh template.*
- const char \* [GetMeshName](#) (UINT idx) const  
*Obtain mesh file name for an on-demand mesh.*
- [MESHHANDLE](#) [CopyMeshFromTemplate](#) (UINT idx) const  
*Make a copy of one of the vessel's mesh templates.*
- WORD [GetMeshVisibilityMode](#) (UINT idx) const  
*Returns the visibility flags for a vessel mesh.*
- void [SetMeshVisibilityMode](#) (UINT idx, WORD mode) const  
*Set the visibility flags for a vessel mesh.*
- bool [MeshgroupTransform](#) ([VISHANDLE](#) vis, const [MESHGROUP\\_TRANSFORM](#) &mt) const  
*Affine transformation of a mesh group.*
- int [MeshModified](#) ([MESHHANDLE](#) hMesh, UINT grp, DWORD modflag)  
*Notifies Orbiter of a change in a mesh group.*

### Animations

- void **RegisterAnimation** () const  
*Logs a request for calls to `VESSEL2::clbkAnimate`.*
- void **UnregisterAnimation** () const  
*Unlogs an animation request.*
- UINT **CreateAnimation** (double initial\_state) const  
*Create a mesh animation object.*
- bool **DelAnimation** (UINT anim) const  
*Delete an existing mesh animation object.*
- ANIMATIONCOMPONENT\_HANDLE **AddAnimationComponent** (UINT anim, double state0, double state1, MGROUP\_TRANSFORM \*trans, ANIMATIONCOMPONENT\_HANDLE parent=NULL) const  
*Add a component (rotation, translation or scaling) to an animation.*
- bool **DelAnimationComponent** (UINT anim, ANIMATIONCOMPONENT\_HANDLE hAC)  
*Remove a component from an animation.*
- bool **SetAnimation** (UINT anim, double state) const  
*Set the state of an animation.*
- double **GetAnimation** (UINT anim) const  
*Return the current state of an animation.*
- UINT **GetAnimPtr** (ANIMATION \*\*anim) const  
*Returns a pointer to the array of animations defined by the vessel.*

### Supervessel functions

If the vessel is a component of a docked superstructure, this set of functions can retrieve information about the superstructure.

- SUPERVESSELHANDLE **GetSupervessel** () const  
*Returns a handle to the vessel's superstructure or NULL if the vessel is not part of a docking assembly.*
- VECTOR3 **GetSupervesselCG** () const  
*Returns the supervessel's centre of gravity in the local vessel frame.*

### Recording/playback functions

- bool **Recording** () const  
*Flag for active recording session.*
- bool **Playback** () const  
*Flag for active playback session.*
- void **RecordEvent** (const char \*event\_type, const char \*event) const  
*Writes a custom tag to the vessel's articulation data stream during a running recording session.*

### Coordinate transformations

- void **ShiftCentreOfMass** (const VECTOR3 &shift)  
*Register a shift in the centre of mass after a structural change (e.g. stage separation).*
- void **ShiftCG** (const VECTOR3 &shift)  
*Shift the centre of gravity of a vessel.*
- bool **GetSuperstructureCG** (VECTOR3 &cg) const  
*Returns the centre of gravity of the superstructure to which the vessel belongs, if applicable.*
- void **GetRotationMatrix** (MATRIX3 &R) const  
*Returns the current rotation matrix for transformations from the vessel's local frame of reference to the global frame.*

- void [SetRotationMatrix](#) (const **MATRIX3** &R) const  
*Applies a rotation by replacing the vessel's local to global rotation matrix.*
- void [GlobalRot](#) (const **VECTOR3** &rloc, **VECTOR3** &rglob) const  
*Performs a rotation of a direction from the local vessel frame to the global frame.*
- void [HorizonRot](#) (const **VECTOR3** &rloc, **VECTOR3** &rhorizon) const  
*Performs a rotation from the local vessel frame to the current local horizon frame.*
- void [HorizonInvRot](#) (const **VECTOR3** &rhorizon, **VECTOR3** &rloc) const  
*Performs a rotation of a direction from the current local horizon frame to the local vessel frame.*
- void [Local2Global](#) (const **VECTOR3** &local, **VECTOR3** &global) const  
*Performs a transformation from local vessel coordinates to global coordinates.*
- void [Global2Local](#) (const **VECTOR3** &global, **VECTOR3** &local) const  
*Performs a transformation from global to local vessel coordinates.*
- void [Local2Rel](#) (const **VECTOR3** &local, **VECTOR3** &rel) const  
*Performs a transformation from local vessel coordinates to the ecliptic frame centered at the vessel's reference body.*

## Docking port management

See also: [Docking port management](#)

- **DOCKHANDLE** [CreateDock](#) (const **VECTOR3** &pos, const **VECTOR3** &dir, const **VECTOR3** &rot) const  
*Create a new docking port.*
- bool [DelDock](#) (**DOCKHANDLE** hDock) const  
*Delete a previously defined docking port.*
- void [ClearDockDefinitions](#) () const  
*Delete all docking ports defined for the vessel.*
- void [SetDockParams](#) (const **VECTOR3** &pos, const **VECTOR3** &dir, const **VECTOR3** &rot) const  
*Set the parameters for the vessel's primary docking port (port 0), or create a new dock if required.*
- void [SetDockParams](#) (**DOCKHANDLE** hDock, const **VECTOR3** &pos, const **VECTOR3** &dir, const **VECTOR3** &rot) const  
*Reset the parameters for a vessel docking port.*
- void [GetDockParams](#) (**DOCKHANDLE** hDock, **VECTOR3** &pos, **VECTOR3** &dir, **VECTOR3** &rot) const  
*Returns the paramters of a docking port.*
- **UINT** [DockCount](#) () const  
*Returns the number of docking ports defined for the vessel.*
- **DOCKHANDLE** [GetDockHandle](#) (**UINT** n) const  
*Returns a handle to a docking port.*
- **OBJHANDLE** [GetDockStatus](#) (**DOCKHANDLE** hDock) const  
*Returns a handle to a docked vessel.*
- **UINT** [DockingStatus](#) (**UINT** port) const  
*Returns a status flag for a docking port.*
- int [Dock](#) (**OBJHANDLE** target, **UINT** n, **UINT** tgttn, **UINT** mode) const  
*Dock to another vessel.*
- bool [Undock](#) (**UINT** n, const **OBJHANDLE** exclude=0) const  
*Release a docked vessel from a docking port.*
- void [SetDockMode](#) (**int** mode) const  
*Set the docking approach mode for all docking ports.*

## Passive attachment management

See also: [Attachment management](#)

- **ATTACHMENTHANDLE CreateAttachment** (bool toparent, const **VECTOR3** &pos, const **VECTOR3** &dir, const **VECTOR3** &rot, const char \*id, bool loose=false) const  
*Define a new attachment point for a vessel.*
- bool **DelAttachment** (ATTACHMENTHANDLE attachment) const  
*Delete an attachment point.*
- void **ClearAttachments** () const  
*Delete all attachment points defined for the vessel.*
- void **SetAttachmentParams** (ATTACHMENTHANDLE attachment, const **VECTOR3** &pos, const **VECTOR3** &dir, const **VECTOR3** &rot) const  
*Reset attachment position and orientation for an existing attachment point.*
- void **GetAttachmentParams** (ATTACHMENTHANDLE attachment, **VECTOR3** &pos, **VECTOR3** &dir, **VECTOR3** &rot) const  
*Retrieve the parameters of an attachment point.*
- const char \* **GetAttachmentId** (ATTACHMENTHANDLE attachment) const  
*Retrieve attachment identifier string.*
- **OBJHANDLE GetAttachmentStatus** (ATTACHMENTHANDLE attachment) const  
*Return the current status of an attachment point.*
- DWORD **AttachmentCount** (bool toparent) const  
*Return the number of child or parent attachment points defined for the vessel.*
- DWORD **GetAttachmentIndex** (ATTACHMENTHANDLE attachment) const  
*Return the list index of the vessel's attachment point defined by its handle.*
- ATTACHMENTHANDLE **GetAttachmentHandle** (bool toparent, DWORD i) const  
*Return the handle of an attachment point identified by its list index.*
- bool **AttachChild** (OBJHANDLE child, ATTACHMENTHANDLE attachment, ATTACHMENTHANDLE childAttachment) const  
*Attach a child vessel to an attachment point.*
- bool **DetachChild** (ATTACHMENTHANDLE attachment, double vel=0.0) const  
*Break an existing attachment to a child.*

## Exhaust and entry render functions

- **UINT AddExhaust** (THRUSTER\_HANDLE th, double lscale, double wscale, SURFHANDLE tex=0) const  
*Add an exhaust render definition for a thruster.*
- **UINT AddExhaust** (THRUSTER\_HANDLE th, double lscale, double wscale, double lofs, SURFHANDLE tex=0) const  
*Add an exhaust render definition for a thruster with additional offset.*
- **UINT AddExhaust** (THRUSTER\_HANDLE th, double lscale, double wscale, const **VECTOR3** &pos, const **VECTOR3** &dir, SURFHANDLE tex=0) const  
*Add an exhaust render definition for a thruster with explicit reference position and direction.*
- **UINT AddExhaust** (EXHAUSTSPEC \*spec)  
*Add an exhaust render definition defined by a parameter structure.*
- bool **DelExhaust** (UINT idx) const  
*Removes an exhaust render definition.*
- DWORD **GetExhaustCount** () const  
*Returns the number of exhaust render definitions for the vessel.*
- bool **GetExhaustSpec** (UINT idx, double \*lscale, double \*wscale, **VECTOR3** \*pos, **VECTOR3** \*dir, SURFHANDLE \*tex) const  
*Returns the parameters of an exhaust definition.*

- bool `GetExhaustSpec` (UINT idx, `EXHAUSTSPEC` \*spec)  
*Returns the parameters of an exhaust definition in a structure.*
- double `GetExhaustLevel` (UINT idx) const  
*Returns the current level of an exhaust source.*
- void `SetReentryTexture` (SURFHANDLE tex, double plimit=6e7, double lscale=1.0, double wscale=1.0) const  
*Select a previously registered texture to be used for rendering reentry flames.*

#### Particle systems

- `PSTREAM_HANDLE AddParticleStream` (`PARTICLESTREAMSPEC` \*pss, const `VECTOR3` &pos, const `VECTOR3` &dir, double \*lvl) const  
*Adds a custom particle stream to a vessel.*
- `PSTREAM_HANDLE AddExhaustStream` (`THRUSTER_HANDLE` th, `PARTICLESTREAMSPEC` \*pss=0) const  
*Adds an exhaust particle stream to a vessel.*
- `PSTREAM_HANDLE AddExhaustStream` (`THRUSTER_HANDLE` th, const `VECTOR3` &pos, `PARTICLESTREAMSPEC` \*pss=0) const  
*Adds an exhaust particle stream to a vessel.*
- `PSTREAM_HANDLE AddReentryStream` (`PARTICLESTREAMSPEC` \*pss) const  
*Adds a reentry particle stream to a vessel.*
- bool `DelExhaustStream` (`PSTREAM_HANDLE` ch) const  
*Delete an existing particle stream.*

#### Nosewheel-steering and wheel brakes

- void `SetNosewheelSteering` (bool activate) const
- bool `GetNosewheelSteering` () const  
*Returns the activation state of the nose-wheel steering system.*
- void `SetMaxWheelbrakeForce` (double f) const  
*Define the maximum force which can be provided by the vessel's wheel brake system.*
- void `SetWheelbrakeLevel` (double level, int which=0, bool permanent=true) const  
*Apply the wheel brake.*
- double `GetWheelbrakeLevel` (int which) const  
*Returns the current wheel brake level.*

#### Beacon management

- void `AddBeacon` (`BEACONLIGHTSPEC` \*bs)  
*Add a light beacon definition to a vessel.*
- bool `DelBeacon` (`BEACONLIGHTSPEC` \*bs)  
*Remove a beacon definition from the vessel.*
- void `ClearBeacons` ()  
*Remove all beacon definitions from the vessel.*
- const `BEACONLIGHTSPEC` \* `GetBeacon` (DWORD idx) const  
*Returns a pointer to one of the vessel's beacon specifications.*
- `LightEmitter` \* `AddPointLight` (const `VECTOR3` &pos, double range, double att0, double att1, double att2, `COLOUR4` diffuse, `COLOUR4` specular, `COLOUR4` ambient) const  
*\ name Light emitters*
- `LightEmitter` \* `AddSpotLight` (const `VECTOR3` &pos, const `VECTOR3` &dir, double range, double att0, double att1, double att2, double umbra, double penumbra, `COLOUR4` diffuse, `COLOUR4` specular, `COLOUR4` ambient) const

- **DWORD LightEmitterCount () const**  
*Returns the number of light sources defined for the vessel.*
- **const LightEmitter \* GetLightEmitter (DWORD i) const**  
*Returns a pointer to a light source object identified by index.*
- **bool DelLightEmitter (LightEmitter \*le) const**  
*Deletes the specified light source from the vessel.*
- **void ClearLightEmitters () const**  
*Remove all light sources defined for the vessel.*

## File I/O

- **void ParseScenarioLineEx (char \*line, void \*status) const**  
*Pass a line read from a scenario file to Orbiter for default processing.*

## Obsolete methods

- **void SetEngineLevel (ENGINETYPE eng, double level) const**  
*Set the thrust level for an engine group.*
- **void IncEngineLevel (ENGINETYPE eng, double dlevel) const**  
*Increase or decrease the thrust level for an engine group.*
- **double GetMaxThrust (ENGINETYPE eng) const**
- **void SetMaxThrust (ENGINETYPE eng, double th) const**
- **double GetEngineLevel (ENGINETYPE eng) const**
- **double \* GetMainThrustModPtr () const**
- **void SetExhaustScales (EXHAUSTTYPE exh, WORD id, double lscale, double wscale) const**
- **bool DelThrusterGroup (THGROUP\_HANDLE &thg, THGROUP\_TYPE thgt, bool delth=false) const**  
*Delete a thruster group and (optionally) all associated thrusters.*
- **UINT AddExhaustRef (EXHAUSTTYPE exh, VECTOR3 &pos, double lscale=-1.0, double wscale=-1.0, VECTOR3 \*dir=0) const**
- **void DelExhaustRef (EXHAUSTTYPE exh, WORD id) const**
- **void ClearExhaustRefs (void) const**
- **UINT AddAttExhaustRef (const VECTOR3 &pos, const VECTOR3 &dir, double wscale=1.0, double lscale=1.0) const**
- **void AddAttExhaustMode (UINT idx, ATTITUDEMODE mode, int axis, int dir) const**
- **void ClearAttExhaustRefs (void) const**
- **void SetTouchdownPoints (const VECTOR3 &pt1, const VECTOR3 &pt2, const VECTOR3 &pt3) const**  
*Defines the three points defining the vessel's ground contact plane.*
- **void GetTouchdownPoints (VECTOR3 &pt1, VECTOR3 &pt2, VECTOR3 &pt3) const**  
*Returns the three points defining the vessel's ground contact plane.*
- **double GetBankMomentScale () const**  
*Returns the scaling factor for the yaw moment.*
- **void SetBankMomentScale (double scale) const**  
*Sets the scaling factor for the yaw moment.*
- **bool SetNavRecv (DWORD n, DWORD ch) const**  
*Sets the channel of a NAV radio receiver.*
- **DWORD GetNavRecv (DWORD n) const**  
*Returns the current channel setting of a NAV radio receiver.*
- **void SetCOG\_elev (double h) const**  
*Set the altitude of the vessel's centre of gravity over ground level when landed.*
- **void ClearMeshes () const**

- **RemoveAllMeshDefinitions** (void) const
 

*Remove all mesh definitions for the vessel.*
- void **SetMeshVisibleInternal** (UINT idx, bool visible) const
 

*Marks a mesh as visible from internal cockpit view.*
- UINT **RegisterAnimSequence** (double defmeshstate) const
- bool **AddAnimComp** (UINT seq, ANIMCOMP \*comp)
- bool **SetAnimState** (UINT seq, double state)
- void **SaveDefaultState** (FILEHANDLE scn) const
 

*Causes Orbiter to write default vessel parameters to a scenario file.*
- void **ParseScenarioLine** (char \*line, VESSELSTATUS \*status) const
 

*Pass a line read from a scenario file to Orbiter for default processing.*
- void **CreateVariableDragElement** (double \*drag, double factor, const VECTOR3 &ref) const
 

*Add a variable drag element.*
- static OBJHANDLE **Create** (const char \*name, const char \*classname, const VESSELSTATUS &status)
 

*Vessel creation.*

### 17.57.1 Detailed Description

Base class for objects of vessel type (spacecraft and similar)

VESSEL is the base class for addon modules of 'vessel' type (spacecraft, space stations, satellites, deep space probes, etc.) This class defines the interface between the module's vessel definition and the parameters maintained internally by Orbiter to define the vessel state. It provides access to the various status parameters and methods of individual spacecraft.

It is important to note that a VESSEL instance represents an *interface* to an existing vessel in Orbiter, rather than the vessel itself. Vessels can exist without a corresponding VESSEL instance, and deleting a VESSEL instance does not delete the vessel.

Most of the methods provided by the VESSEL class are of 'get' and 'set' type, i.e. for retrieving vessel parameter states, or modifying them. It does *not* define any callback functions that Orbiter uses to notify the vessel of events. These are implemented in the VESSEL2 class (derived from VESSEL). The latest version of the interface is VESSEL3, which implements additional functions. User-defined vessel classes should therefore be derived from VESSEL3 instead of VESSEL.

For complete vessel module implementations, see the examples in OrbiterSDK\samples, for example OrbiterSDK\samples\ShuttlePB.

### 17.57.2 Constructor & Destructor Documentation

#### 17.57.2.1 VESSEL::VESSEL ( OBJHANDLE *hVessel*, int *fmodel* = 1 )

Creates a VESSEL interface instance from a vessel handle.

##### Parameters

<i>hVessel</i>	vessel handle
<i>fmodel</i>	level of realism requested (0=simple, 1=realistic)

##### Note

This function creates an interface to an *existing* vessel. It does not create a new vessel. New vessels are created with the [oapiCreateVessel](#) and [oapiCreateVesselEx](#) functions.

The VESSEL constructor (or the constructor of a derived specialised vessel class) will normally be invoked in the [ovclnit](#) callback function of a vessel module:

```
class MyVessel: public VESSEL
{
    // MyVessel interface definition
};
```

```

DLLCLBK VESSEL *ovcInit (OBJHANDLE hvessel, int
    flightmodel)
{
    return new MyVessel (hvessel, flightmodel);
}

DLLCLBK void ovcExit (VESSEL *vessel)
{
    delete (MyVessel*)vessel;
}

```

The VESSEL interface instance created in ovcInit should be deleted in ovcExit.

#### See also

[oapiCreateVessel](#), [oapiCreateVesselEx](#), [ovcInit](#)

### 17.57.3 Member Function Documentation

#### 17.57.3.1 `bool VESSEL::ActivateNavmode ( int mode )`

Activates one of the automated orbital navigation modes.

##### Parameters

<i>mode</i>	navigation mode identifier (see <a href="#">Navigation mode identifiers</a> )
-------------	---

##### Returns

*true* if the specified navigation mode could be activated, *false* if not available or active already.

##### Note

Navmodes are high-level navigation modes which involve e.g. the simultaneous and timed engagement of multiple attitude thrusters to get the vessel into a defined state. Some navmodes terminate automatically once the target state is reached (e.g. killrot), others remain active until explicitly terminated (hlevel). Navmodes may also terminate if a second conflicting navmode is activated.

#### See also

[Navigation mode identifiers](#), [DeactivateNavmode](#), [ToggleNavmode](#), [GetNavmodeState](#)

#### 17.57.3.2 `ANIMATIONCOMPONENT_HANDLE VESSEL::AddAnimationComponent ( UINT anim, double state0, double state1, MGROUP_TRANSFORM * trans, ANIMATIONCOMPONENT_HANDLE parent = NULL ) const`

Add a component (rotation, translation or scaling) to an animation.

Optionally, animations can be stacked hierachically, where transforming a parent recursively also transforms all its children (e.g. a wheel spinning while the landing gear is being retracted).

##### Parameters

<i>anim</i>	animation identifier, as returned by <a href="#">CreateAnimation()</a>
<i>state0</i>	animation cutoff state 0 for the component
<i>state1</i>	animation cutoff state 1 for the component
<i>trans</i>	transformation data (see notes)
<i>parent</i>	parent transformation

##### Returns

Animation component handle

## Note

state0 and state1 (0..1) allow to define the temporal endpoints of the component's animation within the sequence. For example, state0=0 and state1=1 perform the animation over the whole duration of the animation sequence, while state0=0 and state1=0.5 perform the animation over the first half of the total animation. This allows to build complex animations where different components are animated in a defined temporal sequence. MGROUP\_TRANSFORM is the base class for mesh group transforms. Derived classes provide support for rotations, translations and scaling.

To animate a complete mesh, rather than individual mesh groups, set the "grp" pointer to NULL in the constructor of the corresponding MGROUP\_TRANSFORM operator. The "ngrp" value is then ignored.

To define a transformation as a child of another transformation, set parent to the handle returned by the [AddAnimationComponent](#) call for the parent.

Instead of adding mesh groups to an animation, it is also possible to add a local [VECTOR3](#) array. To do this, set "mesh" to [LOCALVERTEXLIST](#), and set "grp" to [MAKEGROUPARRAY\(vtxptr\)](#), where vtxptr is the [VECTOR3](#) array. "ngrp" is set to the number of vertices in the array. Example:

```
VECTOR3 vtx[2] = {_V(0,0,0), _V(1,0,-1)};
MGROUP_TRANSFORM *mt = new MGROUP_TRANSFORM (_LOCALVERTEXLIST,
    MAKEGROUPARRAY(vtx), 2);
AddAnimationComponent (anim, 0, 1, mt);
```

Transforming local vertices in this way does not have an effect on the visual appearance of the animation, but it can be used by the module to keep track of a transformed point during animation. The Atlantis module uses this method to track a grappled satellite during animation of the RMS arm.

The ANIMATIONCOMPONENT\_HANDLE is a pointer to a [ANIMATIONCOMP](#) structure.

**Bug** When defining a scaling transformation as a child of a parent rotation, only homogeneous scaling is supported, i.e. scale.x = scale.y = scale.z is required.

## See also

[CreateAnimation](#), [DelAnimationComponent](#), [Animation flags](#)

17.57.3.3 void VESSEL::AddBeacon ( BEACONLIGHTSPEC \* *bs* )

Add a light beacon definition to a vessel.

## Parameters

<i>bs</i>	structure defining the beacon parameters
-----------	--

## Note

The [BEACONLIGHTSPEC](#) variable passed to AddBeacon (as well as the pos and col vectors pointed to by the structure) must remain valid until the beacon is removed (with [DelBeacon](#), [ClearBeacons](#), or by deleting the vessel). It should therefore either be defined static, or as a member of the derived vessel class.

The [BEACONLIGHTSPEC](#) parameters can be modified at any time by the module after the call to AddBeacon, to modify the beacon appearance. The changes take effect immediately.

To turn the beacon off temporarily, don't delete the beacon but simply set the *active* element to false.

*shape* defines the appearance of the beacon. Currently supported are:

- BEACONSHAPE\_COMPACT (a compact blob)
- BEACONSHAPE\_DIFFUSE (a more diffuse blob)
- BEACONSHAPE\_STAR (a starlike appearance)

*falloff* determines how the render size of the beacon changes with distance. The value should be between 0 and 1, where 0 means that the apparent size of the beacon is proportional to 1/distance, and 1 means that the apparent size doesn't change at all with distance. The higher the value, the further away the beacon will remain visible. (but note that visibility is limited to the range defined by [SetVisibilityLimit](#)).

*period*, *duration* and *tofs* are used to define a periodically blinking beacon (strobe). To define a continuous beacon, set period = 0. The two other parameters are then ignored.

## See also

[DelBeacon](#), [ClearBeacons](#), [SetVisibilityLimit](#)

17.57.3.4 **UINT VESSEL::AddExhaust ( THRUSTER\_HANDLE *th*, double *lscale*, double *wscale*, SURFHANDLE *tex* = 0 ) const**

Add an exhaust render definition for a thruster.

## Parameters

<i>th</i>	thruster handle
<i>lscale</i>	exhaust flame length [m]
<i>wscale</i>	exhaust flame width [m]
<i>tex</i>	texture handle for custom exhaust flames

## Returns

Exhaust identifier

## Note

Thrusters defined with [CreateThruster](#) do not by default render exhaust effects, until an exhaust definition has been specified with [AddExhaust](#).

The size of the exhaust flame is automatically scaled by the thrust level.

This version retrieves exhaust reference position and direction directly from the thruster setting, and will therefore automatically reflect any changes caused by [SetThrusterRef](#) and [SetThrusterDir](#).

To use a custom exhaust texture, set *tex* to a surface handle returned by [oapiRegisterExhaustTexture](#). If *tex* == 0, the default texture is used.

## See also

[AddExhaust\(THRUSTER\\_HANDLE,double,double,double,SURFHANDLE\)const](#), [AddExhaust\(THRUSTER\\_HANDLE,double,double,const VECTOR3&,const VECTOR3&,SURFHANDLE\)const](#), [DelExhaust](#), [CreateThruster](#), [SetThrusterRef](#), [SetThrusterDir](#), [SetThrusterLevel](#), [oapiRegisterExhaustTexture](#)

17.57.3.5 **UINT VESSEL::AddExhaust ( THRUSTER\_HANDLE *th*, double *lscale*, double *wscale*, double *lofs*, SURFHANDLE *tex* = 0 ) const**

Add an exhaust render definition for a thruster with additional offset.

## Parameters

<i>th</i>	thruster handle
<i>lscale</i>	exhaust flame length [m]
<i>wscale</i>	exhaust flame width [m]
<i>lofs</i>	longitudinal offset [m]
<i>tex</i>	texture handle for custom exhaust flames

## Returns

Exhaust identifier

## Note

This method allows to add an additional longitudinal offset between thruster position and exhaust.

## See also

[AddExhaust\(THRUSTER\\_HANDLE,double,double,SURFHANDLE\)const](#), [AddExhaust\(THRUSTER\\_HANDLE,double,double,const VECTOR3&,const VECTOR3&,SURFHANDLE\)const](#), [DelExhaust](#), [CreateThruster](#), [SetThrusterRef](#), [SetThrusterDir](#), [SetThrusterLevel](#), [oapiRegisterExhaustTexture](#)

17.57.3.6 **UINT VESSEL::AddExhaust ( THRUSTER\_HANDLE *th*, double *lscale*, double *wscale*, const VECTOR3 & *pos*, const VECTOR3 & *dir*, SURFHANDLE *tex* = 0 ) const**

Add an exhaust render definition for a thruster with explicit reference position and direction.

## Parameters

<i>th</i>	thruster handle
<i>lscale</i>	exhaust flame length [m]
<i>wscale</i>	exhaust flame width [m]
<i>pos</i>	reference position in vessel coordinates [m]
<i>dir</i>	exhaust direction in vessel coordinates
<i>tex</i>	texture handle for custom exhaust flames

## Note

This version uses the explicitly provided reference position and direction, rather than using the thruster parameters.

This allows multiple exhaust render definitions to refer to a single thruster definition, e.g. where multiple thrusters have been combined into a single "logical" thruster definition. This technique can be used to simplify the description of thruster groups which are always addressed synchronously.

The exhaust direction should be opposite to the thrust direction of the thruster it refers to.

Exhaust positions and directions are fixed in this version, so they will not react to changes caused by [SetThrusterRef](#) and [SetThrusterDir](#).

To use a custom exhaust texture, set *tex* to a surface handle returned by [oapiRegisterExhaustTexture](#). If *tex* == 0, the default texture is used.

## See also

[AddExhaust\(THRUSTER\\_HANDLE,double,double,SURFHANDLE\)const](#), [AddExhaust\(THRUSTER\\_HANDLE,double,double,double,SURFHANDLE\)const](#), [DelExhaust](#), [CreateThruster](#), [SetThrusterRef](#), [SetThrusterDir](#), [SetThrusterLevel](#), [oapiRegisterExhaustTexture](#)

17.57.3.7 **UINT VESSEL::AddExhaust ( EXHAUSTSPEC \* spec )**

Add an exhaust render definition defined by a parameter structure.

## Parameters

<i>spec</i>	exhaust specification
-------------	-----------------------

## Returns

Exhaust identifier

## Note

This method is more versatile than the other `AddExhaust` versions. It allows dynamic custom control of exhaust level, position and direction, and it can be defined independently of thrusters.

To let the exhaust appearance be automatically controlled by a thruster, set *spec->th* to the thruster handle. The fields *spec->level*, *spec->lpos* and *spec->ldir* can then be set to NULL, to indicate that they should be linked to the thruster parameters.

If *spec->th* == NULL (thruster-independent exhaust definition), then *spec->level*, *spec->lpos* and *spec->ldir* must not be NULL. They must point to variables that continuously define the level, position and negative direction of the exhaust cone. The variables themselves must persist during the lifetime of the exhaust definition.

An exception is the definition of a constant parameter. For example, if the exhaust position is to be set to a fixed position, set the *spec->flags* field to `EXHAUST_CONSTANTPOS`. In this case, the value pointed to by *spec->lpos* is copied by Orbiter, and the variable can be discarded after the call to `AddExhaust`. In a similar fashion, the bit flags `EXHAUST_CONSTANTDIR` and `EXHAUST_CONSTANTLEVEL` can be added to indicate fixed direction and exhaust level, respectively.

If the *spec->ldir* parameter is provided, it must specify the engine thrust direction (= the negative exhaust direction), in contrast to the other `AddExhaust` functions, which refer to the positive exhaust direction.

*spec->lsize* and *spec->wsize* define the length and width of the exhaust flame [m].

*spec->lofs* defines a longitudinal offset between the reference position and the exhaust flame.

spec->modulate defines the amplitude of a random variation in exhaust level, between 0 (none) and 1 (max). spec->tex can be used to provide a custom exhaust texture. If spec->tex == NULL, then the default exhaust texture is used.

#### 17.57.3.8 **PSTREAM\_HANDLE** VESSEL::AddExhaustStream ( **THRUSTER\_HANDLE** *th*, **PARTICLESTREAMSPEC** \* *pss* = 0 ) const

Adds an exhaust particle stream to a vessel.

##### Parameters

<i>th</i>	thruster handle
<i>pss</i>	particle stream specification

##### Returns

Particle stream handle

##### Note

Exhaust streams can be emissive (to simulate "glowing" ionised gases) or diffuse (e.g. for simulating vapour trails).

The **PARTICLESTREAMSPEC** structure defined the properties of the particle stream.

Multiple streams can be defined for a single engine. For example, an emissive stream with short lifetime may represent the ionised exhaust gases, while a diffuse stream with longer lifetime represents the vapour trail.

To improve performance, closely packed engines may share a single exhaust stream.

If the user has disabled particle streams in the launchpad dialog, this function will return NULL. The module must be able to cope with this case.

##### See also

[AddExhaustStream\(THRUSTER\\_HANDLE,const VECTOR3&,PARTICLESTREAMSPEC\\*\)const](#), [AddParticleStream](#), [AddReentryStream](#)

#### 17.57.3.9 **PSTREAM\_HANDLE** VESSEL::AddExhaustStream ( **THRUSTER\_HANDLE** *th*, const **VECTOR3** & *pos*, **PARTICLESTREAMSPEC** \* *pss* = 0 ) const

Adds an exhaust particle stream to a vessel.

##### Parameters

<i>th</i>	thruster handle
<i>pos</i>	particle emission reference point
<i>pss</i>	particle stream specification

##### Returns

Particle stream handle

##### Note

This version allows to pass an explicit particle emission reference position, independent of the engine reference point.

If the user has disabled particle streams in the launchpad dialog, this function will return NULL. The module must be able to cope with this case.

##### See also

[AddExhaustStream\(THRUSTER\\_HANDLE,PARTICLESTREAMSPEC\\*\)const](#), [AddParticleStream](#), [AddReentryStream](#)

17.57.3.10 void VESSEL::AddForce ( const VECTOR3 & *F*, const VECTOR3 & *r* ) const

Add a custom body force.

## Parameters

<i>F</i>	force vector [ <b>N</b> ]
<i>r</i>	force attack point in local vessel coordinates [ <b>m</b> ]

## Note

This function can be used to implement custom forces (braking chutes, tethers, etc.). It should not be used for standard forces such as engine thrust or aerodynamic forces which are handled internally (although in theory this function makes it possible to bypass Orbiter's built-in thrust and aerodynamics model completely and replace it by a user-defined model).

The force is applied only for the next time step. AddForce will therefore usually be used inside the [VESSEL::L2::clbkPreStep](#) callback function.

## See also

[GetForceVector](#)

17.57.3.11 **UINT VESSEL::AddMesh ( const char \* *meshname*, const VECTOR3 \* *ofs* = 0 ) const**

Load a mesh definition for the vessel from a file.

## Parameters

<i>meshname</i>	mesh file name
<i>ofs</i>	optional pointer to a displacement vector which describes the offset of the mesh origin against the vessel origin [ <b>m</b> ].

## Returns

mesh index

## Note

*meshname* defines a path to an existing mesh file. The mesh must be in Orbiter's MSH format (see [3D Model.pdf](#)).

The file name (including optional directory path) is relative to Orbiter's mesh directory (usually ".\Meshes"). The file extension must not be specified (.msh is assumed.)

The mesh is either appended to the end of the vessel's mesh list, or inserted at the location of a previously deleted mesh (see [VESSEL::DelMesh](#))

The returned value is the mesh list index at which the mesh reference was stored. It can be used to identify the mesh later (e.g. for animations).

This function only creates a *reference* to a mesh, but does not directly load the mesh from file. The mesh is physically loaded only when it is required (whenever the vessel moves within visual range of the observer camera).

## See also

[AddMesh\(MESHHANDLE,const VECTOR3\\*\)const](#), [DelMesh](#)

17.57.3.12 **UINT VESSEL::AddMesh ( MESHHANDLE *hMesh*, const VECTOR3 \* *ofs* = 0 ) const**

Add a pre-loaded mesh definition to the vessel.

## Parameters

<i>hMesh</i>	mesh handle
<i>ofs</i>	optional pointer to a displacement vector which describes the offset of the mesh origin against the vessel origin [ <b>m</b> ].

## Returns

mesh index

## Note

*hMesh* is a handle to a mesh previously loaded with [oapiLoadMeshGlobal](#).

The global handle *hMesh* represents a "mesh template". Whenever the vessel needs to create its visual representation (when moving within visual range of the observer camera), it creates its individual mesh as a copy of the template.

## See also

[AddMesh\(const char\\*,const VECTOR3\\*\)const, oapiLoadMeshGlobal, DelMesh](#)

**17.57.3.13 PSTREAM\_HANDLE VESSEL::AddParticleStream ( PARTICLESTREAMSPEC \* *pss*, const VECTOR3 & *pos*, const VECTOR3 & *dir*, double \* *lvl* ) const**

Adds a custom particle stream to a vessel.

## Parameters

<i>pss</i>	pointer to particle stream definition structure
<i>pos</i>	particle source position in vessel coordinates [ <b>m</b> ]
<i>dir</i>	particle emission direction in vessel coordinates
<i>lvl</i>	pointer to scaling factor

## Returns

Particle stream handle

## Note

This function can be used to add venting effects and similar. For engine-specific effects such as exhaust and contrails, use the [AddExhaustStream](#) functions instead.

The **PARTICLESTREAMSPEC** structure defined the properties of the particle stream.

The position and direction variables are in vessel-relative coordinates. They cannot be redefined.

*lvl* points to a variable which defines the strength of the particle emission. Its value should be set in the range from 0 (particle generation off) to 1 (emission at full strength). It can be changed continuously to modulate the particle generation.

## See also

[AddExhaustStream, AddReentryStream](#)

**17.57.3.14 LightEmitter\* VESSEL::AddPointLight ( const VECTOR3 & *pos*, double *range*, double *att0*, double *att1*, double *att2*, COLOUR4 *diffuse*, COLOUR4 *specular*, COLOUR4 *ambient* ) const**

\ name Light emitters

Add an isotropic point light source to the vessel.

## Parameters

<i>pos</i>	source position [ <b>m</b> ] in vessel coordinates
<i>range</i>	light source range [m]
<i>att0</i>	attenuation coefficients (see notes)
<i>att1</i>	attenuation coefficients (see notes)
<i>att2</i>	attenuation coefficients (see notes)
<i>diffuse</i>	source contribution to diffuse object colours
<i>specular</i>	source contribution to specular object colours
<i>ambient</i>	source contribution to ambient object colours

## Returns

pointer to new emitter object

## Note

The intensity  $I$  of the light source as a function of distance  $d$  is defined via the coefficients by

$$I = \frac{1}{att_0 + datt_1 + d^2att_2}$$

17.57.3.15 **PSTREAM\_HANDLE** VESSEL::AddReentryStream ( **PARTICLESTREAMSPEC** \* *pss* ) const

Adds a reentry particle stream to a vessel.

## Parameters

<i>pss</i>	particle stream specification
------------	-------------------------------

## Returns

Particle stream handle

## Note

Vessels automatically define a default emissive particle stream, but you may want to add further stream to customise the appearance.

## See also

[AddParticleStream](#), [AddExhaustStream](#)

17.57.3.16 **LightEmitter\*** VESSEL::AddSpotLight ( **const VECTOR3** & *pos*, **const VECTOR3** & *dir*, **double** *range*, **double** *att0*, **double** *att1*, **double** *att2*, **double** *umbra*, **double** *penumbra*, **COLOUR4** *diffuse*, **COLOUR4** *specular*, **COLOUR4** *ambient* ) const

Add a directed spot light source to the vessel.

## Parameters

<i>pos</i>	source position [ <b>m</b> ] in vessel coordinates
<i>dir</i>	light direction in vessel coordinates
<i>range</i>	light source range [m]

<i>att0</i>	attenuation coefficients (see notes)
<i>att1</i>	attenuation coefficients (see notes)
<i>att2</i>	attenuation coefficients (see notes)
<i>umbra</i>	aperture of inner (maximum intensity) cone [rad]
<i>penumbra</i>	aperture of outer (zero intensity) cone [rad]
<i>diffuse</i>	source contribution to diffuse object colours
<i>specular</i>	source contribution to specular object colours
<i>ambient</i>	source contribution to ambient object colours

**Returns**

pointer to new emitter object

**Note**

The intensity  $I$  of the light source as a function of distance  $d$  is defined via the coefficients by

$$I = \frac{1}{att_0 + datt_1 + d^2att_2}$$

### 17.57.3.17 **bool VESSEL::AttachChild ( **OBJHANDLE** *child*, **ATTACHMENTHANDLE** *attachment*, **ATTACHMENTHANDLE** *child\_attachment* ) const**

Attach a child vessel to an attachment point.

**Parameters**

<i>child</i>	handle of child vessel to be attached.
<i>attachment</i>	attachment point to which the child will be attached.
<i>child_attachment</i>	attachment point on the child to which we want to attach.

**Returns**

*true* indicates success, *false* indicates failure (child refuses attachment)

**Note**

The *attachment* handle must refer to an attachment "to child" (i.e. created with *toparent*=false); the *child\_attachment* handle must refer to an attachment "to parent" on the child object (i.e. created with *toparent*=true). It is not possible to connect two parent or two child attachment points.

A child can only be connected to a single parent at any one time. If the child is already connected to a parent, the previous parent connection is severed.

The child may check the parent attachment's id string and, depending on the value, refuse to connect. In that case, the function returns *false*.

**See also**

[CreateAttachment](#), [SetAttachmentParams](#), [GetAttachmentParams](#), [GetAttachmentId](#), [GetAttachmentStatus](#), [AttachmentCount](#), [GetAttachmentIndex](#), [GetAttachmentHandle](#), [DetachChild](#)

### 17.57.3.18 **DWORD VESSEL::AttachmentCount ( **bool** *toparent* ) const**

Return the number of child or parent attachment points defined for the vessel.

## Parameters

<i>toparent</i>	If <i>true</i> , return the number of attachment points to parents. Otherwise, return the number of attachment points to children.
-----------------	--

## Returns

Number of defined attachment points to connect to parents or to children.

## See also

[CreateAttachment](#), [SetAttachmentParams](#), [GetAttachmentParams](#), [GetAttachmentId](#), [GetAttachmentStatus](#), [GetAttachmentIndex](#), [GetAttachmentHandle](#), [AttachChild](#), [DetachChild](#)

## 17.57.3.19 void VESSEL::ClearAirfoilDefinitions ( ) const

Removes all airfoils currently defined for the vessel.

## Note

This function is useful if a vessel needs to re-define all its airfoil definitions as a result of a structural change. After clearing all airfoils, you should generate new ones. Even wingless objects (such as capsules) should define their aerodynamic behaviour by airfoils (see [CreateAirfoil](#)). Vessels without airfoil definitions revert to the obsolete legacy atmospheric flight model.

## See also

[DelAirfoil](#), [CreateAirfoil](#), [CreateAirfoil2](#), [CreateAirfoil3](#)

## 17.57.3.20 void VESSEL::ClearAttachments ( ) const

Delete all attachment points defined for the vessel.

## Note

Any attached parent or child vessels will be released.

After this function returns, all previously defined attachment handles will no longer be valid.

## 17.57.3.21 void VESSEL::ClearBeacons ( )

Remove all beacon definitions from the vessel.

## See also

[AddBeacon](#), [DelBeacon](#)

## 17.57.3.22 void VESSEL::ClearControlSurfaceDefinitions ( ) const

Removes all aerodynamic control surfaces.

## Note

This function is useful if the vessel has to re-define all its control surfaces (e.g. as a result of structural change).

## See also

[DelControlSurface](#)

## 17.57.3.23 void VESSEL::ClearDockDefinitions ( ) const

Delete all docking ports defined for the vessel.

**Note**

Any docked objects will be undocked before deleting the docking ports.

**See also**

[CreateDock](#), [DelDock](#), [DockCount](#), [Dock](#), [Undock](#)

## 17.57.3.24 void VESSEL::ClearLightEmitters ( ) const

Remove all light sources defined for the vessel.

**See also**

[AddPointLight](#), [AddSpotLight](#), [LightEmitterCount](#)

17.57.3.25 void VESSEL::ClearMeshes ( bool *retain\_anim* ) const

Remove all mesh definitions for the vessel.

**Parameters**

<i>retain_anim</i>	flag for retaining mesh animation objects
--------------------	---

**Note**

If *retain\_anim* is *false*, all animations defined for the vessel are deleted together with the meshes. If *true*, the animations stay behind. This is only useful if the same meshes are subsequently added again in the same order, so that the animations point to the appropriate meshes and mesh groups and can be re-used. If different meshes are loaded later, the behaviour of the animations becomes undefined.

In the future, obsolete method [ClearMeshes\(\)const](#) will be removed, and *retain\_anim* will have a default value of *false*.

## 17.57.3.26 void VESSEL::ClearMeshes ( ) const

Remove all mesh definitions for the vessel.

**Deprecated** This version is obsolete and has been replaced by [VESSEL::ClearMeshes\(bool\)const](#) .

**Note**

Equivalent to [ClearMeshes\(true\)](#). This method is only retained for backward compatibility, and may be removed in future versions.

**See also**

[ClearMeshes\(bool\)const](#)

## 17.57.3.27 void VESSEL::ClearPropellantResources ( ) const

Remove all propellant resources for the vessel.

**Note**

After a call to this function, all the vessel's thrusters will be disabled until they are linked to new resources.

**See also**

[DelPropellantResource](#)

## 17.57.3.28 void VESSEL::ClearThrusterDefinitions ( ) const

Delete all thruster and thruster group definitions.

## Note

This function removes all thruster definitions, as well as all the thruster group definitions.  
It also removes all previously defined exhaust render definitions.

## See also

[CreateThruster](#), [DelThruster](#), [CreateThrusterGroup](#), [AddExhaust](#)

## 17.57.3.29 void VESSEL::ClearVariableDragElements ( ) const

Removes all drag elements defined with [CreateVariableDragElement](#).

## See also

[CreateVariableDragElement](#)

17.57.3.30 MESHHANDLE VESSEL::CopyMeshFromTemplate ( *UINT idx* ) const

Make a copy of one of the vessel's mesh templates.

## Parameters

<i>idx</i>	mesh index
------------	------------

## Returns

handle of copied mesh

## Note

Meshes loaded with [oapiLoadMeshGlobal](#) are templates shared between all vessel instances and should never be modified by individual vessels. If a vessel needs to modify its meshes, it should operate on a copy of the template.

17.57.3.31 static OBJHANDLE VESSEL::Create ( *const char \* name*, *const char \* classname*, *const VESSELSTATUS & status* ) [static]

Vessel creation.

**Deprecated** This method has been replaced with [oapiCreateVessel](#) and [oapiCreateVesselEx](#).

17.57.3.32 void VESSEL::CreateAirfoil ( *AIRFOIL\_ORIENTATION align*, *const VECTOR3 & ref*, *AirfoilCoeffFunc cf*, *double c*, *double S*, *double A* ) const

Creates a new airfoil and defines its aerodynamic properties.

## Parameters

<i>align</i>	orientation of the lift vector (LIFT_VERTICAL or LIFT_HORIZONTAL)
--------------	---

<i>ref</i>	centre of pressure in vessel coordinates [ <b>m</b> ]
<i>cf</i>	pointer to coefficient callback function (see notes)
<i>c</i>	airfoil chord length [m]
<i>S</i>	wing area [ $m^2$ ]
<i>A</i>	wing aspect ratio

#### Note

A vessel can define multiple airfoils (for wings, main body, tail stabilisers, etc.). In general, it should define at least one vertical and one horizontal component.

Airfoil definitions for wings and horizontal stabilisers set *align* to LIFT\_VERTICAL. Vertical stabilisers (vertical tail fin, etc.) set *align* to LIFT\_HORIZONTAL.

The centre of pressure is the point at which the lift and drag forces generated by the airfoil are applied to the vessel. Together with the moment coefficient it defines the aerodynamic stability of the vessel. Usually the CoP will be aft of the CG, and the moment coefficient will have a negative slope around the trim angle of attack.

The *AirfoilCoeffFunc* is a callback function which must be supplied by the module. It calculates the lift, moment and drag coefficients for the airfoil. It has the following interface:

```
void AirfoilCoeffFunc (double aoa, double M, double Re,
                      double *cl, double *cm, double *cd)
```

and returns the lift coefficient (*cl*), moment coefficient (*cm*) and drag coefficient (*cd*) as a function of angle of attack *aoa* [rad], Mach number *M* and Reynolds number *Re*. Note that *aoa* can range over the full circle (-pi to pi). For vertical lift components, *aoa* is the pitch angle of attack (a), while for horizontal components it is the yaw angle of attack (b).

If the wing area *S* is set to 0, then Orbiter uses the projected vessel cross sections to define a reference area. Let (*v<sub>x</sub>*, *v<sub>y</sub>*, *v<sub>z</sub>*) be the unit vector of freestream air flow in vessel coordinates. Then the reference area is calculated as *S* = *v<sub>z</sub>C<sub>z</sub>* + *v<sub>y</sub>C<sub>y</sub>* for a LIFT\_VERTICAL airfoil, and as *S* = *v<sub>z</sub>C<sub>z</sub>* + *v<sub>x</sub>C<sub>x</sub>* for a LIFT\_HORIZONTAL airfoil, where *C<sub>x</sub>*, *C<sub>y</sub>*, *C<sub>z</sub>* are the vessel cross-sections in x, y and z direction, respectively.

The wing aspect ratio is defined as *A* = *b*<sup>2</sup>/*S* with wing span *b*.

A vessel should typically define its airfoils in the [VESSEL2::clbkSetClassCaps](#) callback function. If no airfoils are defined, Orbiter will fall back to its legacy drag calculation, using the cw coefficients defined in [SetCW](#). Legacy lift calculation is no longer supported.

For more details, see the Programmer's Guide.

#### See also

[CreateAirfoil2](#), [CreateAirfoil3](#), [EditAirfoil](#), [DelAirfoil](#)

**17.57.3.33 AIRFOILHANDLE VESSEL::CreateAirfoil2 ( AIRFOIL\_ORIENTATION *align*, const VECTOR3 & *ref*, AirfoilCoeffFunc *cf*, double *c*, double *S*, double *A* ) const**

Creates a new airfoil and defines its aerodynamic properties.

#### Parameters

<i>align</i>	orientation of the lift vector (LIFT_VERTICAL or LIFT_HORIZONTAL)
<i>ref</i>	centre of pressure in vessel coordinates [ <b>m</b> ]
<i>cf</i>	pointer to coefficient callback function (see notes)
<i>c</i>	airfoil chord length [m]
<i>S</i>	wing area [ $m^2$ ]
<i>A</i>	wing aspect ratio

#### Returns

Handle for the new airfoil.

**Note**

This method is identical to [CreateAirfoil](#), but returns a handle which can be used to identify the airfoil later.

**See also**

[CreateAirfoil](#), [CreateAirfoil3](#), [EditAirfoil](#), [DelAirfoil](#)

**17.57.3.34 AIRFOILHANDLE VESSEL::CreateAirfoil3 ( AIRFOIL\_ORIENTATION align, const VECTOR3 & ref, AirfoilCoeffFuncEx cf, void \* context, double c, double S, double A ) const**

Creates a new airfoil and defines its aerodynamic properties.

**Parameters**

<i>align</i>	orientation of the lift vector (LIFT_VERTICAL or LIFT_HORIZONTAL)
<i>ref</i>	centre of pressure in vessel coordinates [m]
<i>cf</i>	pointer to coefficient callback function (see notes)
<i>context</i>	pointer to data block passed to cf callback function
<i>c</i>	airfoil chord length [m]
<i>S</i>	wing area [m <sup>2</sup> ]
<i>A</i>	wing aspect ratio

**Returns**

Handle for the new airfoil.

**Note**

This method is an extension to [CreateAirfoil2](#), using a more versatile coefficient callback function. AirfoilCoeffFuncEx has the following interface:

```
void AirfoilCoeffFuncEx (VESSEL *v, double aoa, double M, double Re,
    void *context, double *cl, double *cm, double *cd)
```

where *v* is a pointer to the calling vessel instance, and *context* is the pointer passed to CreateAirfoil3. It can be used to make available to the callback function any additional parameters required to calculate the lift and drag coefficients. All other parameters are identical to AirfoilCoeffFunc (see [CreateAirfoil](#)).

**See also**

[CreateAirfoil](#), [CreateAirfoil2](#), [EditAirfoil](#), [DelAirfoil](#)

**17.57.3.35 UINT VESSEL::CreateAnimation ( double *initial\_state* ) const**

Create a mesh animation object.

The sequence can contain multiple components (rotations, translations, scalings of mesh groups) with a fixed temporal correlation. The animation is driven by manipulating its "state", which is a number between 0 and 1 used to linearly interpolate the animation within its range. See API User's Guide for details.

**Parameters**

<i>initial_state</i>	the animation state corresponding to the unmodified mesh
----------------------	--

**Returns**

Animation identifier

**Note**

After creating an animation, components can be added with [AddAnimationComponent](#).

Use [SetAnimation\(\)](#) to manipulate the animation state.

$0 \leq \text{initial\_state} \leq 1$  defines at which state the animation is stored in the mesh file. Example: Landing gear animation between retracted state (0) and deployed state (1). If the landing gear is retracted in the mesh file, set initial\_state to 0. If it is deployed in the mesh file, set initial\_state to 1.

**See also**

[DelAnimation](#), [AddAnimationComponent](#)

### 17.57.3.36 ATTACHMENTHANDLE VESSEL::CreateAttachment ( *bool toparent*, *const VECTOR3 & pos*, *const VECTOR3 & dir*, *const VECTOR3 & rot*, *const char \* id*, *bool loose = false* ) const

Define a new attachment point for a vessel.

**Parameters**

<i>topleft</i>	If <i>true</i> , the attachment can be used to connect to a parent (i.e. the vessel acts as a child). Otherwise, attachment is used to connect to a child (i.e. vessel acts as parent)
<i>pos</i>	attachment point position in vessel coordinates [m]
<i>dir</i>	attachment direction in vessel coordinates
<i>rot</i>	longitudinal alignment vector in vessel coordinates
<i>id</i>	compatibility identifier
<i>loose</i>	If <i>true</i> , allow loose connections (see notes)

**Returns**

Handle to new attachment point

**Note**

A vessel can define multiple parent and child attachment points, and can subsequently have multiple children attached, but it can only be attached to a single parent at any one time.

The *dir* and *rot* vectors should both be normalised to length 1, and they should be orthogonal.

The identifier string can contain up to 8 characters. It can be used to define compatibility between attachment points.

If the attachment point is defined as *loose*, then the relative orientation between the two attached objects is frozen to the orientation between them at the time the connection was established. Otherwise, the two objects snap to the orientation defined by their *dir* vectors.

**See also**

[SetAttachmentParams](#), [GetAttachmentParams](#), [GetAttachmentId](#), [GetAttachmentStatus](#), [AttachmentCount](#), [GetAttachmentIndex](#), [GetAttachmentHandle](#), [AttachChild](#), [DetachChild](#)

### 17.57.3.37 void VESSEL::CreateControlSurface ( *AIRCTRL\_TYPE type*, *double area*, *double dCl*, *const VECTOR3 & ref*, *int axis = AIRCTRL\_AXIS\_AUTO*, *UINT anim = (UINT) -1* ) const

Creates an aerodynamic control surface.

**Parameters**

<i>type</i>	control surface type (see <a href="#">Aerodynamic control surface types</a> )
<i>area</i>	control surface area [ $m^2$ ]
<i>dCl</i>	shift in lift coefficient achieved by fully extended control
<i>ref</i>	centre of pressure in vessel coordinates [ <b>m</b> ]
<i>axis</i>	rotation axis (see <a href="#">Control surface axis orientation</a> )
<i>anim</i>	animation reference, if applicable

#### Note

Control surfaces include elevators, rudders, ailerons, flaps, etc. They can be used to control the vessel during atmospheric flight.

When selecting automatic axis control (axis=AIRCTRL\_AXIS\_AUTO), the following axes will be used for given control surfaces:

Elevator	XPOS
Rudder	YPOS
Aileron	XPOS if ref.x > 0, XNEG otherwise
Flap	XPOS

For ailerons, at least 2 control surfaces should be defined (e.g. on left and right wing) with opposite rotation axes, to obtain the angular momentum for banking the vessel.

Elevators typically use the XPOS axis, assuming the that the centre of pressure is aft of the centre of gravity. If pitch control is provided by a canard configuration *ahead* of the CoG, XNEG should be used instead.

The centre of pressure defined by the *ref* parameter is the point at which the lift and drag forces for the control surface are applied.

To improve performance, multiple control surfaces may sometimes be defined by a single call to `CreateControlSurface`. For example, the elevator controls on the left and right wing may be combined by setting a centered attack point.

Control surfaces can be animated, by passing an animation reference to `CreateControlSurface`. The animation reference is obtained when creating the animation with [CreateAnimation](#). The animation should support a state in the range from 0 to 1, with neutral surface position at state 0.5.

#### See also

[CreateControlSurface2](#), [CreateControlSurface3](#)

**17.57.3.38 CTRLSURFHANDLE VESSEL::CreateControlSurface2 ( AIRCTRL\_TYPE type, double area, double dCl, const VECTOR3 & ref, int axis = AIRCTRL\_AXIS\_AUTO, UINT anim = (UINT)-1 ) const**

Creates an aerodynamic control surface and returns a handle.

#### Parameters

<i>type</i>	control surface type (see <a href="#">Aerodynamic control surface types</a> )
<i>area</i>	control surface area [ $m^2$ ]
<i>dCl</i>	shift in lift coefficient achieved by fully extended control
<i>ref</i>	centre of pressure in vessel coordinates [ <b>m</b> ]
<i>axis</i>	rotation axis (see <a href="#">Control surface axis orientation</a> )
<i>anim</i>	animation reference, if applicable

#### Returns

Control surface handle.

#### Note

This function is identical to [CreateControlSurface](#), but it returns a handle for later reference (e.g. to delete it with [DelControlSurface](#))

It is equivalent to [CreateControlSurface3](#) with *delay* = 1.

## See also

[CreateControlSurface](#), [CreateControlSurface3](#), [DelControlSurface](#)

**17.57.3.39 CTRLSURFHANDLE VESSEL::CreateControlSurface3 ( AIRCTRL\_TYPE *type*, double *area*, double *dCl*, const VECTOR3 & *ref*, int *axis* = AIRCTRL\_AXIS\_AUTO, double *delay* = 1.0, UINT *anim* = (UINT)-1 ) const**

Creates an aerodynamic control surface and returns a handle.

## Parameters

<i>type</i>	control surface type (see <a href="#">Aerodynamic control surface types</a> )
<i>area</i>	control surface area [ $m^2$ ]
<i>dCl</i>	shift in lift coefficient achieved by fully extended control
<i>ref</i>	centre of pressure in vessel coordinates [ <b>m</b> ]
<i>axis</i>	rotation axis (see <a href="#">Control surface axis orientation</a> )
<i>delay</i>	response delay setting [s]
<i>anim</i>	animation reference, if applicable

## Returns

Control surface handle.

## Note

This function is identical to [CreateControlSurface2](#) except that it specifies an additional 'delay' parameter which defines the response delay for the surface (the time it takes to move from neutral to fully deployed). Setting delay=0 provides direct response.

## See also

[CreateControlSurface](#), [CreateControlSurface2](#)

**17.57.3.40 DOCKHANDLE VESSEL::CreateDock ( const VECTOR3 & *pos*, const VECTOR3 & *dir*, const VECTOR3 & *rot* ) const**

Create a new docking port.

## Parameters

<i>pos</i>	dock reference position in vessel coordinates [ <b>m</b> ]
<i>dir</i>	approach direction in vessel coordinates.
<i>rot</i>	longitudinal rotation alignment vector

## Returns

Handle for the new docking port.

## Note

The *dir* and *rot* vectors should be normalised to length 1.

The *rot* vector should be perpendicular to the *dir* vector.

When two vessels connect at their docking ports, the relative orientation of the vessels is defined such that their respective approach direction vectors (*dir*) are anti-parallel, and their longitudinal alignment vectors (*rot*) are parallel.

## See also

[DelDock](#), [ClearDockDefinitions](#), [GetDockParams](#), [SetDockParams](#), [DockCount](#), [GetDockHandle](#), [GetDockStatus](#), [Dock](#), [Undock](#)

**17.57.3.41 PROPELLANT\_HANDLE VESSEL::CreatePropellantResource ( double *maxmass*, double *mass* = -1.0, double *efficiency* = 1.0 ) const**

Create a new propellant resource ("fuel tank")

Propellant resources are a component of the vessel's propulsion system. They can hold propellants and distribute them to connected engines to generate thrust.

#### Parameters

<i>maxmass</i>	maximum propellant capacity of the tank [kg]
<i>mass</i>	initial propellant mass of the resource [kg]
<i>efficiency</i>	fuel efficiency factor (>0)

#### Returns

propellant resource handle

#### Note

Orbiter doesn't distinguish between propellant and oxidant. A "propellant resource" is assumed to be a combination of fuel and oxidant resources.

The interpretation of a propellant resource (liquid or solid propulsion system, ion drive, etc.) is up to the vessel developer.

The rate of fuel consumption depends on the thrust level and Isp (fuel-specific impulse) of the thrusters attached to the resource.

The fuel efficiency rating, together with a thruster's Isp rating, determines how much fuel is consumed per second to obtain a given thrust:  $R = F(e \cdot Isp)^{-1}$  with fuel rate R [kg/s], thrust F [N], efficiency e and fuel-specific impulse Isp [m/s].

If mass < 0 then mass = maxmass is substituted.

#### See also

[DelPropellantResource](#), [SetPropellantMaxMass](#), [SetPropellantMass](#), [SetPropellantEfficiency](#), [GetPropellantMaxMass](#), [GetPropellantMass](#), [GetPropellantEfficiency](#)

**17.57.3.42 THRUSTER\_HANDLE VESSEL::CreateThruster ( const VECTOR3 & *pos*, const VECTOR3 & *dir*, double *maxth0*, PROPELLANT\_HANDLE *hp* = NULL, double *isp0* = 0.0, double *isp\_ref* = 0.0, double *p\_ref* = 101.4e3 ) const**

Add a logical thruster definition for the vessel.

#### Parameters

<i>pos</i>	thrust force attack point in vessel coordinates [m]
<i>dir</i>	thrust force direction in vessel coordinates (normalised)
<i>maxth0</i>	max. vacuum thrust rating [N]
<i>hp</i>	propellant resource feeding the thruster
<i>isp0</i>	vacuum fuel-specific impulse (Isp) [m/s]
<i>isp_ref</i>	Isp value at reference pressure <i>p_ref</i> [m/s]
<i>p_ref</i>	reference pressure for <i>isp_ref</i> [Pa]

#### Returns

Thruster identifier

**Note**

The fuel-specific impulse defines how much thrust is produced by burning 1kg of fuel per second. If the Isp level is not specified or is = 0, a default value is used (see [SetISP\(\)](#)).

To define the thrust and Isp ratings to be pressure-dependent, specify an isp\_ref value > 0, and set p\_ref to the corresponding atmospheric pressure. Thrust and Isp at pressure p will then be calculated as

$$Isp(p) = Isp_0(1 - p\eta), \quad Th(p) = Th_0(1 - p\eta), \quad \text{where} \quad \eta = \frac{Isp_0 - Isp_{ref}}{p_{ref} Isp_0}$$

If isp\_ref = 0 then no pressure-dependency is assumed (  $\eta = 0$  ).

If no propellant resource is specified, the thruster is disabled until it is linked to a resource by [SetThrusterResource\(\)](#).

If  $isp_0 \leq 0$ , then the default Isp value is substituted (see [SetISP\(\)](#)).

Thruster forces can create linear as well as angular moments, depending on the attack point and direction.

Use [CreateThrusterGroup](#) to assemble thrusters into logical groups.

**See also**

[DelThruster](#), [CreateThrusterGroup](#), [AddExhaust](#), [SetISP](#), [SetThrusterIsp](#), [SetThrusterResource](#)

#### 17.57.3.43 THGROUP\_HANDLE VESSEL::CreateThrusterGroup ( **THRUSTER\_HANDLE** \* *th*, **int** *nth*, **THGROUP\_TYPE** *thgt* ) const

Combine thrusters into a logical group.

**Parameters**

<i>th</i>	array of thruster handles to form a group
<i>nth</i>	number of thrusters in the array
<i>thgt</i>	thruster group type (see <a href="#">Thruster and thruster-group parameters</a> )

**Returns**

thruster group handle

**Note**

Thruster groups (except for user-defined groups) are engaged by Orbiter as a result of user input. For example, pushing the stick backward in rotational attitude mode will engage the thrusters in the THGROUP\_ATT\_PI→TCHUP group.

It is the responsibility of the vessel designer to make sure that the thruster groups are designed so that they behave in a sensible way.

Thrusters can be added to more than one group. For example, an attitude thruster can be simultaneously grouped into THGROUP\_ATT\_PITCHUP and THGROUP\_ATT\_UP.

Rotational thrusters should be designed so that they don't induce a significant linear momentum. This means rotational groups require at least 2 thrusters each.

Linear thrusters should be designed such that they don't induce a significant angular momentum.

If a vessel does not define a complete set of attitude thruster groups, certain navmode sequences (e.g. KIL→LROT) may fail.

**See also**

[DelThrusterGroup](#), [CreateThruster](#), [Thruster and thruster-group parameters](#)

#### 17.57.3.44 void VESSEL::CreateVariableDragElement ( **const double** \* *drag*, **double** *factor*, **const VECTOR3** & *ref* ) const

Attaches a modifiable drag component to the vessel.

## Parameters

<i>drag</i>	pointer to external drag control parameter
<i>factor</i>	drag magnitude scaling factor
<i>ref</i>	drag force attack point [m]

## Note

This method is useful for defining drag produced by movable parts such as landing gear and airbrakes. The magnitude of the drag force is calculated as

$$D = d \cdot f \cdot q_\infty$$

where *d* is the control parameter, *f* is the scale factor, and *q* is the freestream dynamic pressure. The value of *d* (the parameter pointed to by *drag*) should be set to values between 0 (no drag) and 1 (full drag). Any changes to the value have immediate effect. Depending on the attack point, the applied drag force may create torque in addition to linear force.

## See also

[ClearVariableDragElements](#)

17.57.3.45 void VESSEL::CreateVariableDragElement ( double \* *drag*, double *factor*, const VECTOR3 & *ref* ) const

Add a variable drag element.

**Deprecated** This method has been replaced with [CreateVariableDragElement\(const double\\*,double,const VEC<VECTOR3>&\)](#).

17.57.3.46 bool VESSEL::DeactivateNavmode ( int *mode* )

Deactivates an automated orbital navigation mode.

## Parameters

<i>mode</i>	navigation mode identifier (see <a href="#">Navigation mode identifiers</a> )
-------------	---

## Returns

*true* if the specified navigation mode could be deactivated, *false* if not available or inactive already.

## See also

[Navigation mode identifiers](#), [ActivateNavmode](#), [ToggleNavmode](#), [GetNavmodeState](#)

17.57.3.47 void VESSEL::DefSetState ( const VESSELSTATUS \* *status* ) const

Set default vessel status parameters.

Invokes Orbiter's vessel state initialisation with the standard status parameters provided via a [VESSELSTATUS](#) structure.

## Parameters

<i>status</i>	structure containing vessel status parameters
---------------	---

**Note**

The [VESSELSTATUS](#) structure contains only a limited set of parameters. Applications should normally use `DefSetStateEx` in combination with an extended [VESSELSTATUSx](#) structure.

**See also**

[VESSELSTATUS](#), [DefSetStateEx](#), [GetStatus](#)

**17.57.3.48 void VESSEL::DefSetStateEx ( const void \* *status* ) const**

Set default vessel status parameters.

Invokes Orbiter's vessel state initialisation with the standard status parameters provided in a [VESSELSTATUSx](#) structure.

**Parameters**

<i>status</i>	pointer to a <a href="#">VESSELSTATUSx</a> structure (x >= 2).
---------------	--

**Note**

*status* must point to a [VESSELSTATUSx](#) structure. Currently only [VESSELSTATUS2](#) is supported, but future Orbiter versions may introduce new interfaces.

Typically, this function will be called in the body of an overloaded [VESSEL2::clbkSetStateEx](#) to enable default state initialisation.

**See also**

[VESSELSTATUS2](#), [GetStatusEx](#), [VESSEL2::clbkSetStateEx](#)

**17.57.3.49 bool VESSEL::DelAirfoil ( AIRFOILHANDLE *hAirfoil* ) const**

Deletes a previously defined airfoil.

**Parameters**

<i>hAirfoil</i>	airfoil handle
-----------------	----------------

**Returns**

*false* indicates failure (invalid handle)

**Note**

If all the vessel's airfoils are deleted without creating new ones, Orbiter reverts to the obsolete legacy atmospheric flight model.

**See also**

[CreateAirfoil2](#), [CreateAirfoil3](#), [ClearAirfoilDefinitions](#)

**17.57.3.50 bool VESSEL::DelAnimation ( UINT *anim* ) const**

Delete an existing mesh animation object.

**Parameters**

<i>anim</i>	animation identifier, as returned by CreateAnimation
-------------	--

**Returns**

true if animation was deleted successfully

**Note**

The animation is deleted by removing all the components associated with it. Subsequently, any calls to SetAnimation using this animation index will not have any effect.

Before the animation is deleted, the mesh groups associated with the animation are reset to their default (initial) positions. To avoid jumps in the visual appearance of the vessel, animations should therefore only be deleted when the animation state has returned to the default state.

**See also**

[CreateAnimation](#)

**17.57.3.51 bool VESSEL::DelAnimationComponent ( **UINT** *anim*, **ANIMATIONCOMPONENT\_HANDLE** *hAC* )**

Remove a component from an animation.

**Parameters**

<i>anim</i>	animation identifier
<i>hAC</i>	animation component handle

**Returns**

*false* indicates failure (*anim* out of range, or *hAC* invalid)

**Note**

If the component has children belonging to the same animation, these will be deleted as well.

In the current implementation, the component must not have children belonging to other animations. Trying to delete such a component will result in undefined behaviour.

**See also**

[AddAnimationComponent](#)

**17.57.3.52 bool VESSEL::DelAttachment ( **ATTACHMENTHANDLE** *attachment* ) const**

Delete an attachment point.

**Parameters**

<i>attachment</i>	attachment handle
-------------------	-------------------

**Returns**

*false* indicates failure (invalid attachment handle)

**Note**

The attachment handle can refer to either a child or parent attachment point.  
Any object attached to this point will be released.  
After this function returns successfully, the attachment handle is no longer valid.

**See also**

[CreateAttachment](#)

**17.57.3.53 bool VESSEL::DelBeacon ( BEACONLIGHTSPEC \* *bs* )**

Remove a beacon definition from the vessel.

**Parameters**

<i>bs</i>	pointer to the BEACONLIGHTSPEC structure previously use to define the beacon with <a href="#">AddBeacon</a> .
-----------	---

**Returns**

*true* if the beacon definition was found and removed, *false* otherwise.

**Note**

[DelBeacon](#) removes the beacon reference from the vessel's list of beacons, but does not deallocate the beacon itself. If the vessel had defined the beacon specification dynamically, it should deallocate it after this call.

**See also**

[AddBeacon](#), [ClearBeacons](#)

**17.57.3.54 bool VESSEL::DelControlSurface ( CTRLSURFHANDLE *hCtrlSurf* ) const**

Deletes a previously defined aerodynamic control surface.

**Parameters**

<i>hCtrlSurf</i>	control surface handle
------------------	------------------------

**Returns**

*false* indicates error (invalid handle)

**See also**

[CreateControlSurface2](#), [CreateControlSurface3](#)

**17.57.3.55 bool VESSEL::DelDock ( DOCKHANDLE *hDock* ) const**

Delete a previously defined docking port.

**Parameters**

<i>hDock</i>	dock handle
--------------	-------------

#### Returns

*false* indicates failure (invalid dock handle)

#### Note

Any object docked at the port will be undocked before the docking port is deleted.

#### See also

[CreateDock](#), [ClearDockDefinitions](#), [DockCount](#), [Dock](#), [Undock](#)

### 17.57.3.56 bool VESSEL::DelExhaust ( **UINT** *idx* ) const

Removes an exhaust render definition.

#### Parameters

<i>idx</i>	exhaust identifier
------------	--------------------

#### Returns

*false* if exhaust definition does not exist, *true* otherwise.

#### See also

[AddExhaust](#), [GetExhaustCount](#)

### 17.57.3.57 bool VESSEL::DelExhaustStream ( **PSTREAM\_HANDLE** *ch* ) const

Delete an existing particle stream.

#### Parameters

<i>ch</i>	particle stream handle
-----------	------------------------

#### Returns

*false* indicates failure (particle stream not found)

#### Note

If a thruster is deleted (with ref [DelThruster](#)), any attached particle streams are deleted automatically. A deleted particle stream will no longer emit particles, but existing particles persist until they expire.

#### See also

[AddParticleStream](#), [AddExhaustStream](#), [AddReentryStream](#)

### 17.57.3.58 bool VESSEL::DelLightEmitter ( **LightEmitter** \* *le* ) const

Deletes the specified light source from the vessel.

## Parameters

<i>le</i>	pointer to light emitter object
-----------	---------------------------------

## Returns

*true* if the emitter was successfully deleted, *false* if the source was not recognised by the vessel.

## Note

If the method returns *true*, the emitter (*le*) was deallocated and the pointer should no longer be used.

## See also

[ClearLightEmitters](#), [LightEmitterCount](#)

17.57.3.59 bool VESSEL::DelMesh ( **UINT** *idx*, **bool** *retain\_anim* = *false* ) const

Remove a mesh from the vessel's mesh list.

## Parameters

<i>idx</i>	mesh list index ( $\geq 0$ )
<i>retain_anim</i>	flag for keeping mesh animations

## Returns

*true* on success, *false* to indicate failure (index out of range, or mesh already deleted.)

## Note

After a mesh has been deleted, the mesh index is no longer valid, and should not be used any more in function calls (e.g. for animations).

If meshes are added subsequently, they are placed in the vacant list slots, and therefore can be assigned the indices of previously deleted meshes.

If you want to replace a mesh, it is easier to use the [InsertMesh](#) function instead of a combination of [DelMesh](#) and [AddMesh](#).

By default, all animation components associated with the mesh are deleted. This can be prevented by setting *retain\_anim* to *true*. In general this is only useful if the same mesh is subsequently loaded again into the same mesh index slot. In all other cases, retaining the animations of deleted meshes can lead to undefined behaviour.

## See also

[InsertMesh](#), [AddMesh](#), [ClearMeshes](#)

17.57.3.60 void VESSEL::DelPropellantResource ( **PROPELLANT\_HANDLE** & *ph* ) const

Remove a propellant resource.

## Parameters

<i>ph</i>	propellant resource handle (NULL on return)
-----------	---

## Note

If any thrusters were attached to this fuel resource, they are disabled until connected to a new fuel resource.

## See also

[CreatePropellantResource](#), [ClearPropellantResources](#)

17.57.3.61 `bool VESSEL::DelThruster( THRUSTER_HANDLE & th ) const`

Delete a logical thruster definition.

## Parameters

<i>th</i>	thruster handle (NULL on return)
-----------	----------------------------------

## Returns

true on success, false if the supplied thruster handle was invalid.

## Note

Deleted thrusters will be automatically removed from all thruster groups they had been assigned to. All exhaust render definitions which refer to the deleted thruster are removed.

## See also

[CreateThruster](#), [CreateThrusterGroup](#), [AddExhaust](#)

17.57.3.62 bool VESSEL::DelThrusterGroup ( THGROUP\_HANDLE *thg*, bool *delth* = false ) const

Delete a thruster group and (optionally) all associated thrusters.

## Parameters

<i>thg</i>	thruster group handle
<i>delth</i>	thruster destruction flag (see notes)

## Returns

true on success.

## Note

If *delth*=true, all thrusters associated with the group will be destroyed. Note that this can have side effects if the thrusters were associated with multiple groups, since they are removed from all those groups as well.

## See also

[DelThrusterGroup\(THGROUP\\_TYPE,bool\)const](#), [CreateThrusterGroup](#), [DelThruster](#), [Thruster](#) and [thruster-group](#) parameters

17.57.3.63 bool VESSEL::DelThrusterGroup ( THGROUP\_TYPE *thgt*, bool *delth* = false ) const

Delete a default thruster group and (optionally) all associated thrusters.

## Parameters

<i>thgt</i>	thruster group type (excluding THGROUP_USER)
<i>delth</i>	thruster destruction flag

## Returns

true on success

## Note

This version can only be used for default thruster groups (< THGROUP\_USER). If *delth*=true, all thrusters associated with the group will be destroyed. Note that this can have side effects if the thrusters were associated with multiple groups, since they are removed from all those groups as well.

## See also

[DelThrusterGroup\(THGROUP\\_HANDLE,bool\)const](#), [CreateThrusterGroup](#), [DelThruster](#), [Thruster](#) and [thruster-group](#) parameters

17.57.3.64 `bool VESSEL::DelThrusterGroup ( THGROUP_HANDLE & thg, THGROUP_TYPE thgt, bool delth = false ) const`

Delete a thruster group and (optionally) all associated thrusters.

**Deprecated** This method has been replaced by `VESSEL::DelThrusterGroup(THGROUP_HANDLE,bool)const`.

#### Parameters

<i>thg</i>	thruster group handle (NULL on return)
<i>thgt</i>	thruster group type (see <a href="#">Thruster and thruster-group parameters</a> )
<i>delth</i>	thruster destruction flag (see notes)

#### Returns

*true* on success.

#### Note

If *delth*==*true*, all thrusters associated with the group will be destroyed. Note that this can have side effects if the thrusters were associated with multiple groups, since they are removed from all those groups as well.

#### See also

[DelThrusterGroup\(THGROUP\\_TYPE,bool\)const](#), [CreateThrusterGroup](#), [DelThruster](#), [Thruster and thruster-group parameters](#)

17.57.3.65 `bool VESSEL::DetachChild ( ATTACHMENTHANDLE attachment, double vel = 0.0 ) const`

Break an existing attachment to a child.

#### Parameters

<i>attachment</i>	attachment handle
<i>vel</i>	separation velocity [m/s]

#### Returns

*true* when detachment is successful, *false* if no child was attached, or if child refuses to detach.

#### See also

[CreateAttachment](#), [SetAttachmentParams](#), [GetAttachmentParams](#), [GetAttachmentId](#), [GetAttachmentStatus](#), [AttachmentCount](#), [GetAttachmentIndex](#), [GetAttachmentHandle](#), [AttachChild](#)

17.57.3.66 `int VESSEL::Dock ( OBJHANDLE target, UINT n, UINT tgtm, UINT mode ) const`

Dock to another vessel.

#### Parameters

<i>target</i>	handle of docking target vessel
<i>n</i>	docking port index on vessel ( $\geq 0$ )
<i>tgtm</i>	docking port index on target ( $\geq 0$ )
<i>mode</i>	attachment mode (see notes)

**Returns**

- 0=ok
- 1=docking port *n* on the vessel already in use
- 2=docking port *tgn* on the target already in use
- 3=target vessel already part of the vessel's superstructure

**Note**

This function is useful for designing scenario editors and during startup configuration, but its use should be avoided during a running simulation, because it can lead to unphysical situations: it allows to dock two vessels regardless of their current separation, by teleporting one of them to the location of the other.

During a simulation, Orbiter will dock two vessels automatically when their docking ports are brought into close proximity.

The mode parameter determines how the vessels are connected. The following settings are supported:

- 0: calculate the linear and angular moments of the superstructure from the moments of the docking components. This should only be used if the two vessels are already in close proximity and aligned for docking.
- 1: Keep this in place, and teleport the target vessel for docking
- 2: Keep the target in place, and teleport this for docking.

**See also**

[Undock](#), [GetDockHandle](#), [GetDockStatus](#), [DockCount](#)

**17.57.3.67 UINT VESSEL::DockCount ( ) const**

Returns the number of docking ports defined for the vessel.

**Returns**

Number of docking ports.

**See also**

[CreateDock](#), [DelDock](#), [ClearDockDefinitions](#)

**17.57.3.68 UINT VESSEL::DockingStatus ( UINT *port* ) const**

Returns a status flag for a docking port.

**Parameters**

<i>port</i>	docking port index ( $\geq 0$ )
-------------	---------------------------------

**Returns**

Docking status (0=free, 1=engaged)

**Note**

This method has the same functionality as

`(GetDockStatus (GetDockHandle(port)) ? 1:0)`

**See also**

[GetDockStatus](#), [GetDockHandle](#)

---

```
17.57.3.69 void VESSEL::EditAirfoil ( AIRFOILHANDLE hAirfoil, DWORD flag, const VECTOR3 & ref, AirfoilCoeffFunc cf,  
double c, double S, double A ) const
```

Resets the parameters of an existing airfoil definition.

## Parameters

<i>hAirfoil</i>	airfoil handle
<i>flag</i>	bitflags to define which parameters to reset (see notes)
<i>ref</i>	new centre of pressure
<i>cf</i>	new callback function for coefficient calculation
<i>c</i>	new chord length [m]
<i>S</i>	new wing area [ $m^2$ ]
<i>A</i>	new wing aspect ratio

## Note

This function can be used to modify the parameters of a previously created airfoil. *flag* contains the bit flags defining which parameters will be modified. It can be any combination of the following:

0x01	modify force attack point
0x02	modify coefficient callback function
0x04	modify chord length
0x08	modify wing area
0x10	modify wing aspect ratio

If the airfoil identified by *hAirfoil* was created with [CreateAirfoil3](#), and you want to modify the callback function, then *cf* must point to a function with *AirfoilCoeffFuncEx* interface, and must be cast to *AirfoilCoeffFunc* when passed to [EditAirfoil](#).

## See also

[CreateAirfoil2](#), [CreateAirfoil3](#)

17.57.3.70 void VESSEL::EnableIDS ( DOCKHANDLE *hDock*, bool *bEnable* ) const

Enable/disable one of the vessel's IDS (Instrument Docking System) transmitters.

## Parameters

<i>hDock</i>	docking port handle
<i>bEnable</i>	<i>true</i> to enable, <i>false</i> to disable the IDS for the dock.

## Note

If the IDS transmitter is turned on (*bEnable* = *true*), its channel is initially set to 0 (transmitter frequency 108.00 MHz). Use [SetIDSChannel](#) to tune to a different channel.

## See also

[SetIDSChannel](#), [EnableTransponder](#)

17.57.3.71 void VESSEL::EnableTransponder ( bool *enable* ) const

Enable/disable transmission of transponder signal.

## Parameters

<i>enable</i>	<i>true</i> to enable the transponder, <i>false</i> to disable.
---------------	---

## Note

The transponder is a radio transmitter which can be used by other vessels to obtain navigation information, e.g. for docking rendezvous approaches.

If the transponder is turned on (*enable* = *true*), its initial frequency is set to 108.00 MHz (channel 0). Use [SetTransponderChannel](#) to tune to a different frequency.

## See also

[SetTransponderChannel](#), [SetIDSChannel](#)

17.57.3.72 **DWORD VESSEL::GetADCtrlMode ( ) const**

Returns aerodynamic control surfaces currently under manual control.

## Returns

Bit flags defining the current address mode for aerodynamic control surfaces.

## Note

The input mode defines which types of control surfaces can be manually controlled by the user.

The returned control mode contains bit flags as follows:

- bit 0: elevator enabled/disabled
- bit 1 rudder enabled/disabled
- bit 2 ailerons enabled/disabled

Therefore, mode=0 indicates control surfaces disabled, mode=7 indicates fully enabled.

Some vessel types may support not all, or not any, types of control surfaces.

## See also

[SetADCtrlMode](#), [CreateControlSurface](#), [CreateControlSurface2](#), [GetControlSurfaceLevel](#), [SetControlSurfaceLevel](#)

17.57.3.73 **bool VESSEL::GetAirfoilParam ( AIRFOILHANDLE *hAirfoil*, VECTOR3 \* *ref*, AirfoilCoeffFunc \* *cf*, void \*\* *context*, double \* *c*, double \* *S*, double \* *A* ) const**

Returns the parameters of an existing airfoil.

## Parameters

in	<i>hAirfoil</i>	airfoil handle
out	<i>ref</i>	pointer to centre of pressure [m]
out	<i>cf</i>	pointer to aerodynamic coefficient callback function
out	<i>c</i>	pointer to chord length [m]
out	<i>S</i>	pointer to wing area [m <sup>2</sup> ]
out	<i>A</i>	pointer to wing aspect ratio
out	<i>context</i>	pointer to callback context data

## Returns

*false* indicates failure

## Note

This function copies the airfoil parameters into the variables referenced by the pointers in the parameter list. Any pointers set to NULL are ignored.

```
VECTOR3 cop;
AirfoilCoeffFunc cf;
void *context;
double c, S, A;
v->GetAirfoilParam(hAirfoil,&cop,&cf,&context,&c,&S,&A);
```

## See also

[CreateAirfoil](#), [CreateAirfoil2](#), [CreateAirfoil3](#), [EditAirfoil](#), [DelAirfoil](#)

## 17.57.3.74 double VESSEL::GetAirspeed ( ) const

Returns magnitude of the true airspeed vector.

**Returns**

Magnitude of airspeed velocity vector [m/s]

**Note**

The airspeed vector is defined as the ship's velocity vector relative to the velocity vector of the surrounding freestream airflow.

This function returns the length of the vector returned by [GetAirspeedVector\(\)](#).

**See also**

[GetAirspeedVector](#), [GetGroundspeed](#), [GetGroundspeedVector](#), [GetMachNumber](#), [GetAtmRef](#)

17.57.3.75 bool VESSEL::GetAirspeedVector ( REFFRAME *frame*, VECTOR3 & *v* ) const

Returns the vessel's true airspeed vector.

**Parameters**

in	<i>frame</i>	frame of reference for returned vector.
out	<i>v</i>	airspeed vector on exit [m/s]

**Returns**

Status flag (*false* indicates error). Error conditions: invalid *frame* parameter, or ground speed data could not be obtained.

**Note**

This method returns the true airspeed vector in the requested frame of reference. The ground airvector is defined as the vessel's velocity vector with respect to the surrounding freestream air flow.

If the vessel is not within an a planetary atmosphere, the returned vector is equal to the groundspeed vector.

Valid entries for *frame* are

- FRAME\_GLOBAL: Returns velocity vector in the global frame of reference
- FRAME\_LOCAL: Returns velocity vector in the vessel's local frame of reference
- FRAME\_REFLOCAL: Returns velocity vector in the celestial reference body's local frame of reference
- FRAME\_HORIZON: Returns velocity vector in the local horizon frame (x = longitudinal component, y = vertical component, z = latitudinal component)

**See also**

[GetAirspeed](#), [GetGroundspeed](#), [GetGroundspeedVector](#), [GetAtmRef](#)

## 17.57.3.76 double VESSEL::GetAltitude ( ) const

Returns the altitude above the mean radius of the current surface reference body.

**Returns**

Altitude above mean radius [m]

**Note**

For altitude above ground, use [GetAltitude\(AltitudeMode,int\\*\)](#)

Currently all celestial bodies are assumed to be spheres. This method therefore returns the distance to the centre of the reference body minus the reference body radius.

The reference body is the planet or moon whose surface is closest to the current vessel position (i.e. the body with minimal altitude).

**See also**

[GetAltitude\(AltitudeMode,int\\*\)](#), [GetSurfaceRef](#)

**17.57.3.77 double VESSEL::GetAltitude ( AltitudeMode mode, int \* reslvl = 0 )**

Returns the vessel altitude.

**Parameters**

in	<i>mode</i>	altitude mode (altitude over ground/over mean radius)
out	<i>reslvl</i>	pointer to variable receiving the resolution level at which ground altitude was calculated.

**Returns**

Altitude [m]

**Note**

For mode==ALTMODE\_MEANRAD, this method is equivalent to [GetAltitude\(\)](#).

For mode==ALTMODE\_GROUND, if reslvl is set, on return the int variable it points to will be filled with the planet surface resolution level at which the altitude was calculated. At higher altitudes, Orbiter may use a lower resolution setting.

For mode==ALTMODE\_MEANRAD, the resolution level has no meaning, and always returns 0.

**See also**

[GetAltitude\(\)](#)

**17.57.3.78 void VESSEL::GetAngularAcc ( VECTOR3 & aacc ) const**

Returns the vessel's current angular acceleration components around its principal axes.

**Parameters**

out	<i>aacc</i>	angular acceleration [rad/s <sup>2</sup> ]
-----	-------------	--

**Note**

The returned vector contains the angular accelerations  $\partial\omega_x/\partial t, \partial\omega_y/\partial t, \partial\omega_z/\partial t$  around the vessel's x, y and z axes, in the rotating vessel frame.

**See also**

[GetAngularVel](#), [GetAngularMoment](#)

**17.57.3.79 void VESSEL::GetAngularMoment ( VECTOR3 & amom ) const**

Returns the sum of angular moments currently acting on the vessel.

## Parameters

out	<i>amom</i>	angular moment [Nm]
-----	-------------	---------------------

## Note

Given all force components  $\mathbf{F}_i$  acting on the vessel at positions  $\mathbf{r}_i$ , the angular moment is defined as

$$\vec{M} = \sum_i \vec{F}_i \times \vec{r}_i$$

(note the left-handed reference frame in the order of operands for the cross product).

## See also

[GetLinearMoment](#)

17.57.3.80 void VESSEL::GetAngularVel ( VECTOR3 & *avel* ) const

Returns the vessel's current angular velocity components around its principal axes.

## Parameters

out	<i>avel</i>	vector receiving angular velocity components [rad/s]
-----	-------------	--

## Note

The returned vector contains the angular velocities  $\omega_x, \omega_y, \omega_z$  around the vessel's x, y and z axes, in the rotating vessel frame.

Because the change of the angular velocity components is governed by Euler's coupled differential equations of rigid body motion, the values can fluctuate between the axes even if no torque is acting on the vessel.

## See also

[SetAngularVel](#), [GetAngularAcc](#)

17.57.3.81 double VESSEL::GetAnimation ( UINT *anim* ) const

Return the current state of an animation.

## Parameters

<i>anim</i>	animation identifier
-------------	----------------------

## Returns

animation state (0 ... 1)

## See also

[SetAnimation](#)

17.57.3.82 UINT VESSEL::GetAnimPtr ( ANIMATION \*\* *anim* ) const

Returns a pointer to the array of animations defined by the vessel.

**Parameters**

out	<i>anim</i>	pointer list of vessel animations
-----	-------------	-----------------------------------

**Returns**

list length (number of animations)

**Note**

The pointer can become invalid whenever the vessel adds or deletes animations. It should therefore not be stored, but queried on demand.

**17.57.3.83 double VESSEL::GetAOA ( ) const**

Returns the current angle of attack.

**Returns**

AOA (angle of attack) value [rad] in the range -Pi ... +Pi.

**Note**

The AOA value is defined as the angle between the vessel's positive z axis and the flight path direction, projected into the yz-plane of the vessel's local coordinate system.

**See also**

[GetSlipAngle](#)

**17.57.3.84 OBJHANDLE VESSEL::GetApDist ( double & *apdist* ) const**

Returns the apoapsis distance of the current osculating orbit.

**Parameters**

out	<i>apdist</i>	apoapsis distance [m]
-----	---------------	-----------------------

**Returns**

Handle of reference body, relative to which the orbit is calculated. NULL indicates failure (no orbit information available)

**Note**

the apoapsis distance is the largest radius of the orbit (see [Basics of orbital mechanics](#)).

**See also**

[Basics of orbital mechanics](#), [ELEMENTS](#), [ORBITPARAM](#), [GetPeDist](#), [GetArgPer](#), [GetElements](#)

**17.57.3.85 OBJHANDLE VESSEL::GetArgPer ( double & *arg* ) const**

Returns argument of periapsis of the current osculating orbit.

**Parameters**

out	<i>arg</i>	argument of periapsis for current orbit [rad]
-----	------------	---

**Returns**

Handle of reference body, relative to which the orbit is calculated. NULL indicates failure (no orbit information available)

**Note**

The argument of periapsis is the angle between periapsis and the ascending node (see [The orbit in space](#)).

**See also**

[Basics of orbital mechanics](#), [ELEMENTS](#), [ORBITPARAM](#), [GetPeDist](#), [GetApDist](#), [GetElements](#)

**17.57.3.86 double VESSEL::GetAtmDensity ( ) const**

Returns atmospheric density at current vessel position.

**Returns**

Atmospheric density [kg/m<sup>3</sup>] at current vessel position.

**Note**

This function returns 0 if the vessel is outside all planetary atmospheric hulls, as defined by the planets' AtmAltLimit parameters.

**See also**

[GetAtmPressure](#), [GetAtmTemperature](#), [GetAtmRef](#)

**17.57.3.87 double VESSEL::GetAtmPressure ( ) const**

Returns static atmospheric pressure at current vessel position.

**Returns**

Static atmospheric pressure [Pa] at current vessel position.

**Note**

This function returns 0 if the vessel is outside all planetary atmospheric hulls, as defined by the planets' AtmAltLimit parameters.

**See also**

[GetDynPressure](#), [GetAtmDensity](#), [GetAtmTemperature](#), [GetAtmRef](#)

**17.57.3.88 const OBJHANDLE VESSEL::GetAtmRef ( ) const**

Returns a handle to the reference body for atmospheric calculations.

**Returns**

Handle for the celestial body whose atmosphere the vessel is currently moving through, or NULL if the vessel is not inside an atmosphere.

**See also**

[GetAtmTemperature](#), [GetAtmDensity](#), [GetAtmPressure](#)

17.57.3.89 **double VESSEL::GetAtmTemperature ( ) const**

Returns ambient atmospheric temperature at current vessel position.

**Returns**

Ambient temperature [K] at current vessel position.

**Note**

This function returns 0 if the vessel is outside all planetary atmospheric hulls, as defined by the planets' AtmAltLimit parameters.

**See also**

[GetAtmDensity](#), [GetAtmPressure](#), [GetAtmRef](#)

17.57.3.90 **ATTACHMENTHANDLE VESSEL::GetAttachmentHandle ( bool *toparent*, DWORD *i* ) const**

Return the handle of an attachment point identified by its list index.

**Parameters**

<i>toparent</i>	If <i>true</i> , return a handle for an attachment point to a parent. Otherwise, return a handle for an attachment point to a child.
<i>i</i>	attachment index ( $\geq 0$ )

**Returns**

Attachment handle, or NULL if index out of range.

**See also**

[CreateAttachment](#), [SetAttachmentParams](#), [GetAttachmentParams](#), [GetAttachmentId](#), [GetAttachmentStatus](#), [AttachmentCount](#), [GetAttachmentIndex](#), [AttachChild](#), [DetachChild](#)

17.57.3.91 **const char\* VESSEL::GetAttachmentId ( ATTACHMENTHANDLE *attachment* ) const**

Retrieve attachment identifier string.

**Parameters**

<i>attachment</i>	attachment handle
-------------------	-------------------

**Returns**

Pointer to attachment string [8 characters]

**See also**

[CreateAttachment](#), [SetAttachmentParams](#), [GetAttachmentParams](#), [GetAttachmentStatus](#), [AttachmentCount](#), [GetAttachmentIndex](#), [GetAttachmentHandle](#), [AttachChild](#), [DetachChild](#)

17.57.3.92 **DWORD VESSEL::GetAttachmentIndex ( ATTACHMENTHANDLE *attachment* ) const**

Return the list index of the vessel's attachment point defined by its handle.

## Parameters

<i>attachment</i>	attachment handle
-------------------	-------------------

## Returns

List index ( $\geq 0$ )

## Note

A vessel defines separate lists for child and parent attachment points. Therefore two different attachment points may return the same index.

The index for a given attachment point can change when the vessel deletes any of its attachments. The returned index should therefore be used only within the current frame.

## See also

[CreateAttachment](#), [SetAttachmentParams](#), [GetAttachmentParams](#), [GetAttachmentId](#), [GetAttachmentStatus](#), [AttachmentCount](#), [GetAttachmentHandle](#), [AttachChild](#), [DetachChild](#)

17.57.3.93 void VESSEL::GetAttachmentParams ( **ATTACHMENTHANDLE** *attachment*, **VECTOR3** & *pos*, **VECTOR3** & *dir*, **VECTOR3** & *rot* ) const

Retrieve the parameters of an attachment point.

## Parameters

<i>in</i>	<i>attachment</i>	attachment handle
<i>out</i>	<i>pos</i>	attachment point position in vessel coordinates [ <b>m</b> ]
<i>out</i>	<i>dir</i>	attachment direction in vessel coordinates
<i>out</i>	<i>rot</i>	longitudinal alignment vector in vessel coordinates

## See also

[CreateAttachment](#), [SetAttachmentParams](#), [GetAttachmentId](#), [GetAttachmentStatus](#), [AttachmentCount](#), [GetAttachmentIndex](#), [GetAttachmentHandle](#), [AttachChild](#), [DetachChild](#)

17.57.3.94 **OBJHANDLE** VESSEL::GetAttachmentStatus ( **ATTACHMENTHANDLE** *attachment* ) const

Return the current status of an attachment point.

## Parameters

<i>attachment</i>	attachment handle
-------------------	-------------------

## Returns

Handle of the attached vessel, or NULL if no vessel is attached to this point.

## See also

[CreateAttachment](#), [SetAttachmentParams](#), [GetAttachmentParams](#), [GetAttachmentId](#), [AttachmentCount](#), [GetAttachmentIndex](#), [GetAttachmentHandle](#), [AttachChild](#), [DetachChild](#)

17.57.3.95 void VESSEL::GetAttitudeLinLevel ( **VECTOR3** & *th* ) const

Returns the current combined thrust levels for the reaction control system thruster groups in linear (translational) mode.

## Parameters

out	<i>th</i>	vector containing RCS thruster group levels for translation along the 3 principal vessel axes (values: -1 to +1)
-----	-----------	--

## Note

The fractional thrust levels of the RCS engines for translation along the vessel's x, y and z axis are returned in the x, y, and z components of *th*, respectively.

The orientation of the vessel axes is implementation-dependent, but usually by convention, +x is "right", +y is "up", and +z is "forward".

A value of +1 denotes maximum thrust in the positive direction along an axis, while -1 denotes maximum thrust in the negative direction.

This method combines the results of calls to GetThrusterGroupLevel for all relevant RCS thruster groups in the following combinations:

th.x	THGROUP_ATT_RIGHT - THGROUP_ATT_LEFT
th.y	THGROUP_ATT_UP - THGROUP_ATT_DOWN
th.z	THGROUP_ATT_FORWARD - THGROUP_ATT_BACK

To obtain the actual thrust force magnitudes [N], the absolute values must be multiplied with the max. attitude thrust.

## See also

[GetAttitudeRotLevel](#), [SetAttitudeLinLevel](#), [GetThrusterGroupLevel](#), [GetAttitudeMode](#)

## 17.57.3.96 int VESSEL::GetAttitudeMode ( ) const

Returns the current RCS (reaction control system) thruster mode.

## Returns

Current RCS mode (see [RCS mode identifiers](#))

## Note

The reaction control system consists of a set of small thrusters arranged around the vessel. They can be fired in pre-defined configurations to provide either a change in angular velocity (in RCS\_ROT mode) or in linear velocity (in RCS\_LIN mode).

RCS\_NONE indicates that the RCS is disabled or not available.

Currently Orbiter doesn't allow simultaneous linear and rotational RCS control via keyboard or joystick. The user has to switch between the two. However, simultaneous operation is possible via the "RControl" plugin module.

Not all vessel classes may define a complete RCS.

## See also

[SetAttitudeMode](#), [RCS mode identifiers](#)

17.57.3.97 void VESSEL::GetAttitudeRotLevel ( VECTOR3 & *th* ) const

Returns the current combined thrust levels for the reaction control system thruster groups in rotational mode.

## Parameters

out	th	vector containing RCS thruster group levels for rotation around the 3 principal vessel axes (values: -1 to +1).
-----	----	---

## Note

The fractional thrust levels of the RCS engines for rotation around the vessel's x, y and z axis are returned in the x, y, and z components of *th*, respectively.

The orientation of the vessel axes is implementation-dependent, but usually by convention, +x is "right", +y is "up", and +z is "forward".

A value of +1 denotes maximum thrust in the positive direction around an axis, while -1 denotes maximum thrust in the negative direction.

This method combines the results of calls to `GetThrusterGroupLevel` for all relevant RCS thruster groups in the following combinations:

th.x	THGROUP_ATT_PITCHUP - THGROUP_ATT_PITCHDOWN
th.y	THGROUP_ATT_YAWLEFT - THGROUP_ATT_YAWRIGHT
th.z	THGROUP_ATT_BANKRIGHT - THGROUP_ATT_BANKLEFT

To obtain the actual thrust force magnitudes [N], the absolute values must be multiplied with the max. attitude thrust.

## See also

[GetAttitudeLinLevel](#), [SetAttitudeRotLevel](#), [GetThrusterGroupLevel](#), [GetAttitudeMode](#)

## 17.57.3.98 double VESSEL::GetBank ( ) const

Returns the current bank (roll) angle with respect to the local horizon.

## Returns

bank angle [rad]

## Note

The bank angle *b* is defined as the angle between the vessel's positive y axis (up direction) and the projection of the normal of the local horizon into the x-y plane.

## See also

[GetSurfaceRef](#), [GetPitch](#), [GetYaw](#)

## 17.57.3.99 double VESSEL::GetBankMomentScale ( ) const

Returns the scaling factor for the yaw moment.

**Deprecated** This method has been replaced by [VESSEL::GetYawMomentScale](#).

## Returns

yaw moment scale factor

## Note

The method is misnamed. It refers to the vessel's yaw moment.

## See also

[GetYawMomentScale](#)

17.57.3.100 const **BEACONLIGHTSPEC**\* VESSEL::GetBeacon ( DWORD *idx* ) const

Returns a pointer to one of the vessel's beacon specifications.

**Parameters**

<i>idx</i>	beacon list index ( $\geq 0$ )
------------	--------------------------------

**Returns**

Pointer to specification for vessel beacon at list index *idx*, or NULL if *idx* is out of range.

**Note**

The list index for a given beacon can change when the vessel adds or deletes beacons.

**17.57.3.101 void VESSEL::GetCameraDefaultDirection ( VECTOR3 & *cd* ) const**

Returns the default camera direction for internal (cockpit) view.

**Parameters**

<i>cd</i>	default camera direction in vessel coordinates
-----------	--

**Note**

The default camera direction may change as a result of invoking SetCameraDefaultDirection, typically when the user selects a different instrument panel or virtual cockpit position.

The returned direction vector is normalised to length 1.

**See also**

[SetCameraDefaultDirection\(const VECTOR3&\)](#)const, [SetCameraDefaultDirection\(const VECTOR3&,double\)](#)const

**17.57.3.102 void VESSEL::GetCameraOffset ( VECTOR3 & *co* ) const**

Returns the current camera position for internal (cockpit) view.

**Parameters**

<i>co</i>	camera offset in vessel coordinates [m]
-----------	---

**See also**

[SetCameraOffset](#)

**17.57.3.103 char\* VESSEL::GetClassName ( ) const**

Returns the vessel's class name.

**Returns**

Pointer to vessel's class name.

**See also**

[GetName](#)

**17.57.3.104 double VESSEL::GetClipRadius ( ) const**

Returns the radius of the vessel's circumscribing sphere.

**Returns**

Radius of the circumscribing sphere of the vessel's visual representation [m].

**Note**

This parameter describes the radius of the sphere around the vessel that is protected from clipping at the observer camera's near clipping plane. (The near clipping plane defines an area around the view camera within which no objects are rendered. The distance of the near clipping plane cannot be made arbitrarily small for technical reasons.)

By default, the clip radius is identical to the vessel's "Size" parameter. However, the size parameter is correlated to physical vessel properties and may therefore be smaller than the sphere that contains the vessel's complete visual representation. In that case, defining a clip radius that is larger than the size parameter can avoid visual artefacts.

The view camera's near clip plane distance is adjusted so that it does not intersect any nearby vessel's clip radius. However, there is a minimum near clip distance of 2.5m. This means that if the camera approaches a vessel to less than clip radius + 2.5, clipping may still occur.

Visual cockpit meshes are rendered in a separate pass and are not affected by the general near clip distance (they have a separate near clip distance of 10cm).

**See also**

[SetClipRadius](#), [GetSize](#)

**17.57.3.105 double VESSEL::GetCOG\_elev ( ) const**

Elevation of the vessel's centre of gravity (COG) above ground.

**Returns**

Distance of COG from vessel ground contact plane [m].

**Note**

The COG elevation is defined as the normal distance of the vessel's centre of gravity from the ground contact plane defined by its three touchdown points.

By definition, the vessel's centre of gravity coincides with the origin of the local vessel frame.

**See also**

[GetTouchdownPoints](#), [SetTouchdownPoints](#)

**17.57.3.106 double VESSEL::GetControlSurfaceLevel ( AIRCTRL\_TYPE type ) const**

Returns the current position of a control surface.

**Parameters**

<i>type</i>	control surface type (see <a href="#">Aerodynamic control surface types</a> )
-------------	---

**Returns**

Current position of the surface [-1..+1]

**Note**

This method returns the *actual*, not the *target* position. Due to finite response time, it may therefore not return the value set by a preceding call to SetControlSurfaceLevel.

**See also**

[SetControlSurfaceLevel](#)

17.57.3.107 void VESSEL::GetCrossSections ( VECTOR3 & *cs* ) const

Returns the vessel's cross sections projected in the direction of the vessel's principal axes.

## Parameters

cs	vector receiving the cross sections of the vessel's projection into the yz, xz and xy planes, respectively [ $\text{m}^2$ ]
----	---

## See also

[SetCrossSections](#)

17.57.3.108 void VESSEL::GetCW ( double & cw\_z\_pos, double & cw\_z\_neg, double & cw\_x, double & cw\_y ) const

Returns the vessel's wind resistance coefficients (legacy flight model only).

## Parameters

cw_z_pos	resistance coefficient in positive z direction (forward)
cw_z_neg	resistance coefficient in negative z direction (back)
cw_x	resistance coefficient in lateral direction (left/right)
cw_y	resistance coefficient in vertical direction (up/down)

## Note

**[Legacy aerodynamic flight model only]**

The cw coefficients are only used by the legacy flight model (if no airfoils are defined). In the presence of airfoils, drag calculations are performed on the basis of the airfoil parameters.

The first value (cw\_z\_pos) is the coefficient used if the vessel's airspeed z-component is positive (vessel moving forward). The second value is used if the z-component is negative (vessel moving backward).

Lateral and vertical components are assumed symmetric.

## See also

[SetCW](#), [CreateAirfoil](#)

17.57.3.109 int VESSEL::GetDamageModel ( ) const

Returns the current user setting for damage and systems failure simulation.

## Returns

Damage modelling flags. The following settings are currently supported:

- 0 = no damage or failures
- 1 = simulate vessel damage and system failures

## Note

The return value depends on the user parameter selection in the Launchpad dialog. It does not change during a simulation session and will be the same for all vessels.

Future versions may support more differentiated bit flags to indicate different types of damage and failure simulation.

A vessel implementation should query the damage flag to decide whether to simulate failures.

## See also

[GetFlightModel](#)

## 17.57.3.110 PROPELLANT\_HANDLE VESSEL::GetDefaultPropellantResource ( ) const

Returns the handle for the vessel's default propellant resource.

**Returns**

Default propellant resource handle

**See also**

[SetDefaultPropellantResource](#)

17.57.3.111 DEVMESHHANDLE VESSEL::GetDevMesh ( VISHANDLE *vis*, **UINT** *idx* ) const

Returns a handle for a device-specific mesh instance.

**Parameters**

<i>vis</i>	identifies the visual for which the mesh was created.
<i>idx</i>	mesh index (0 <= <i>idx</i> < <a href="#">GetMeshCount()</a> )

**Returns**

device mesh handle

**Note**

For Orbiter\_ng, this method returns a handle for a mesh instance managed by the external graphics client. Graphics clients may implement their own mesh formats, so the object pointed to by the handle is client-specific.

For inline graphics version, the returned handle points to the same object as the handle returned by [GetMesh](#)

**See also**

[GetMesh](#)

17.57.3.112 DOCKHANDLE VESSEL::GetDockHandle ( **UINT** *n* ) const

Returns a handle to a docking port.

**Parameters**

<i>n</i>	docking port index ( $\geq 0$ )
----------	---------------------------------

**Returns**

Dock handle, or NULL if index is out of range.

**See also**

[CreateDock](#), [DelDock](#), [SetDockParams](#), [GetDockParams](#), [GetDockStatus](#), [oapiGetDockHandle](#)

17.57.3.113 void VESSEL::GetDockParams ( DOCKHANDLE *hDock*, **VECTOR3** & *pos*, **VECTOR3** & *dir*, **VECTOR3** & *rot* ) const

Returns the parameters of a docking port.

## Parameters

in	<i>hDock</i>	dock handle
out	<i>pos</i>	dock reference position [ <b>m</b> ]
out	<i>dir</i>	approach direction
out	<i>rot</i>	longitudinal rotation alignment vector

## See also

[CreateDock](#), [SetDockParams\(const VECTOR3&,const VECTOR3&,const VECTOR3&\)const](#), [SetDockParams\(DOCKHANDLE,const VECTOR3&,const VECTOR3&,const VECTOR3&\)const](#)

17.57.3.114 **OBJHANDLE VESSEL::GetDockStatus ( DOCKHANDLE *hDock* ) const**

Returns a handle to a docked vessel.

## Parameters

<i>hDock</i>	dock handle
--------------	-------------

## Returns

Handle of the vessel docked at the specified port, or NULL if the docking port is not engaged.

## See also

[CreateDock](#), [GetDockHandle](#), [Dock](#), [Undock](#), [oapiGetDockStatus](#)

17.57.3.115 **double VESSEL::GetDrag ( ) const**

Returns magnitude of aerodynamic drag force vector.

## Returns

Magnitude of drag force vector [N].

## Note

Return value is the sum of drag components from all airfoils.

## See also

[GetDragVector](#), [GetLift](#)

17.57.3.116 **bool VESSEL::GetDragVector ( VECTOR3 & *D* ) const**

Returns aerodynamic drag force vector in local vessel coordinates.

## Parameters

out	<i>D</i>	drag vector [ <b>N</b> ]
-----	----------	--------------------------

## Returns

false indicates zero drag. In that case, the returned vector is (0,0,0).

**Note**

On return, *D* contains the sum of drag components from all airfoils.  
 The drag vector is parallel to the relative wind (direction of air flow).

**See also**

[GetDrag](#), [GetWeightVector](#), [GetThrustVector](#), [GetLiftVector](#), [GetForceVector](#)

**17.57.3.117 double VESSEL::GetDynPressure ( ) const**

Returns the current dynamic pressure for the vessel.

**Returns**

Current vessel dynamic pressure [Pa].

**Note**

The dynamic pressure is defined as

$$q = \frac{1}{2} \rho V^2$$

with density  $\rho$  and airflow velocity  $V$ . Dynamic pressure is an important aerodynamic parameter.

**See also**

[GetAtmPressure](#), [GetAtmRef](#)

**17.57.3.118 bool VESSEL::GetEditorModule ( char \* *fname* ) const**

Returns the file name of the DLL containing the vessel's scenario editor extensions.

**Parameters**

<i>out</i>	<i>fname</i>	module file name
------------	--------------	------------------

**Returns**

*true* if the vessel defines an editor module, *false* otherwise.

**Note**

The vessel's editor module, if it exists, contains extensions for the *Scenario editor* module that allows the user to set vessel-specific parameters (see *Doc\ScenarioEditor.pdf*).

The string returned by this method is identical to the *EditorModule* entry in the vessel's configuration file.

If the *EditorModule* entry is not found in the configuration file, this method returns *false*.

**17.57.3.119 OBJHANDLE VESSEL::GetElements ( ELEMENTS & *el*, double & *mjd\_ref* ) const**

Returns osculating orbital elements.

Calculates the set of osculating elements at the current time with respect to the dominant gravitational source.

**Parameters**

out	<i>el</i>	current osculating elements relative to dominant gravity source, in ecliptic frame of reference.
out	<i>mjd_ref</i>	reference date (in Modified Julian Date format) to which the returned el. $\leftarrow$ L (mean longitude) value refers.

#### Returns

Handle of reference object. NULL indicates failure (no elements available).

#### Note

This method will return the mean longitude at a fixed reference date, so the value will not change over time, unless the orbit itself changes.

For extended functionality, see version 2 of GetElements.

#### See also

[Basics of orbital mechanics](#), [ELEMENTS](#), [GetElements\(OBJHANDLE,ELEMENTS&,ORBITPARAM\\*,double,int\)const](#), [SetElements](#)

**17.57.3.120** `bool VESSEL::GetElements ( OBJHANDLE hRef, ELEMENTS & el, ORBITPARAM * prm = 0, double mjd_ref = 0, int frame = FRAME_ECL ) const`

Returns osculating elements and additional orbit parameters.

Returns the current osculating elements for the vessel. This version has an extended functionality: it allows to specify an arbitrary celestial body as reference object, an arbitrary reference time, and can return elements either in the ecliptic or equatorial frame of reference.

#### Parameters

<i>hRef</i>	reference body handle
<i>el</i>	current osculating elements relative to hRef
<i>prm</i>	additional orbital parameters
<i>mjd_ref</i>	reference date (in Modified Julian Date format) to which the el.L (mean longitude) value refers.
<i>frame</i>	orientation of reference frame (see notes)

#### Returns

Currently always true.

#### Note

For an overview of orbital parameters, see [Basics of orbital mechanics](#).

This version returns the elements with respect to an arbitrary celestial body, even if that body is not the main source of the gravity field acting on the vessel. If *hRef*==NULL, the default reference body is used.

If the *prm* pointer is not set to NULL, the [ORBITPARAM](#) structure it points to will be filled with additional orbital parameters derived from the primary elements.

All parameters returned in the *prm* structure refer to the current date, rather than the reference date *mjd\_ref*. Therefore, the values of *el.L* and *prm->MnL* can be different.

Unlike [GetElements\(ELEMENTS&,double&\)](#), *mjd\_ref* is a user-provided input parameter which specifies to which date the returned *el.L* (mean longitude) value will refer. An exception is *mjd\_ref* = 0, which is interpreted as the current time (equivalent to *mjd\_ref* = [oapiGetSimMJD\(\)](#) ).

The frame parameter can be set to one of the following:

- FRAME\_ECL: returned elements are expressed in the ecliptic frame (epoch J2000).
- FRAME\_EQU: returned elements are expressed in the equatorial frame of the reference object (*hRef*).

#### See also

[Basics of orbital mechanics](#), [ELEMENTS](#), [ORBITPARAM](#), [GetElements\(ELEMENTS&,double&\)const](#), [SetElements](#)

## 17.57.3.121 double VESSEL::GetEmptyMass ( ) const

Returns the vessel's empty mass (excluding propellants).

**Returns**

Vessel empty mass [kg].

**Note**

The empty mass combines all parts of the vessel except propellant resources defined via `CreatePropellantResource`.

The empty mass may change during the simulation, often discontinuously, for example as a result of stage separation.

**See also**

[oapiGetEmptyMass](#), [GetMassDistribution](#), [SetEmptyMass](#), [CreatePropellantResource](#)

## 17.57.3.122 bool VESSEL::GetEnableFocus ( ) const

Returns true if the vessel can receive the input focus, false otherwise.

**Returns**

Focus enabled status.

**Note**

The vessel can be allowed or prohibited to receive the input focus by using the `SetEnableFocus` method.

The initial state is defined by the `EnableFocus` setting in the vessel's configuration file. If the entry is missing, the default is true.

Focus-enabled vessels can be selected by the user via the jump vessel dialog (F3).

Once a vessel has received the input focus, all user input via keyboard, mouse and joystick is directed to this vessel.

For some object types, such as jettisoned rocket stages, enabling input focus may not be useful.

**See also**

[SetEnableFocus](#), [clbkFocusChanged](#), [oapiGetFocusObject](#), [oapiSetFocusObject](#)

17.57.3.123 **OBJHANDLE** VESSEL::GetEquPos ( double & *longitude*, double & *latitude*, double & *radius* ) const

Returns vessel's current equatorial position with respect to the closest planet or moon.

**Parameters**

<i>out</i>	<i>longitude</i>	longitude coordinate [rad]
<i>out</i>	<i>latitude</i>	latitude coordinate [rad]
<i>out</i>	<i>radius</i>	distance from planet centre [m]

**Returns**

Handle to reference body to which the parameters refer. NULL indicates failure (no reference body available).

**See also**

[GetSurfaceRef](#)

17.57.3.124 **DWORD VESSEL::GetExhaustCount ( ) const**

Returns the number of exhaust render definitions for the vessel.

**Returns**

Number of exhaust render definitions

**See also**

[AddExhaust](#), [DelExhaust](#)

17.57.3.125 **double VESSEL::GetExhaustLevel ( *UINT idx* ) const**

Returns the current level of an exhaust source.

**Parameters**

<i>idx</i>	exhaust identifier
------------	--------------------

**Returns**

Exhaust level (0..1)

**Note**

The exhaust level is equivalent to the thrust level of the thruster to which the exhaust definition is attached.

**See also**

[AddExhaust](#), [GetThrusterLevel](#)

17.57.3.126 **bool VESSEL::GetExhaustSpec ( *UINT idx*, *double \* lscale*, *double \* wscale*, *VECTOR3 \* pos*, *VECTOR3 \* dir*, *SURFHANDLE \* tex* ) const**

Returns the parameters of an exhaust definition.

**Parameters**

<i>in</i>	<i>idx</i>	exhaust identifier
<i>out</i>	<i>lscale</i>	exhaust flame length [m]
<i>out</i>	<i>wscale</i>	exhaust flame width [m]
<i>out</i>	<i>pos</i>	reference position [m]
<i>out</i>	<i>dir</i>	exhaust direction
<i>out</i>	<i>tex</i>	texture handle for custom exhaust flames, if any

**Returns**

*false* if *idx* out of range, *true* otherwise.

**See also**

[AddExhaust](#)

17.57.3.127 **bool VESSEL::GetExhaustSpec ( *UINT idx*, *EXHAUSTSPEC \* spec* )**

Returns the parameters of an exhaust definition in a structure.

**Parameters**

in	<i>idx</i>	exhaust identifier
out	<i>spec</i>	pointer to <a href="#">EXHAUSTSPEC</a> structure

**Returns**

*false* if *idx* is out of range, *true* otherwise.

**Note**

On return the parameters of the specified exhaust object are copied into the structure pointed to by *spec*.

**17.57.3.128 int VESSEL::GetFlightModel ( ) const**

Returns the requested realism level for the flight model.

**Returns**

Flight model realism level. These values are currently supported:

- 0 = simple
- 1 = realistic

**Note**

The returned value corresponds to that passed to the [VESSEL](#) constructor. This will normally be the same as the argument of the [ovcInit](#) callback function.

The module can use this method to implement different flavours of the flight model (e.g. simplified and realistic), by defining separate sets of parameters (possibly higher fuel-specific impulse and higher thrust ratings in the simplified model, less severe damage limits, etc.)

**See also**

[ovcInit](#), [GetDamageModel](#)

**17.57.3.129 DWORD VESSEL::GetFlightStatus ( ) const**

Returns a bit flag defining the vessel's current flight status.

**Returns**

vessel status flags (see notes).

**Note**

The following flags are currently defined:

- bit 0:
  - 0 = vessel is active (in flight),
  - 1 = vessel is inactive (landed)
- bit 1:
  - 0 = simple vessel (not docked to anything),
  - 1 = part of superstructure, (docked to another vessel)

**17.57.3.130 bool VESSEL::GetForceVector ( VECTOR3 & *F* ) const**

Returns total force vector acting on the vessel in local vessel coordinates.

**Parameters**

out	$F$	total force vector [N]
-----	-----	------------------------

**Returns**

Always true

**Note**

On return,  $F$  contains the sum of all forces acting on the vessel.

This may not be equal to the sum of weight, thrust, lift and drag vectors, because it also includes surface contact forces, user-defined forces and any other forces.

**See also**

[GetWeightVector](#), [GetThrustVector](#), [GetLiftVector](#), [GetDragVector](#), [GetTorqueVector](#)

**17.57.3.131 double VESSEL::GetFuelMass ( ) const**

Returns the current mass of the vessel's default propellant resource.

**Returns**

Current mass of the default propellant resource [kg].

**See also**

[GetPropellantMass](#), [SetDefaultPropellantResource](#)

**17.57.3.132 double VESSEL::GetFuelRate ( ) const**

Returns the current mass flow rate from the default propellant resource.

**Returns**

Current mass flow rate from the default propellant resource [kg/s].

**See also**

[GetPropellantFlowrate](#), [SetDefaultPropellantResource](#)

**17.57.3.133 void VESSEL::GetGlobalOrientation ( VECTOR3 & arot ) const**

Returns the Euler angles defining the vessel's orientation.

**Parameters**

arot	vector receiving the three Euler angles [rad]
------	---

**Note**

The components of the returned vector  $arot = (\alpha, \beta, \gamma)$  are the angles of rotation [rad] around the x,y,z axes in the global (ecliptic) frame to produce the rotation matrix  $R$  for mapping from the vessel's local frame of reference to the global frame of reference:

$$R = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos \alpha & \sin \alpha \\ 0 & -\sin \alpha & \cos \alpha \end{bmatrix} \begin{bmatrix} \cos \beta & 0 & -\sin \beta \\ 0 & 1 & 0 \\ \sin \beta & 0 & \cos \beta \end{bmatrix} \begin{bmatrix} \cos \gamma & \sin \gamma & 0 \\ -\sin \gamma & \cos \gamma & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

**See also**

[SetGlobalOrientation](#), [GetRotationMatrix](#)

17.57.3.134 void VESSEL::GetGlobalPos ( VECTOR3 & *pos* ) const

Returns the vessel's current position in the global reference frame.

## Parameters

pos	Vector receiving position [m]
-----	-------------------------------

## Note

The global reference frame is the solar barycentric ecliptic system at ecliptic and equinox of J2000.0.

## See also

[oapiGetGlobalPos](#), [GetGlobalVel](#), [GetRelativePos](#)

## 17.57.3.135 void VESSEL::GetGlobalVel ( VECTOR3 &amp; vel ) const

Returns the vessel's current velocity in the global reference frame.

## Parameters

vel	Vector receiving velocity [m/s]
-----	---------------------------------

## Note

The global reference frame is the solar barycentric ecliptic system at ecliptic and equinox of J2000.0.

## See also

[oapiGetGlobalVel](#), [GetGlobalPos](#), [GetRelativeVel](#)

## 17.57.3.136 double VESSEL::GetGravityGradientDamping ( ) const

Returns the vessel's damping coefficient for gravity field gradient-induced torque.

## Returns

Torque damping coefficient ( $\geq 0$ )

## Note

A nonspherical object in an inhomogeneous gravitational field experiences a torque. Orbiter calculates this torque with

$$\vec{M}_G = \frac{3\mu m}{R^3} (\vec{R}_0 \times \vec{L} \vec{R}_0)$$

where  $\mu = GM$ ,  $G$  is the gravity constant,  $M$  is the reference body mass,  $m$  is the vessel mass,  $R$  is the distance of the vessel to the reference body centre,  $R_0$  is the unit vector towards the reference body, and  $L$  is the mass-normalised inertia tensor (assumed diagonal).

This generates an undamped attitude oscillation in the vessel orbiting the reference body.

Damping may occur due to tidal deformation of the vessel, movement of liquids (fuel) etc. Orbiter allows to introduce a damping term of the form

$$\vec{M}_D = -\alpha \omega_G$$

where  $\omega_G$  is the angular velocity, and  $\alpha = dm/r$ , with damping coefficient  $d$ , vessel mass  $m$  and vessel radius  $r$ .

If gravity gradient torque has been disabled in the launchpad dialog, this function always returns 0.

## See also

[SetGravityGradientDamping](#), [GetEmptyMass](#), [GetPMI](#)

## 17.57.3.137 const OBJHANDLE VESSEL::GetGravityRef( ) const

Returns a handle to the main contributor of the gravity field at the vessel's current position.

## Returns

Handle for gravity reference object.

## Note

All parameters calculated by functions in this section refer to the gravity reference object, unless explicitly stated otherwise.

## 17.57.3.138 double VESSEL::GetGroundspeed( ) const

Returns magnitude of the ground speed vector.

## Returns

Magnitude of ground speed velocity vector [m/s]

## Note

The ground speed vector is defined as the ship's velocity vector in the rotating frame of the celestial reference body.

This function returns the length of the vector returned by GetGroundspeedVector.

## See also

[GetGroundspeedVector](#), [GetAirspeed](#), [GetAirspeedVector](#), [GetMachNumber](#), [GetAtmRef](#)

17.57.3.139 bool VESSEL::GetGroundspeedVector( REFFRAME *frame*, VECTOR3 & *v* ) const

Returns the vessel's ground speed vector.

## Parameters

in	<i>frame</i>	frame of reference for returned vector.
out	<i>v</i>	ground speed vector on exit [m/s]

## Returns

Status flag (*false* indicates error). Error conditions: invalid *frame* parameter, or ground speed data could not be obtained.

## Note

This method returns the ground speed vector in the requested frame of reference. The ground speed vector is defined as the vessel's velocity vector measured in the rotating frame of the celestial reference body.

Valid entries for *frame* are

- FRAME\_GLOBAL: Returns velocity vector in the global frame of reference
- FRAME\_LOCAL: Returns velocity vector in the vessel's local frame of reference
- FRAME\_REFLOCAL: Returns velocity vector in the celestial reference body's local frame of reference
- FRAME\_HORIZON: Returns velocity vector in the local horizon frame (x = longitudinal component, y = vertical component, z = latitudinal component)

## See also

[GetGroundspeed](#), [GetAirspeed](#), [GetAirspeedVector](#), [GetAtmRef](#)

17.57.3.140 **THRUSTER\_HANDLE** VESSEL::GetGroupThruster ( **THGROUP\_HANDLE** *thg*, **DWORD** *idx* ) **const**

Returns a handle for a thruster that belongs to a specified thruster group.

## Parameters

<i>thg</i>	thruster group handle
<i>idx</i>	thruster index (0 <= idx < <a href="#">GetGroupThrusterCount()</a> )

## Returns

Thruster handle

17.57.3.141 THRUSTER\_HANDLE VESSEL::GetGroupThruster ( THGROUP\_TYPE *thgt*, DWORD *idx* ) const

Returns a handle for a thruster that belongs to a standard thruster group.

## Parameters

<i>thgt</i>	thruster group enumeration type (see <a href="#">Thruster and thruster-group parameters</a> )
<i>idx</i>	thruster index (0 <= idx < <a href="#">GetGroupThrusterCount()</a> )

## Returns

Thruster handle

## Note

This function only works for standard group types. Do not use with THGROUP\_USER. For user-defined groups, use [GetGroupThruster\(THGROUP\\_HANDLE,DWORD\)const](#).

17.57.3.142 DWORD VESSEL::GetGroupThrusterCount ( THGROUP\_HANDLE *thg* ) const

Returns the number of thrusters assigned to a logical thruster group.

## Parameters

<i>thg</i>	thruster group handle
------------	-----------------------

## Returns

Number of thrusters assigned to the specified thruster group.

## Note

Thrusters can be assigned to more than one group (and some thrusters may not be assigned to any group) so the sum of GetGroupThrusterCount values over all groups can be different to the total number of thrusters.

## See also

[GetGroupThrusterCount\(THGROUP\\_TYPE\)const](#)17.57.3.143 DWORD VESSEL::GetGroupThrusterCount ( THGROUP\_TYPE *thgt* ) const

Returns the number of thrusters assigned to a standard logical thruster group.

## Parameters

<i>thgt</i>	thruster group enumeration type (see <a href="#">Thruster and thruster-group parameters</a> )
-------------	---

#### Returns

Number of thrusters assigned to the specified thruster group.

#### Note

This function only works for standard group types. Do not use it with THGROUP\_USER. For user-defined groups, use [VESSEL::GetGroupThrusterCount\(THGROUP\\_HANDLE\)const](#) instead.

Thrusters can be assigned to more than one group (and some thrusters may not be assigned to any group) so the sum of GetGroupThrusterCount values over all groups can be different to the overall number of thrusters.

#### See also

[GetGroupThrusterCount\(THGROUP\\_HANDLE\)const](#)

### 17.57.3.144 const OBJHANDLE VESSEL::GetHandle( ) const

Returns a handle to the vessel object.

#### Returns

vessel handle, as passed to the [VESSEL](#) constructor.

#### Note

The handle is useful for various vessel-related API function calls.

### 17.57.3.145 bool VESSEL::GetHorizonAirspeedVector( VECTOR3 & v ) const

Returns the airspeed vector in local horizon coordinates.

**Deprecated** This method has been replaced by [VESSEL::GetAirspeedVector](#)

### 17.57.3.146 bool VESSEL::GetHoverHoldAltitude( double & alt, bool & terrainalt )

Returns the altitude that the hover hold altitude program tries to maintain.

#### Parameters

<i>out</i>	<i>alt</i>	target altitude [m]
<i>out</i>	<i>terrainalt</i>	indicates true altitude (terrainalt==true) or altitude relative to mean planet radius (terrainalt==false)

#### Returns

true: hold altitude program is active; false: hold altitude program is not active

#### Note

If the function returns false, the values pointed to by alt and terrainalt are unchanged.

#### See also

[ActivateNavmode](#), [DeactivateNavmode](#), [ToggleNavmode](#), [GetNavmodeState](#)

### 17.57.3.147 NAVHANDLE VESSEL::GetIDS( DOCKHANDLE *hDock* ) const

Return handle of one of the vessel's instrument docking system (IDS) radio transmitters.

**Parameters**

<i>hDock</i>	docking port handle
--------------	---------------------

**Returns**

Navigation radio handle of the vessel's IDS transmitter for docking port *hDock*.

**Note**

This function returns NULL if *hDock* does not define an IDS transmitter.

Docking port handles are returned by the [CreateDock](#) and [GetDockHandle](#) methods.

The IDS handle becomes invalid when the dock is deleted (e.g. as a result of [DelDock](#) or [ClearDockDefinitions](#)).

The handle returned by this function can be used to retrieve information about the transmitter, such as sender frequency.

**See also**

[CreateDock](#), [GetDockHandle](#), [DelDock](#), [ClearDockDefinitions](#), [EnableIDS](#), [GetTransponder](#)

**17.57.3.148 double VESSEL::GetISP ( ) const**

Returns the vessel's current default fuel-specific impulse.

**Returns**

Fuel-specific impulse [m/s]. This is the amount of thrust [N] obtained by burning 1kg of fuel per second.

**Note**

The function returns the current default Isp value which will be used for all subsequently defined thrusters which do not define their individual Isp settings.

To obtain an actual Isp value for a thruster, use [GetThrusterISP](#).

The default Isp value can be set by the [SetISP\(\)](#) method, or via the 'Isp' entry in the vessel configuration file. If not defined, the default value is 5e4.

**See also**

[SetISP](#), [GetThrusterISP](#)

**17.57.3.149 double VESSEL::GetLift ( ) const**

Returns magnitude of aerodynamic lift force vector.

**Returns**

Magnitude of lift force vector [N].

**Note**

Return value is the sum of lift components from all airfoils.

**See also**

[GetLiftVector](#), [GetDrag](#)

**17.57.3.150 bool VESSEL::GetLiftVector ( VECTOR3 & L ) const**

Returns aerodynamic lift force vector in local vessel coordinates.

## Parameters

out	$L$	lift vector [ <b>N</b> ]
-----	-----	--------------------------

## Returns

false indicates zero lift. In that case, the returned vector is (0,0,0).

## Note

Return value is the sum of lift components from all airfoils.

The lift vector is perpendicular to the relative wind (and thus to the drag vector) and has zero x-component.

## See also

[GetLift](#), [GetWeightVector](#), [GetThrustVector](#), [GetDragVector](#), [GetForceVector](#)

17.57.3.151 const **LightEmitter\*** VESSEL::GetLightEmitter ( **DWORD**  $i$  ) const

Returns a pointer to a light source object identified by index.

## Parameters

$i$	emitter index ( $\geq 0$ )
-----	----------------------------

## Returns

Pointer to light source object, or NULL if index out of range

## Note

The index of a given source object can change if other objects in the list are deleted.

## See also

[LightEmitterCount](#)

17.57.3.152 void VESSEL::GetLinearMoment ( **VECTOR3** &  $F$  ) const

Returns the linear force vector currently acting on the vessel.

## Parameters

out	$F$	force vector in vessel coordinates [ <b>N</b> ]
-----	-----	---

## Note

The returned vector is the vector sum of all forces (gravity, thrust, aerodynamic forces, etc.) currently acting on the vessel.

## See also

[GetAngularMoment](#)

## 17.57.3.153 double VESSEL::GetMachNumber( ) const

Returns the vessel's current Mach number.

**Returns**

Mach number - the ratio of current freestream airflow velocity over speed of sound.

**Note**

The speed of sound depends on several parameters, e.g. atmospheric composition and temperature. The Mach number can therefore vary even if the airspeed is constant.

**See also**

[GetAirspeed](#), [GetAtmRef](#)

17.57.3.154 double VESSEL::GetManualControlLevel( THGROUPTYPE *thgt*, DWORD *mode* = MANCTRL\_ATTMODE, DWORD *device* = MANCTRL\_ANYDEVICE ) const

Returns the thrust level of an attitude thruster group set via keyboard or mouse input.

**Parameters**

<i>thgt</i>	thruster group identifier
<i>mode</i>	attitude control mode (see <a href="#">Manual control mode identifiers</a> )
<i>device</i>	input device (see <a href="#">Manual control device identifiers</a> )

**Returns**

Manual thrust level [0..1]

**Note**

If *mode* is not MANCTRL\_ANYMODE, only thruster groups which are of the specified mode (linear or rotational) will return nonzero values.

## 17.57.3.155 double VESSEL::GetMass( ) const

Returns current (total) vessel mass.

**Returns**

Current vessel mass [kg].

**Note**

The returned value does not include any docked or attached vessels.

**See also**

[SetEmptyMass](#), [GetWeightVector](#), [oapiGetMass](#)

## 17.57.3.156 double VESSEL::GetMaxFuelMass ( ) const

Returns the maximum capacity of the vessel's default propellant resource.

**Returns**

Max. capacity of default propellant resource [kg].

**Note**

The function returns 0 if no fuel resources are defined.

**See also**

[GetPropellantMaxMass](#), [SetDefaultPropellantResource](#)

17.57.3.157 MESHHANDLE VESSEL::GetMesh ( VISHANDLE *vis*, *UINT idx* ) const

Obtain mesh handle for a vessel mesh.

Returns a handle for a vessel mesh *instance*. Mesh instances only exist while the vessel is within visual range of the camera. This function should therefore only be called between [VESSEL2::clbkVisualCreated](#) and [VESSEL2::clbkVisualDestroyed](#), with the VISHANDLE provided by these functions.

**Parameters**

<i>vis</i>	identifies the visual for which the mesh was created
<i>idx</i>	mesh index ( $0 \leq idx < \text{GetMeshCount}()$ )

**Returns**

mesh handle

**orbiter\_ng:**

The non-graphics version of Orbiter returns always NULL, even if a graphics client is attached. To obtain a client-specific mesh handle, use [GetDevMesh](#).

**See also**

[GetMeshTemplate](#), [GetMeshCount](#), [GetDevMesh](#)

17.57.3.158 *UINT* VESSEL::GetMeshCount ( ) const

Number of meshes.

Returns the number of meshes currently defined for the vessel

**Returns**

mesh count ( $\geq 0$ )

17.57.3.159 *const char\** VESSEL::GetMeshName ( *UINT idx* ) const

Obtain mesh file name for an on-demand mesh.

Returns the mesh file name (with path relative to Orbiter's main mesh directory) for a vessel mesh that is loaded on demand (i.e. not pre-loaded).

## Parameters

<i>idx</i>	mesh index (0 <= <i>idx</i> < <a href="#">GetMeshCount()</a> )
------------	--

## Returns

mesh file name, or NULL if mesh is pre-loaded

## Note

The file names for pre-loaded meshes are not retained by Orbiter.

Graphics clients can obtain pre-loaded mesh file names by intercepting the [oapi::GraphicsClient::clbkStoreMeshPersistent\(\)](#) method.

17.57.3.160 bool VESSEL::GetMeshOffset ( *UINT idx*, *VECTOR3 & ofs* ) const

Returns the mesh offset in the vessel frame.

## Parameters

	<i>idx</i>	mesh index (0 <= <i>idx</i> < <a href="#">GetMeshCount()</a> )
<i>out</i>	<i>ofs</i>	mesh offset [ <a href="#">m</a> ]

## Returns

true if *idx* refers to a valid mesh index

## See also

[AddMesh](#), [InsertMesh](#), [ShiftMesh](#), [ShiftMeshes](#)

17.57.3.161 const MESHHANDLE VESSEL::GetMeshTemplate ( *UINT idx* ) const

Obtain a handle for a vessel mesh template.

Returns the mesh handle for a pre-loaded mesh template, if available.

## Parameters

<i>idx</i>	mesh index (0 <= <i>idx</i> < <a href="#">GetMeshCount()</a> )
------------	--

## Returns

mesh template handle

## Note

Mesh templates can only be returned for meshes pre-loaded with [oapiLoadMeshGlobal\(\)](#). For all other (load-on-demand) meshes this method returns NULL.

Mesh templates are resources shared between all vessels and should never be modified by individual vessels. Orbiter creates individual copies of the templates whenever a vessel is rendered.

17.57.3.162 WORD VESSEL::GetMeshVisibilityMode ( *UINT idx* ) const

Returns the visibility flags for a vessel mesh.

**Parameters**

<i>idx</i>	mesh index ( $\geq 0$ )
------------	-------------------------

**Returns**

Visibility mode flags (see [SetMeshVisibilityMode](#) for possible values).

**See also**

[SetMeshVisibilityMode](#), [Vessel mesh visibility flags](#)

**17.57.3.163 `char* VESSEL::GetName( ) const`**

Returns the vessel's name.

**Returns**

Pointer to vessel's name

**See also**

[GetClassName](#)

**17.57.3.164 `DWORD VESSEL::GetNavChannel( DWORD n ) const`**

Returns the current channel setting of a NAV radio receiver.

**Parameters**

<i>n</i>	receiver index ( $\geq 0$ )
----------	-----------------------------

**Returns**

Receiver channel [0..639]. If index *n* is out of range, the return value is 0.

**See also**

[GetNavRecvFreq](#), [SetNavChannel](#)

**17.57.3.165 `DWORD VESSEL::GetNavCount( ) const`**

Returns the number of NAV radio receivers.

**Returns**

Number of NAV receivers ( $\geq 0$ )

**See also**

[InitNavRadios](#)

**17.57.3.166 `bool VESSEL::GetNavmodeState( int mode )`**

Returns the current active/inactive state of a navigation mode.

**Parameters**

<i>mode</i>	navigation mode identifier (see <a href="#">Navigation mode identifiers</a> )
-------------	---

**Returns**

*true* if the specified navigation mode is active, *false* otherwise.

**See also**

[Navigation mode identifiers](#), [ActivateNavmode](#), [DeactivateNavmode](#), [ToggleNavmode](#)

**17.57.3.167 DWORD VESSEL::GetNavRecv ( DWORD *n* ) const**

Returns the current channel setting of a NAV radio receiver.

**Deprecated** This method has been replaced by [VESSEL::GetNavChannel](#)

**Parameters**

<i>n</i>	receiver index ( $\geq 0$ )
----------	-----------------------------

**Returns**

Receiver channel [0..639]. If index *n* is out of range, the return value is 0.

**17.57.3.168 float VESSEL::GetNavRecvFreq ( DWORD *n* ) const**

Returns the current radio frequency of a NAV radio receiver.

**Parameters**

<i>n</i>	receiver index ( $\geq 0$ )
----------	-----------------------------

**Returns**

Receiver frequency [MHz](#). If index *n* is out of range, the return value is 0.0.

**See also**

[GetNavChannel](#)

**17.57.3.169 NAVHANDLE VESSEL::GetNavSource ( DWORD *n* ) const**

Return handle of transmitter source currently received by one of the vessel's NAV receivers.

**Parameters**

<i>n</i>	NAV receiver index ( $\geq 0$ )
----------	---------------------------------

**Returns**

handle of transmitter currently received, or NULL if the receiver is not tuned to any station, or if *n* is out of range.

**Note**

The handle returned by this function may change in consecutive calls, depending on the radio frequency of the corresponding receiver, the vessel position and the position of radio transmitters in the range of the receiver.

### 17.57.3.170 bool VESSEL::GetNosewheelSteering ( ) const

Returns the activation state of the nose-wheel steering system.

#### Returns

*true* indicates nose-wheel steering is active, *false* indicates disabled.

#### See also

[SetNosewheelSteering](#)

### 17.57.3.171 OBJHANDLE VESSEL::GetPeDist ( double & *pedist* ) const

Returns the periapsis distance of the current osculating orbit.

#### Parameters

out	<i>pedist</i>	periapsis distance [m]
-----	---------------	------------------------

#### Returns

Handle of reference body, relative to which the orbit is calculated. NULL indicates failure (no orbit information available)

#### Note

The periapsis distance is the smallest radius of the orbit (see [Basics of orbital mechanics](#)).

#### See also

[Basics of orbital mechanics](#), [ELEMENTS](#), [ORBITPARAM](#), [GetApDist](#), [GetArgPer](#), [GetElements](#)

### 17.57.3.172 double VESSEL::GetPitch ( ) const

Returns the current pitch angle with respect to the local horizon.

#### Returns

pitch angle [rad]

#### Note

The pitch angle *p* is defined as

$$p = \frac{\pi}{2} - q$$

where *q* is the angle between the vessel's positive z axis (forward direction) and the normal of the local horizon.

#### See also

[GetSurfaceRef](#), [GetBank](#), [GetYaw](#)

## 17.57.3.173 double VESSEL::GetPitchMomentScale ( ) const

Returns the scaling factor for the pitch moment.

**Returns**

pitch moment scale factor

**Note**

The pitch moment is the angular moment around the vessel's lateral (x) axis occurring in atmospheric flight. It works toward reducing the pitch angle (angle of attack).

The larger the scaling factor, the stronger the effect becomes ("stiff handling")

This value is only used with the old aerodynamic flight model, i.e. if no airfoils have been defined.

**See also**

[SetPitchMomentScale](#), [GetYawMomentScale](#), [CreateAirfoil](#)

17.57.3.174 void VESSEL::GetPMI ( VECTOR3 & *pmi* ) const

Returns the vessel's mass-normalised principal moments of inertia (PMI)

**Parameters**

<i>pmi</i>	Diagonal elements of the vessel's inertia tensor [ $\text{m}^2$ ]
------------	---

**Note**

The inertia tensor describes the behaviour of a rigid body under angular acceleration. It is the analog of the body's mass in the linear case.

The values returned by this function are the diagonal elements of the inertia tensor, in the local vessel frame of reference.

Orbiter's definition of PMI is mass-normalised, that is, the values are divided by the total vessel mass. The elements of *pmi* have the following meaning:

$$\begin{aligned} \text{pmi}_1 &= M^{-1} \int \rho(\vec{r}) (\vec{r}_y^2 + \vec{r}_z^2) d\vec{r} \\ \text{pmi}_2 &= M^{-1} \int \rho(\vec{r}) (\vec{r}_z^2 + \vec{r}_x^2) d\vec{r} \\ \text{pmi}_3 &= M^{-1} \int \rho(\vec{r}) (\vec{r}_x^2 + \vec{r}_y^2) d\vec{r} \end{aligned}$$

Orbiter assumes that off-diagonal elements can be neglected, that is, that the diagonal elements are the principal moments of inertia. This is usually a good approximation when the vessel is sufficiently symmetric with respect to its coordinate frame. Otherwise, a diagonalisation by rotating the local frame may be required. The shipedit utility in the SDK package allows to calculate the inertia tensor from a mesh, assuming a homogeneous mass distribution.

**See also**

[SetPMI](#)

## 17.57.3.175 DWORD VESSEL::GetPropellantCount ( ) const

Returns the current number of vessel propellant resources.

**Returns**

Number of propellant resources currently defined for the vessel.

**See also**

[CreatePropellantResource](#), [GetPropellantHandleByIndex](#)

**17.57.3.176 double VESSEL::GetPropellantEfficiency ( PROPELLANT\_HANDLE *ph* ) const**

Returns the efficiency factor of a propellant resource.

**Parameters**

<i>ph</i>	propellant resource handle
-----------	----------------------------

**Returns**

Fuel efficiency factor

**Note**

The fuel efficiency rating, together with a thruster's Isp rating, determines how much fuel is consumed per second to obtain a given thrust:  $R = F/(e Isp)$  with fuel rate  $R$  [kg/s], thrust  $F$  [N], efficiency  $e$  and fuel-specific impulse  $Isp$  [m/s].

**See also**

[SetPropellantEfficiency](#), [GetPropellantMaxMass](#), [CreatePropellantResource](#)

**17.57.3.177 double VESSEL::GetPropellantFlowrate ( PROPELLANT\_HANDLE *ph* ) const**

Returns the current mass flow rate from a propellant resource.

**Parameters**

<i>ph</i>	propellant resource handle
-----------	----------------------------

**Returns**

Current propellant mass flow rate [kg/s].

**See also**

[GetPropellantMass](#), [GetTotalPropellantFlowrate](#), [GetFuelRate](#)

**17.57.3.178 PROPELLANT\_HANDLE VESSEL::GetPropellantHandleByIndex ( DWORD *idx* ) const**

Returns the handle of a propellant resource for a given index.

**Parameters**

<i>idx</i>	propellant resource index ( $\geq 0$ )
------------	--

**Returns**

Propellant resource handle

**Note**

The index must be in the range between 0 and `GetPropellantCount()`-1. If the index is out of range, the returned handle is NULL.

The index of a given propellant resource may change if any resources are deleted. The handle remains valid until the corresponding resource is deleted.

**See also**

[CreatePropellantResource](#), [GetPropellantCount](#)

**17.57.3.179 double VESSEL::GetPropellantMass ( PROPELLANT\_HANDLE *ph* ) const**

Returns the current mass of a propellant resource.

**Parameters**

<i>ph</i>	propellant resource handle
-----------	----------------------------

**Returns**

Current propellant mass [kg].

**See also**

[SetPropellantMass](#), [GetPropellantMaxMass](#), [SetPropellantMaxMass](#)

**17.57.3.180 double VESSEL::GetPropellantMaxMass ( PROPELLANT\_HANDLE *ph* ) const**

Returns the maximum capacity of a propellant resource.

**Parameters**

<i>ph</i>	propellant resource handle
-----------	----------------------------

**Returns**

Max. propellant capacity [kg].

**See also**

[SetPropellantMaxMass](#), [GetPropellantMass](#), [SetPropellantMass](#)

**17.57.3.181 void VESSEL::GetRelativePos ( OBJHANDLE *hRef*, VECTOR3 & *pos* ) const**

Returns the vessel's current position with respect to another object.

**Parameters**

<i>hRef</i>	reference object handle
<i>pos</i>	vector receiving position [m]

**Note**

This function returns the vessel's position relative to the position of the object defined by handle *hRef*.

Results are returned in the ecliptic frame (ecliptic and equinox of J2000.0).

**See also**

[oapiGetRelativePos](#), [GetRelativeVel](#), [GetGlobalPos](#)

**17.57.3.182 void VESSEL::GetRelativeVel ( OBJHANDLE *hRef*, VECTOR3 & *vel* ) const**

Returns the vessel's current velocity relative to another object.

## Parameters

<i>hRef</i>	reference object handle
<i>vel</i>	vector receiving velocity [m/s]

## Note

This function returns the vessel's velocity relative to the velocity of the object defined by handle *hRef*. Results are returned in the ecliptic frame (ecliptic and equinox of J2000.0).

## See also

[oapiGetRelativeVel](#), [GetGlobalVel](#), [GetRelativePos](#)

17.57.3.183 void VESSEL::GetRotationMatrix ( MATRIX3 & *R* ) const

Returns the current rotation matrix for transformations from the vessel's local frame of reference to the global frame.

## Parameters

<i>R</i>	rotation matrix
----------	-----------------

## Note

To transform a point *rlocal* from local vessel coordinates to a global point *rglobal*, the following formula is used:

*rglobal* = *R* *rlocal* + *pvesSEL*,

where *pvesSEL* is the vessel's global position.

This transformation can be directly performed by a call to Local2Global.

## See also

[Local2Global](#), [SetRotationMatrix](#), [GlobalRot](#)

17.57.3.184 void VESSEL::GetRotDrag ( VECTOR3 & *rd* ) const

Returns the vessel's atmospheric rotation resistance coefficients.

## Parameters

<i>rd</i>	drag coefficients for rotation around the 3 vessel axes
-----------	---

## Note

*rd* contains the components  $r_{x,y,z}$  against rotation around the local vessel axes in atmosphere, where angular deceleration due to atmospheric friction is defined as  $a_{x,y,z} = -w_{x,y,z} q S_y r_{x,y,z}$  with angular velocity *w*, dynamic pressure *q* and reference surface *Sy*, defined by the vessel's cross section projected along the vertical (y) axis.

## See also

[SetRotDrag](#)

17.57.3.185 bool VESSEL::GetShipAirspeedVector ( VECTOR3 & *v* ) const

Returns the airspeed vector in vessel coordinates.

**Deprecated** This method has been replaced by [VESSEL::GetAirspeedVector](#)

## 17.57.3.186 double VESSEL::GetSize ( ) const

Returns the vessel's mean radius.

**Returns**

Vessel mean radius [m].

**Note**

The value returned is that set by a previous call to SetSize or from the Size entry in the vessel's configuration file.

There is no guarantee that the return value is correlated to the vessel's visual representation. In particular, the size parameter does not change (scale) the visual appearance.

**See also**

[SetSize](#)

## 17.57.3.187 double VESSEL::GetSlipAngle ( ) const

Returns the lateral (yaw) angle between the velocity vector and the vessel's longitudinal axis.

**Returns**

slip angle [rad] in the range -Pi ... +Pi.

**Note**

The slip angle is defined as the angle between the vessel's positive z axis and the flight path direction, projected into the xz-plane of the vessel's local coordinate system.

**See also**

[GetAOA](#)

17.57.3.188 OBJHANDLE VESSEL::GetSMi ( double & *smi* ) const

Returns the magnitude of the semi-minor axis of the current osculating orbit.

**Parameters**

out	<i>smi</i>	semi-minor axis [m]
-----	------------	---------------------

**Returns**

Handle of reference object, relative to which the orbit is calculated. NULL indicates failure (no orbit information available)

**Note**

The semi-minor axis is the smallest semi-diameter of the orbit ellipse (see [Basics of orbital mechanics](#)).

**See also**

[Basics of orbital mechanics](#), [ELEMENTS](#), [ORBITPARAM](#), [GetElements](#)

17.57.3.189 void VESSEL::GetStatus ( VESSELSTATUS & *status* ) const

Returns the vessel's current status parameters in a [VESSELSTATUS](#) structure.

**Parameters**

<i>status</i>	structure receiving the current vessel status.
---------------	--

**Note**

The [VESSELSTATUS](#) structure provides only limited information. Applications should normally use [GetStatusEx](#) to obtain a [VESSELSTATUSx](#) structure which contains additional parameters.

**See also**

[VESSELSTATUS](#), [GetStatusEx](#)

**17.57.3.190 void VESSEL::GetStatusEx ( void \* *status* ) const**

Returns the vessel's current status parameters in a [VESSELSTATUSx](#) structure (version x >= 2).

**Parameters**

<i>status</i>	pointer to a <a href="#">VESSELSTATUSx</a> structure
---------------	--

**Note**

This method can be used with any [VESSELSTATUSx](#) interface version supported by Orbiter. Currently only [VESSELSTATUS2](#) is supported.

The version field of the [VESSELSTATUSx](#) structure must be set by the caller prior to calling the method, to tell Orbiter which interface version is required.

In addition, the caller must set the `VS_FUELLIST`, `VS_THRUSTLIST` and `VS_DOCKINFOLIST` bits in the flag field, if the corresponding lists are required. Otherwise Orbiter will not produce these lists.

If `VS_FUELLIST` is specified and the fuel field is `NULL`, Orbiter will allocate memory for the list. The caller is responsible for deleting the list after use. If the fuel field is not `NULL`, Orbiter assumes that a list of sufficient length to store all propellant resources has been allocated by the caller.

The same applies to the thruster and dockinfo lists.

**See also**

[clbkSetStateEx](#), [DefSetStateEx](#), [VESSELSTATUS2](#)

**17.57.3.191 bool VESSEL::GetSuperstructureCG ( VECTOR3 & *cg* ) const**

Returns the centre of gravity of the superstructure to which the vessel belongs, if applicable.

**Parameters**

<i>cg</i>	superstructure centre of gravity [ <code>m</code> ]
-----------	---

**Returns**

*true* if the vessel is part of a superstructure, *false* otherwise.

**Note**

The returned vector is the position of the superstructure centre of gravity, in coordinates of the local vessel frame.

If the vessel is not part of a superstructure, *cg* returns (0,0,0).

## 17.57.3.192 VECTOR3 VESSEL::GetSupervesselCG ( ) const

Returns the supervessel's centre of gravity in the local vessel frame.

**Note**

If the vessel is not part of a superstructure, the return value is the vessel's CG, i.e. (0,0,0)

## 17.57.3.193 double VESSEL::GetSurfaceElevation ( ) const

Returns the elevation of the surface at the vessel's current longitude/latitude above the reference radius.

**Returns**

surface elevation [m]

## 17.57.3.194 VECTOR3 VESSEL::GetSurfaceNormal ( ) const

Returns the normal (in local horizon frame) of the surface below the vessel's current position.

**Returns**

surface normal in local horizon frame

## 17.57.3.195 const OBJHANDLE VESSEL::GetSurfaceRef ( ) const

Returns a handle to the surface reference object (planet or moon).

**Returns**

Surface reference object handle

**Note**

The surface reference is the planet or moon whose surface is closest to the current vessel position. All methods in this group refer to this celestial body.

## 17.57.3.196 DWORD VESSEL::GetThrusterCount ( ) const

Returns the number of thrusters currently defined.

**Returns**

Number of logical thruster definitions.

**See also**

[CreateThruster](#), [GetThrusterHandleByIndex](#)

17.57.3.197 void VESSEL::GetThrusterDir ( THRUSTER\_HANDLE *th*, VECTOR3 & *dir* ) const

Returns the force direction of a thruster.

## Parameters

in	<i>th</i>	thruster handle
out	<i>dir</i>	thrust direction (vessel frame of reference)

## See also

[SetThrusterDir](#), [GetThrusterRef](#)

17.57.3.198 **THGROUP\_HANDLE** VESSEL::GetThrusterGroupHandle ( **THGROUP\_TYPE** *thgt* ) const

Returns the handle of a default thruster group.

## Parameters

<i>thgt</i>	thruster group type (see <a href="#">Thruster and thruster-group parameters</a> )
-------------	---

## Returns

thruster group handle (or NULL if no group is defined for the specified type).

## Note

The thruster group type must not be THGROUP\_USER. To retrieve the handle of a nonstandard thruster group, use  [GetUserThrusterGroupHandleByIndex\(\)](#).

## See also

[GetUserThrusterGroupHandleByIndex](#)

17.57.3.199 **double** VESSEL::GetThrusterGroupLevel ( **THGROUP\_HANDLE** *thg* ) const

Returns the mean thrust level for a thruster group.

## Parameters

<i>thg</i>	thruster group identifier
------------	---------------------------

## Returns

Mean group thrust level [0..1]

## Note

In general, this method is only useful for groups where all thrusters have the same maximum thrust rating and the same thrust direction.

## See also

[GetThrusterGroupLevel\(THGROUP\\_TYPE\)const](#)

17.57.3.200 **double** VESSEL::GetThrusterGroupLevel ( **THGROUP\_TYPE** *thgt* ) const

Returns the mean thrust level for a default thruster group.

## Parameters

<i>thgt</i>	thruster group type
-------------	---------------------

## Returns

Mean group thrust level [0..1]

## Note

In general, this method is only useful for groups where all thrusters have the same maximum thrust rating and the same thrust direction.

## See also

[GetThrusterGroupLevel\(THGROUP\\_HANDLE\)const](#)

17.57.3.201 THRUSTER\_HANDLE VESSEL::GetThrusterHandleByIndex ( *DWORD idx* ) const

Returns the handle of a thruster specified by its index.

## Parameters

<i>idx</i>	thruster index (>= 0)
------------	-----------------------

## Returns

Thruster handle

## Note

The index must be in the range between 0 and *nthruster*-1, where *nthruster* is the thruster count returned by [GetThrusterCount\(\)](#). If the index is out of range, the returned handle is NULL.

The index of a given thruster may change if vessel thrusters are deleted. The handle remains valid until the corresponding thruster is deleted.

## See also

[CreateThruster](#), [DelThruster](#), [GetThrusterCount](#)

17.57.3.202 double VESSEL::GetThrusterIsp ( *THRUSTER\_HANDLE th* ) const

Returns the current fuel-specific impulse (Isp) rating of a thruster.

## Parameters

<i>th</i>	thruster handle
-----------	-----------------

## Returns

Current Isp value [m/s].

## Note

If the vessel is moving within a planetary atmosphere, and if a pressure-dependent Isp rating has been defined for this thruster, the returned Isp value will vary with ambient atmospheric pressure.

## See also

[GetThrusterIsp\(THRUSTER\\_HANDLE,double\)const](#),  
[GetThrusterIsp0](#),  
[SetThrusterIsp\(THRUSTER\\_HANDLE,double\)const](#),  
[SetThrusterIsp\(THRUSTER\\_HANDLE,double,double,double\)const](#),  
[CreateThruster](#)

17.57.3.203 double VESSEL::GetThrusterIsp ( THRUSTER\_HANDLE *th*, double *p\_ref* ) const

Returns the fuel-specific impulse (Isp) rating of a thruster at a specific ambient atmospheric pressure.

## Parameters

<i>th</i>	thruster handle
<i>p_ref</i>	reference pressure [Pa]

## Returns

Isp value at ambient pressure *p\_ref* [m/s].

## Note

If no pressure-dependent Isp rating has been defined for this thruster, it will always return the vacuum rating, independent of the specified pressure.

To obtain vacuum Isp rating, set *p\_ref* to 0.

To obtain the Isp rating at (Earth) sea level, set *p\_ref* = 101.4e3.

## See also

[GetThrusterIsp\(THRUSTER\\_HANDLE\)const](#),  
[GetThrusterIsp0](#),  
[SetThrusterIsp\(THRUSTER\\_HANDLE,double\)const](#),  
[SetThrusterIsp\(THRUSTER\\_HANDLE,double,double,double\)const](#),  
[CreateThruster](#)

17.57.3.204 double VESSEL::GetThrusterIsp0 ( THRUSTER\_HANDLE *th* ) const

Returns the vacuum fuel-specific impulse (Isp) rating for a thruster.

## Parameters

<i>th</i>	thruster handle
-----------	-----------------

## Returns

Isp value in vacuum [m/s]

## Note

Equivalent to GetThrusterIsp (th,0)

## See also

[GetThrusterIsp\(THRUSTER\\_HANDLE\)const](#),  
[GetThrusterIsp\(THRUSTER\\_HANDLE,double\)const](#),  
[SetThrusterIsp\(THRUSTER\\_HANDLE,double\)const](#),  
[SetThrusterIsp\(THRUSTER\\_HANDLE,double,double,double\)const](#),  
[CreateThruster](#)

17.57.3.205 double VESSEL::GetThrusterLevel ( THRUSTER\_HANDLE *th* ) const

Returns the current thrust level setting of a thruster.

## Parameters

<i>th</i>	thruster handle
-----------	-----------------

## Returns

Current thrust level (0...1)

## Note

To obtain the actual force [N] currently generated by the thruster, multiply the thrust level with the max. thrust rating returned by [GetThrusterMax\(\)](#).

## See also

[GetThrusterMax](#), [SetThrusterLevel](#)

17.57.3.206 double VESSEL::GetThrusterMax ( **THRUSTER\_HANDLE** *th* ) const

Returns the current maximum thrust rating of a thruster.

## Parameters

<i>th</i>	thruster handle
-----------	-----------------

## Returns

Max. thrust rating a the current atmospheric pressure [N].

## Note

If a pressure-dependent Isp rating has been defined for the thruster, and if the vessel is moving through a planetary atmosphere, this method returns the maximum thrust rating given the current atmospheric pressure. Otherwise it returns the maximum vacuum thrust rating of the thruster.

## See also

[GetThrusterMax\(THRUSTER\\_HANDLE,double\)const](#),  
[SetThrusterIsp\(THRUSTER\\_HANDLE,double\)const](#),  
[SetThrusterIsp\(THRUSTER\\_HANDLE,double,double,double\)const](#),  
[CreateThruster](#)

17.57.3.207 double VESSEL::GetThrusterMax ( **THRUSTER\_HANDLE** *th*, double *p\_ref* ) const

Returns the maximum thrust rating of a thruster at a specific ambient pressure.

## Parameters

<i>th</i>	thruster handle
<i>p_ref</i>	reference pressure [Pa]

## Returns

Max. thrust rating a atmospheric pressure *p\_ref* [N].

**Note**

If a pressure-dependent Isp rating has been defined for the thruster, and if the vessel is moving through a planetary atmosphere, this method returns the maximum thrust rating at ambient pressure  $p_{ref}$ . Otherwise it returns the maximum vacuum thrust rating of the thruster.

**See also**

[GetThrusterMax\(THRUSTER\\_HANDLE\)const](#),  
[SetThrusterIsp\(THRUSTER\\_HANDLE,double\)const](#),  
[SetThrusterIsp\(THRUSTER\\_HANDLE,double,double,double\)const](#),  
[CreateThruster](#)

**17.57.3.208 double VESSEL::GetThrusterMax0 ( THRUSTER\_HANDLE *th* ) const**

Returns the maximum vacuum thrust rating of a thruster.

**Parameters**

<i>th</i>	thruster handle
-----------	-----------------

**Returns**

Maximum vacuum thrust rating [N]

**Note**

To retrieve the actual current maximum thrust rating (which may be lower in the presence of ambient atmospheric pressure), use [GetThrusterMax\(\)](#).

**See also**

[SetThrusterMax0](#),  
[GetThrusterMax\(THRUSTER\\_HANDLE\)const](#),  
[GetThrusterMax\(THRUSTER\\_HANDLE,double\)const](#)

**17.57.3.209 void VESSEL::GetThrusterMoment ( THRUSTER\_HANDLE *th*, VECTOR3 & *F*, VECTOR3 & *T* ) const**

Returns the linear moment (force) and angular moment (torque) currently generated by a thruster.

**Parameters**

<i>th</i>	thruster handle
<i>F</i>	linear force [N]
<i>T</i>	torque [Nm]

**Note**

The returned values include the influence of ambient pressure on the thrust generated by the engine.

**17.57.3.210 void VESSEL::GetThrusterRef ( THRUSTER\_HANDLE *th*, VECTOR3 & *pos* ) const**

Returns the thrust force attack point of a thruster.

## Parameters

in	<i>th</i>	thruster handle
out	<i>pos</i>	thrust attack point [m]

## Note

*pos* is returned in the vessel frame of reference.

## See also

[SetThrusterRef](#), [GetThrusterDir](#)

17.57.3.211 PROPELLANT\_HANDLE VESSEL::GetThrusterResource ( THRUSTER\_HANDLE *th* ) const

Returns a handle for the propellant resource feeding the thruster.

## Parameters

<i>th</i>	thruster handle
-----------	-----------------

## Returns

Propellant resource handle, or NULL if the thruster is not connected.

## See also

[SetThrusterResource](#), [CreateThruster](#)

17.57.3.212 bool VESSEL::GetThrustVector ( VECTOR3 & *T* ) const

Returns thrust force vector in local vessel coordinates.

## Parameters

out	<i>T</i>	thrust vector [N]
-----	----------	-------------------

## Returns

false indicates zero thrust. In that case, the returned vector is (0,0,0).

## Note

On return, *T* contains the vector sum of thrust components from all engines.

This function provides information about the linear thrust force, but not about the angular moment (torque) induced.

## See also

[GetWeightVector](#), [GetLiftVector](#), [GetDragVector](#), [GetForceVector](#)

17.57.3.213 bool VESSEL::GetTorqueVector ( VECTOR3 & *M* ) const

Returns the total torque vector acting on the vessel in local vessel coordinates.

## Parameters

out	<i>M</i>	total torque vector [Nm]
-----	----------	--------------------------

## Returns

Always true

## Note

On return, *M* contains the total torque vector acting on the vessel in its centre of mass. The torque vector contains contributions from thrusters, aerodynamic forces and gravity gradient effects (if enabled).

## See also

[GetForceVector](#)

## 17.57.3.214 double VESSEL::GetTotalPropellantFlowrate ( ) const

Returns the current total mass flow rate, summed over all propellant resources.

## Returns

Total propellant mass flow rate [kg/s].

## See also

[GetPropellantFlowrate](#), [GetFuelRate](#)

## 17.57.3.215 double VESSEL::GetTotalPropellantMass ( ) const

Returns the vessel's current total propellant mass.

## Returns

Sum of current mass of all propellant resources defined for the vessel [kg].

## See also

[GetPropellantMass](#), [GetPropellantMaxMass](#)

17.57.3.216 bool VESSEL::GetTouchdownPoint ( **TOUCHDOWNVTX** & *tdvtx*, DWORD *idx* ) const

Returns one of the touchdown vertex definitions for the vessel.

## Parameters

out	<i>tdvtx</i>	Reference of touchdown descriptor to be filled.
in	<i>idx</i>	Vertex index ( $\geq 0$ )

## Returns

True on success (index in valid range) false otherwise.

## See also

[GetTouchdownPointCount](#), [SetTouchdownPoints](#)(const **TOUCHDOWNVTX**\*, DWORD)const

## 17.57.3.217 DWORD VESSEL::GetTouchdownPointCount ( ) const

Returns the number of touchdown points defining the impact hull of the vessel;.

**Returns**

Number of touchdown points

## 17.57.3.218 void VESSEL::GetTouchdownPoints ( VECTOR3 &amp; pt1, VECTOR3 &amp; pt2, VECTOR3 &amp; pt3 ) const

Returns the three points defining the vessel's ground contact plane.

**Deprecated** This method has been replaced by [VESSEL::GetTouchdownPoint\(TOUCHDOWNVTX&,DWORD\)const](#)

**Parameters**

<i>pt1</i>	touchdown point of nose wheel (or equivalent)
<i>pt2</i>	touchdown point of left main wheel (or equivalent)
<i>pt3</i>	touchdown point of right main wheel (or equivalent)

**Note**

The function returns 3 reference points defining the vessel's surface contact points when touched down on a planetary surface (e.g. landing gear).

This function is superseded by [GetTouchdownPoint\(TOUCHDOWNVTX&,DWORD\)const](#), which provides access to additional parameters and can be used for touchdown points  $\geq 3$ .

**See also**

[GetTouchdownPoint](#), [SetTouchdownPoints](#), [GetCOG\\_elev](#)

## 17.57.3.219 NAVHANDLE VESSEL::GetTransponder ( ) const

Return handle of vessel transponder if available.

**Returns**

Navigation radio handle of the vessel's transponder, or NULL if not available.

**Note**

This function returns NULL unless the transponder has been enabled by a call to [EnableTransponder](#) or by setting the EnableXPDR entry in the vessel's config file to TRUE.

It is not safe to store the handle, because it can become invalid as a result of disabling/enabling the transponder. Instead, the handle should be queried when needed.

The handle can be used to retrieve information about the transmitter, such as current frequency.

**See also**

[EnableTransponder](#), [SetTransponderChannel](#)

## 17.57.3.220 double VESSEL::GetTrimScale ( ) const

Returns the scaling factor for the pitch trim control.

**Returns**

pitch trim scale factor.

**Note**

This function returns the value previously set with SetTrimScale  
It is only used with the old atmospheric flight model (if no airfoils have been defined).

**See also**

[SetTrimScale](#), [GetPitchMomentScale](#), [GetYawMomentScale](#), [CreateAirfoil](#)

**17.57.3.221 DWORD VESSEL:: GetUserThrusterGroupCount ( ) const**

Returns the number of user-defined (nonstandard) thruster groups.

**Returns**

Number of user-defined thruster groups.

**Note**

The value returned by this method only includes user-defined thruster groups (created with the THGROUP\_USER flag). It does not contain any standard thruster groups (such as THGROUP\_MAIN, etc.).

**17.57.3.222 THGROUP\_HANDLE VESSEL:: GetUserThrusterGroupHandleByIndex ( DWORD idx ) const**

Returns the handle of a user-defined (nonstandard) thruster group.

**Parameters**

<i>idx</i>	index of user-defined thruster group ( $\geq 0$ )
------------	---

**Returns**

thruster group handle (or NULL if index out of range)

**Note**

Use this method only to retrieve handles for nonstandard thruster groups (created with the THGROUP\_USER flag). For standard groups, use [GetThrusterGroupHandle\(\)](#) instead.

The index must be in the range between 0 and nuserthgroup-1, where nuserthgroup is the number of non-standard thruster groups. Use  [GetUserThrusterGroupCount\(\)](#) to obtain this value.

**See also**

[GetThrusterGroupHandle](#),  [GetUserThrusterGroupCount](#)

**17.57.3.223 bool VESSEL::GetWeightVector ( VECTOR3 & G ) const**

Returns gravitational force vector in local vessel coordinates.

**Parameters**

<i>out</i>	<i>G</i>	gravitational force vector [N]
------------	----------	--------------------------------

**Returns**

Always true.

**Note**

When the vessel status is updated dynamically,  $G$  is composed of all gravity sources currently used for the vessel propagation (excluding sources with contributions below threshold).

During orbit stabilisation, only the contribution from the primary source is returned.

**See also**

[GetThrustVector](#), [GetLiftVector](#), [GetDragVector](#), [GetForceVector](#)

**17.57.3.224 double VESSEL::GetWheelbrakeLevel ( int *which* ) const**

Returns the current wheel brake level.

**Parameters**

<i>which</i>	0 = average of both main gear levels, 1 = left, 2 = right
--------------	---

**Returns**

wheel brake level [0..1]

**See also**

[SetMaxWheelbrakeForce](#), [SetWheelbrakeLevel](#)

**17.57.3.225 double VESSEL::GetWingAspect ( ) const**

Returns the vessel's wing aspect ratio (wingspan<sup>2</sup> / wing area)

**Returns**

Wing aspect ratio (wingspan<sup>2</sup> / wing area)

**Note****[Legacy aerodynamic flight model only]**

The aspect ratio returned by this function is only used by the legacy aerodynamic flight model. If the vessel uses the new flight model (i.e. defines at least one airfoil), then this value is ignored, and the airfoil parameters are used instead.

The aspect ratio is used in the calculation of induced drag.

**See also**

[SetWingAspect](#), [GetWingEffectiveness](#), [CreateAirfoil](#)

**17.57.3.226 double VESSEL::GetWingEffectiveness ( ) const**

Returns the wing form factor used in aerodynamic calculations.

**Returns**

wing form factor

## Note

**[Legacy aerodynamic flight model only]**

The form factor returned by this function is only used by the legacy aerodynamic flight model. If the vessel uses the new flight model (i.e. defines at least one airfoil), then this value is ignored, and the airfoil parameters are used instead.

The form factor, together with the aspect ratio, determines the amount of induced drag for given lift. Higher values of the form factor result in lower drag.

Typical values are  $\sim 3.1$  for elliptic wings,  $\sim 2.8$  for tapered wings, and  $\sim 2.5$  for rectangular wings. Default is 2.8.

## See also

[SetWingEffectiveness](#), [GetWingAspect](#), [CreateAirfoil](#)

**17.57.3.227 double VESSEL::GetYaw ( ) const**

Returns the current yaw angle with respect to the local horizon.

## Returns

yaw angle [rad]

## Note

The yaw angle  $y$  is defined as the angle between the the projection of the vessel's positive  $z$  axis (forward direction) into the horizon plane, and the local horizon "north" direction.

## See also

[GetSurfaceRef](#), [GetPitch](#), [GetBank](#)

**17.57.3.228 double VESSEL::GetYawMomentScale ( ) const**

Returns the scaling factor for the yaw moment.

## Returns

yaw moment scale factor

## Note

The yaw moment is the angular moment around the vessel's vertical ( $y$ ) axis occurring in atmospheric flight. It works toward reducing the slip angle between the vessel's longitudinal axis and the airstream vector. This value is only used with the old aerodynamic flight model, i.e. if no airfoils have been defined.

## See also

[SetYawMomentScale](#), [GetPitchMomentScale](#), [CreateAirfoil](#)

**17.57.3.229 void VESSEL::Global2Local ( const VECTOR3 & global, VECTOR3 & local ) const**

Performs a transformation from global to local vessel coordinates.

## Parameters

in	global	point in global coordinates [m]
out	local	transformed point in local vessel coordinates [m]

## Note

This is the inverse transform of [Local2Global](#). It maps a point from global ecliptic coordinates into the vessel's local frame.

The transformation has the form

$$\vec{p}_l = R_v^{-1}(\vec{p}_g - \vec{p}_v)$$

where  $R_v$  is the vessel's global rotation matrix (as given by [GetRotationMatrix](#)), and  $\vec{p}_v$  is the vessel position in the global frame.

## See also

[GetRotationMatrix](#), [Local2Global](#)

## 17.57.3.230 void VESSEL::GlobalRot ( const VECTOR3 &amp; rloc, VECTOR3 &amp; rglob ) const

Performs a rotation of a direction from the local vessel frame to the global frame.

## Parameters

in	rloc	point in local vessel coordinates
out	rglob	rotated point

## Note

This function is equivalent to multiplying rloc with the rotation matrix returned by [GetRotationMatrix](#).

Should be used to transform *directions*. To transform *points*, use [Local2Global](#), which additionally adds the vessel's global position to the rotated point.

## See also

[GetRotationMatrix](#), [Local2Global](#)

## 17.57.3.231 bool VESSEL::GroundContact ( ) const

Returns a flag indicating contact with a planetary surface.

## Returns

true indicates ground contact (at least one of the vessel's touchdown reference points is in contact with a planet surface).

## See also

[SetTouchdownPoints](#)

## 17.57.3.232 void VESSEL::HorizonInvRot ( const VECTOR3 &amp; rhizon, VECTOR3 &amp; rloc ) const

Performs a rotation of a direction from the current local horizon frame to the local vessel frame.

## Parameters

in	<i>rhorizon</i>	vector in local horizon coordinates
out	<i>rloc</i>	vector in local vessel coordinates

## Note

This function performs the inverse operation of [HorizonRot](#).

## See also

[HorizonRot](#), [GlobalRot](#), [GetRotationMatrix](#), [SetRotationMatrix](#)

17.57.3.233 void VESSEL::HorizonRot ( const VECTOR3 & *rloc*, VECTOR3 & *rhorizon* ) const

Performs a rotation from the local vessel frame to the current local horizon frame.

## Parameters

in	<i>rloc</i>	vector in local vessel coordinates
out	<i>rhorizon</i>	vector in local horizon coordinates

## Note

The local horizon frame is defined as follows:

- y is "up" direction (planet centre to vessel centre)
- z is "north" direction
- x is "east" direction

## See also

[HorizonInvRot](#), [GlobalRot](#), [GetRotationMatrix](#), [SetRotationMatrix](#)

17.57.3.234 void VESSEL::IncEngineLevel ( **ENGINETYPE** *eng*, double *dlevel* ) const

Increase or decrease the thrust level for an engine group.

**Deprecated** This method has been replaced by [VESSEL::IncThrusterGroupLevel](#).

## Parameters

<i>eng</i>	engine group identifier
<i>dlevel</i>	thrust increment

## Note

Use negative *dlevel* to decrease the engine's thrust level.

Levels are clipped to valid range.

## See also

[IncThrusterGroupLevel](#), [SetEngineLevel](#)

17.57.3.235 void VESSEL::IncThrusterGroupLevel ( **THGROUP\_HANDLE** *thg*, double *dlevel* ) const

Increments the thrust level for all thrusters in a group.

## Parameters

<i>thg</i>	thruster group identifier
<i>dlevel</i>	thrust level increment

## Note

Resulting thrust levels are automatically truncated to the range [0..1]

Use negative *dlevel* to decrement the thrust level.

## See also

[VESSEL::IncThrusterGroupLevel\(THGROUP\\_TYPE,double\)const](#)

**17.57.3.236 void VESSEL::IncThrusterGroupLevel ( THGROUP\_TYPE *thgt*, double *dlevel* ) const**

Increments the thrust level for all thrusters in a standard group.

## Parameters

<i>thgt</i>	thruster group type
<i>dlevel</i>	thrust level increment

## Note

This method can be used for standard thruster group types enumerated in [Thruster and thruster-group parameters](#) except THGROUP\_USER.

Resulting thrust levels are automatically truncated to the range [0..1]

Use negative *dlevel* to decrement the thrust level.

## See also

[VESSEL::IncThrusterGroupLevel\(THGROUP\\_HANDLE,double\)const](#)

**17.57.3.237 void VESSEL::IncThrusterGroupLevel\_SingleStep ( THGROUP\_HANDLE *thg*, double *dlevel* ) const**

Increments the thrust level of a group for a single time step.

## Parameters

<i>thg</i>	thruster group identifier
<i>dlevel</i>	thrust level increment

## Note

The total thrust level of a thruster group is composed of the sum of a *permanent* and an *override* portion, constrained to range [0..1]. The permanent setting only changes when reset explicitly, while the override setting is reset to zero after each time step.

This function increments the override portion of the thrust level for the thruster group for the current time step only.

Negative values for the override thrust level are permitted to reduce the total thrust level below its permanent setting (down to a minimum of 0).

Any override adjustments of individual thrusters in the group with [IncThrusterLevel\\_SingleStep](#) are added to their total level.

## See also

[IncThrusterGroupLevel\\_SingleStep\(THGROUP\\_TYPE,double\)const](#), [IncThrusterLevel\\_SingleStep](#)

**17.57.3.238 void VESSEL::IncThrusterGroupLevel\_SingleStep ( THGROUP\_TYPE *thgt*, double *dlevel* ) const**

Increments the thrust level of a standard group for a single time step.

## Parameters

<i>thgt</i>	thruster group type
<i>dlevel</i>	thrust level increment

## Note

The total thrust level of a thruster group is composed of the sum of a *permanent* and an *override* portion, constrained to range [0..1]. The permanent setting only changes when reset explicitly, while the override setting is reset to zero after each time step.

This function increments the override portion of the thrust level for the thruster group for the current time step only.

Negative values for the override thrust level are permitted to reduce the total thrust level below its permanent setting (down to a minimum of 0).

Any override adjustments of individual thrusters in the group with [IncThrusterLevel\\_SingleStep](#) are added to their total level.

## See also

[IncThrusterGroupLevel\\_SingleStep\(THGROUP\\_HANDLE,double\)const](#), [IncThrusterLevel\\_SingleStep](#)

17.57.3.239 void VESSEL::IncThrusterLevel ( **THRUSTER\_HANDLE** *th*, double *dlevel* ) const

Apply a change to the thrust level of a thruster.

## Parameters

<i>th</i>	thruster handle
<i>dlevel</i>	thrust level change (-1...1)

## Note

The applied thrust level change is limited to give a resulting thrust level in the range (0...1).

## See also

[SetThrusterLevel](#), [GetThrusterLevel](#)

17.57.3.240 void VESSEL::IncThrusterLevel\_SingleStep ( **THRUSTER\_HANDLE** *th*, double *dlevel* ) const

Apply a thrust level change to a thruster for the current time step only.

## Parameters

<i>th</i>	thruster handle
<i>dlevel</i>	thrust level change (-1...1)

## Note

This method overrides the thruster's permanent thrust level for the current time step only, so it should normally only be used in the body of the [VESSEL2::clbkPreStep\(\)](#) method.

This method may be overridden by manual user input via keyboard and joystick, or by automatic attitude sequences.

The applied thrust level change is limited to give a resulting thrust level in the range (0...1).

## See also

[SetThrusterLevel\\_SingleStep](#), [IncThrusterLevel](#), [VESSEL2::clbkPreStep\(\)](#)

17.57.3.241 void VESSEL::InitNavRadios ( **DWORD** *nnav* ) const

Defines the number of navigation (NAV) radio receivers supported by the vessel.

## Parameters

<i>nnav</i>	number of NAV radio receivers
-------------	-------------------------------

## Note

A vessel requires NAV radio receivers to obtain instrument navigation aids such as ILS or docking approach information.

If no NAV receivers are available, then certain [MFD](#) modes such as Landing or Docking will not be supported. Default is 2 NAV receivers.

## See also

[GetNavCount](#)

17.57.3.242 **UINT VESSEL::InsertMesh ( const char \* *meshname*, **UINT** *idx*, const **VECTOR3** \* *ofs* = 0 ) const**

Insert or replace a mesh at a specific index location of the vessel's mesh list.

## Parameters

<i>meshname</i>	mesh file name
<i>idx</i>	mesh list index ( $\geq 0$ )
<i>ofs</i>	optional pointer to a displacement vector which describes the offset of the mesh origin against the vessel origin [ <a href="#">m</a> ].

## Returns

mesh index

## Note

*meshname* defines a path to an existing mesh file. The mesh must be in Orbiter's MSH format.

The file name (including optional directory path) is relative to Orbiter's mesh directory (usually ".\Meshes"). The file extension should not be specified (.msh is assumed.)

*idx* is a zero-based index which specifies at which point the mesh reference is added into the vessel's mesh list. If a mesh already exists at this position, it is overwritten. If *idx* > number of meshes, then the required number of (empty) entries is generated.

The return value is always equal to *idx*.

## See also

[InsertMesh\(MESHHANDLE,UINT,const VECTOR3\\*\)const](#), [AddMesh\(const char\\*,const VECTOR3\\*\)const](#), [AddMesh\(MESHHANDLE,const VECTOR3\\*\)const](#)

17.57.3.243 **UINT VESSEL::InsertMesh ( **MESHHANDLE** *hMesh*, **UINT** *idx*, const **VECTOR3** \* *ofs* = 0 ) const**

Insert or replace a mesh at a specific index location of the vessel's mesh list.

## Parameters

<i>hMesh</i>	mesh handle
<i>idx</i>	mesh list index ( $\geq 0$ )
<i>ofs</i>	optional pointer to a displacement vector which describes the offset of the mesh origin against the vessel origin [ <a href="#">m</a> ].

## Returns

mesh index

## Note

*hMesh* is a handle to a mesh previously loaded with [oapiLoadMeshGlobal](#).

The global handle *hMesh* represents a "mesh template". Whenever the vessel needs to create its visual representation (when moving within visual range of the observer camera), it creates its individual mesh as a copy of the template.

*idx* is a zero-based index which specifies at which point the mesh reference is added into the vessel's mesh list. If a mesh already exists at this position, it is overwritten. If *idx* > number of meshes, then the required number of (empty) entries is generated.

The return value is always equal to *idx*.

## See also

[InsertMesh](#)(const char\*,UINT,const VECTOR3\*)const, [AddMesh](#)(const char\*,const VECTOR3\*)const,  
[AddMesh](#)(MESHHANDLE,const VECTOR3\*)const

## 17.57.3.244 DWORD VESSEL::LightEmitterCount ( ) const

Returns the number of light sources defined for the vessel.

## Returns

Number of light sources.

## 17.57.3.245 void VESSEL::Local2Global ( const VECTOR3 &amp; local, VECTOR3 &amp; global ) const

Performs a transformation from local vessel coordinates to global coordinates.

## Parameters

in	<i>local</i>	point in local vessel coordinates [ <b>m</b> ]
out	<i>global</i>	transformed point in global coordinates [ <b>m</b> ]

## Note

This function maps a point from the vessel's local coordinate system (centered at the vessel CG) into the global ecliptic system (centered at the solar system barycentre).

The transform has the form

$$\vec{p}_g = R_v \vec{p}_l + \vec{p}_v$$

where  $R_v$  is the vessel's global rotation matrix (as given by [GetRotationMatrix](#)), and  $\vec{p}_v$  is the vessel position in the global frame.

## See also

[GetRotationMatrix](#), [Global2Local](#)

## 17.57.3.246 void VESSEL::Local2Rel ( const VECTOR3 &amp; local, VECTOR3 &amp; rel ) const

Performs a transformation from local vessel coordinates to the ecliptic frame centered at the vessel's reference body.

## Parameters

in	<i>local</i>	point in local vessel coordinates [ <b>m</b> ]
----	--------------	--

out	rel	transformed point in reference body-relative ecliptic coordinates [m].
-----	-----	--

**Note**

This function maps a point from the vessel's local coordinate system into an ecliptic system centered at the centre of mass of the vessel's *gravity reference object* (the celestial body that is currently being orbited).

A handle to the reference object can be obtained via [GetGravityRef](#). The reference object may change if the vessel enters a different object's sphere of influence.

The transformation has the form

$$\vec{p}_r = R_v \vec{p}_l + \vec{p}_v - \vec{p}_{\text{ref}}$$

where  $R_v$  is the vessel's global rotation matrix (as given by [GetRotationMatrix](#)),  $\vec{p}_v$  is the vessel's global position, and  $\vec{p}_{\text{ref}}$  is the reference body's global position.

**See also**

[GetRotationMatrix](#), [Global2Local](#), [Local2Global](#), [GetGravityRef](#)

**17.57.3.247 bool VESSEL::MeshgroupTransform ( VISHANDLE vis, const MESHGROUP\_TRANSFORM & mt ) const**

Affine transformation of a mesh group.

**Parameters**

vis	vessel visual handle
mt	transformation parameter structure

**Returns**

*true* on success, *false* on failure (group index out of range)

**orbiter\_ng:**

This function is not yet supported in orbiter\_ng and always returns *false*.

**17.57.3.248 int VESSEL::MeshModified ( MESHHANDLE hMesh, UINT grp, DWORD modflag )**

Notifies Orbiter of a change in a mesh group.

**Parameters**

hMesh	mesh handle
grp	group index ( $\geq 0$ )
modflag	type of modification (currently ignored)

**Returns**

error code (0=ok)

**Note**

This method should be called if the components of a mesh group (vertices or indices) have been modified, to allow Orbiter to propagate the changes to the render object.

For the built-in renderer, this registration is not strictly necessary, because it uses the mesh directly as the render object, so any changes to the mesh groups are applied directly.

External graphics clients however may map the mesh data into device-specific data structures. In that case, MeshModified tells the graphics subsystem to synchronise its mesh data.

MeshModified does not need to be called after applying an affine transformation of the mesh group as a whole ([MeshgroupTransform](#)), because this is performed by assigning a transformation matrix, rather than by modifying the vertex positions themselves.

## See also

[oapiMeshGroup](#), [oapiMeshGroupEx](#)

#### 17.57.3.249 `bool VESSEL::NonsphericalGravityEnabled ( ) const`

Flag for nonspherical gravity perturbations.

Indicates whether the vessel considers gravity field perturbations due to nonspherical planet shapes when updating its state vectors for the current time step.

## Returns

true indicates that gravity perturbations due to nonspherical planet shapes are taken into account.

## Note

This function will always return false if the user has disabled the "Nonspherical gravity sources" option in the Launchpad dialog.

If the user has enabled orbit stabilisation in the Launchpad, this function may sometimes return false during high time compression, even if the nonspherical option has been selected. In such situations Orbiter can exclude nonspherical perturbations to avoid numerical instabilities.

## See also

[GetWeightVector](#)

#### 17.57.3.250 `bool VESSEL::OrbitStabilised ( ) const`

Flag indicating whether orbit stabilisation is used for the vessel at the current time step.

## Returns

true indicates that the vessel's state is currently updated by using the stabilisation algorithm, which calculates the osculating elements with respect to the primary gravitational source, and treats all additional forces as perturbations.

## Note

A vessel switches to orbit stabilisation only if the user has enabled it in the launchpad dialog, and the user-defined perturbation and time step limits are currently satisfied.

Stabilised mode reduces the effect of deteriorating orbits due to accumulating numerical errors in the state vector propagation, but is limited in handling multiple gravitational sources.

## See also

[GetElements](#)

#### 17.57.3.251 `void VESSEL::ParseScenarioLine ( char * line, VESSELSTATUS * status ) const`

Pass a line read from a scenario file to Orbiter for default processing.

**Deprecated** This function is retained for backward compatibility only. New modules should overload the [VESSEL::clbkLoadStateEx](#) function and use [VESSEL::ParseScenarioLineEx](#) for default state parsing.

**Parameters**

<i>line</i>	line to be interpreted
<i>status</i>	state parameter set

**See also**

[ParseScenarioLineEx](#), [VESSELSTATUS](#)

**17.57.3.252 void VESSEL::ParseScenarioLineEx ( char \* *line*, void \* *status* ) const**

Pass a line read from a scenario file to Orbiter for default processing.

**Parameters**

<i>line</i>	line to be interpreted
<i>status</i>	status parameters (points to a VESSELSTATUSx variable).

**Note**

This function should be used within the body of [VESSEL2::clbkLoadStateEx](#).

The parser clbkLoadStateEx should forward all lines not recognised by the module to Orbiter via Parse← ScenarioLineEx to allow processing of standard vessel settings.

clbkLoadStateEx currently provides a [VESSELSTATUS2](#) status definition. This may change in future versions, so status should not be used within clbkLoadStateEx other than passing it to ParseScenarioLineEx.

**See also**

[VESSEL2::clbkLoadStateEx](#)

**17.57.3.253 bool VESSEL::Playback ( ) const**

Flag for active playback session.

**Returns**

*true* if the current session is a playback of a recorded flight, *false* otherwise.

**See also**

[Recording](#)

**17.57.3.254 void VESSEL::RecordEvent ( const char \* *event\_type*, const char \* *event* ) const**

Writes a custom tag to the vessel's articulation data stream during a running recording session.

**Parameters**

<i>event_type</i>	event tag label
<i>event</i>	event string

**Note**

This function can be used to record custom vessel events (e.g. animations) to the articulation stream (.atc) of a vessel record.

The function does nothing if no recording is active, so it is not necessary to check for a running recording before invoking RecordEvent.

To read the recorded articulation tags during the playback of a recorded session, overload the [VESSEL2::clbkPlaybackEvent](#) callback function.

## See also

[Recording](#), [VESSEL2::clbkPlaybackEvent](#)

### 17.57.3.255 bool VESSEL::Recording ( ) const

Flag for active recording session.

## Returns

*true* if flight recording is active, *false* otherwise.

## See also

[Playback](#), [RecordEvent](#)

### 17.57.3.256 void VESSEL::RegisterAnimation ( ) const

Logs a request for calls to [VESSEL2::clbkAnimate](#).

## Note

This function allows to implement animation sequences in combination with the [VESSEL2::clbkAnimate](#) callback function. After a call to [RegisterAnimation](#), [VESSEL2::clbkAnimate](#) is called at each time step whenever the vessel's visual object exists.

Use [UnregisterAnimation](#) to stop further calls to [VESSEL2::clbkAnimate](#).

Each call to [RegisterAnimation](#) increments a reference counter, while each call to [UnregisterAnimation](#) decrements the counter. Orbiter continues calling [VESSEL2::clbkAnimate](#) as long as the counter is greater than 0.

If [VESSEL2::clbkAnimate](#) is not overloaded by the module, [RegisterAnimation](#) has no effect.

The [RegisterAnimation](#) mechanism leaves the actual implementation of the animation (transformation of mesh groups, etc.) entirely to the module. The [VESSEL::CreateAnimation](#) / [VESSEL::AddAnimationComponent](#) mechanism is an alternative way to define animations where the transformations are managed by the Orbiter core.

## See also

[VESSEL2::clbkAnimate](#), [UnregisterAnimation](#), [CreateAnimation](#), [AddAnimationComponent](#)

### 17.57.3.257 void VESSEL::SaveDefaultState ( FILEHANDLE *scn* ) const

Causes Orbiter to write default vessel parameters to a scenario file.

**Deprecated** Use a call to the base class [VESSEL2::clbkSaveState](#) from within the overloaded callback function instead.

## Parameters

<i>scn</i>	scenario file handle
------------	----------------------

## Note

This method saves the vessel's default state parameters (such as position, velocity, orientation, etc.) to a scenario file.

This functionality is now included in the default implementation of [VESSEL2::clbkSaveState](#). Therefore, vessel classes which overload this method to save custom vessel parameters should call the base class method to allow Orbiter to save the default vessel parameters.

## See also

[VESSEL2::clbkSaveState](#)

17.57.3.258 int VESSEL::SendBufferedKey ( DWORD *key*, bool *down* = *true*, char \* *kstate* = 0 )

Send a simulated buffered key event to the vessel.

## Parameters

<i>key</i>	key code
<i>down</i>	key down event flag
<i>kstate</i>	key state map for additional modifier keys

## Returns

Process flag (0=key not processed, 1=key processed)

## Note

This method simulates a manual keyboard press and can be used to trigger actions associated with the key. If *down* = true, a key down event is simulated. Otherwise, a key up event is simulated. Additional modifier keys (e.g. Ctrl, Shift, Alt) can be set by passing a *kstate* array with the appropriate keys defined. This method triggers a call to [VESSEL2::clbkConsumeBufferedKey](#). If not consumed by the callback function, the key event is offered to the default key handler.

## See also

[VESSEL2::clbkConsumeBufferedKey](#)

17.57.3.259 void VESSEL::SetADCtrlMode ( DWORD *mode* ) const

Configure manual input mode for aerodynamic control surfaces.

## Parameters

<i>mode</i>	bit flags defining the address mode for aerodynamic control surfaces (see notes)
-------------	--

## Note

The mode parameter contains bit flags as follows:

- bit 0: enable/disable elevator
- bit 1: enable/disable rudder
- bit 2 enable/disable ailerons

Therefore, use mode = 0 to disable all control surfaces, mode = 7 to enable all control surfaces.

## See also

[GetADCtrlMode](#), [CreateControlSurface](#), [CreateControlSurface2](#), [GetControlSurfaceLevel](#), [SetControlSurfaceLevel](#)

17.57.3.260 void VESSEL::SetAlbedoRGB ( const VECTOR3 & *albedo* ) const

Set the average colour distribution reflected by the vessel.

## Parameters

<i>albedo</i>	vessel colour vector (red, green blue), range [0..1] for each component.
---------------	--

## Note

The colour passed to this function is currently used to define the "spot" colour with which the vessel is rendered at long distances. It should represent an average colour and brightness of the vessel surface when fully lit.

The values for each of the RGB components should be in the range 0-1.

The default vessel albedo is bright white (1,1,1).

The albedo can be overridden by the AlbedoRGB entry in the vessel's config file.

---

```
17.57.3.261 void VESSEL::SetAngularVel ( const VECTOR3 & avel ) const
```

Applies new angular velocity to the vessel.

## Parameters

<i>avel</i>	vector containing the new angular velocity components [ <b>rad/s</b> ]
-------------	--

## Note

The input vector defines the angular velocities around the vessel's x, y and z axes. They refer to the rotating vessel frame.

## See also

[GetAngularVel](#)

17.57.3.262 **bool VESSEL::SetAnimation ( *UINT anim, double state* ) const**

Set the state of an animation.

## Parameters

<i>anim</i>	animation identifier
<i>state</i>	animation state (0 ... 1)

## Returns

*false* indicates failure (animation identifier out of range)

## Note

Each animation is defined by its state, with extreme points state=0 and state=1. When setting a state between 0 and 1, Orbiter carries out the appropriate transformations to advance the animation to that state. It is the responsibility of the code developer to call SetAnimation in such a way as to provide a smooth movement of the animated parts.

## See also

[GetAnimation](#)

17.57.3.263 **void VESSEL::SetAttachmentParams ( *ATTACHMENTHANDLE attachment, const VECTOR3 & pos, const VECTOR3 & dir, const VECTOR3 & rot* ) const**

Reset attachment position and orientation for an existing attachment point.

## Parameters

<i>attachment</i>	attachment handle
<i>pos</i>	new attachment point position in vessel coordinates [ <b>m</b> ]
<i>dir</i>	new attachment direction in vessel coordinates
<i>rot</i>	new longitudinal alignment vector in vessel coordinates

## Note

If the parameters of an attachment point are changed while a vessel is attached to that point, the attached vessel will be shifted to the new position automatically.

The *dir* and *rot* vectors should both be normalised to length 1, and they should be orthogonal.

## See also

[CreateAttachment](#), [GetAttachmentParams](#), [GetAttachmentId](#), [GetAttachmentStatus](#), [AttachmentCount](#), [GetAttachmentIndex](#), [GetAttachmentHandle](#), [AttachChild](#), [DetachChild](#)

17.57.3.264 **void VESSEL::SetAttitudeLinLevel ( *const VECTOR3 & th* ) const**

Set RCS thruster levels for linear translation in all 3 vessel axes.

## Parameters

<i>th</i>	RCS thruster levels (range -1...+1)
-----------	-------------------------------------

## Note

This method is functional even if the manual RCS input mode is set to rotational.

## See also

[SetAttitudeLinLevel\(int,double\)const](#), [SetAttitudeLinLevel](#), [SetAttitudeRotLevel](#)

17.57.3.265 void VESSEL::SetAttitudeLinLevel ( int *axis*, double *th* ) const

Set RCS thruster level for linear translation along a single axis.

## Parameters

<i>axis</i>	translation axis (0=x, 1=y, 2=z)
<i>th</i>	RCS thruster level (range -1...+1)

## Note

This method is functional even if the manual RCS input mode is set to rotational.

## See also

[SetAttitudeLinLevel\(const VECTOR3&\)const](#), [SetAttitudeLinLevel](#), [SetAttitudeRotLevel](#)

17.57.3.266 bool VESSEL::SetAttitudeMode ( int *mode* ) const

Sets the vessel's RCS (reaction control system) thruster mode.

## Parameters

<i>mode</i>	New RCS mode (see <a href="#">RCS mode identifiers</a> )
-------------	--

## Returns

true on success, false for invalid argument

## Note

The reaction control system consists of a set of small thrusters arranged around the vessel. They can be fired in pre-defined configurations to provide either a change in angular velocity (in RCS\_ROT mode) or in linear velocity (in RCS\_LIN mode).

Set RCS\_NONE to disable the RCS.

## See also

[GetAttitudeMode](#), [RCS mode identifiers](#)

17.57.3.267 void VESSEL::SetAttitudeRotLevel ( const VECTOR3 & *th* ) const

Set RCS thruster levels for rotation in all 3 vessel axes.

## Parameters

<i>th</i>	RCS thruster levels for rotation around x,y,z axes (range -1...+1)
-----------	--

## Note

This method is functional even if the manual RCS input mode is set to linear.

If RCS thrusters are involved in multiple rotation groups, calling this method can lead to side effects due to thruster level saturation. In this case, the maximum commanded level should be sufficiently low that a thruster level doesn't saturate if it is engaged by all involved groups simultaneously. For example, if a thruster is member of the THGROUP\_ATT\_PITCHUP and THGROUP\_ATT\_BANKRIGHT groups, then commanding simultaneous pitch up and bank right should be limited to level 0.5: SetAttitudeRotLevel(0.5, 0, 0.5)

Commanding rotations around multiple axes simultaneously can often lead to complex rotation behaviour due to moment transfer between axes (torques and accelerations coupled by Euler's equations).

## See also

[SetAttitudeRotLevel\(int,double\)const](#), [GetAttitudeRotLevel](#), [SetAttitudeLinLevel](#)

17.57.3.268 void VESSEL::SetAttitudeRotLevel ( int *axis*, double *th* ) const

Set RCS thruster level for rotation around a single axis.

## Parameters

<i>axis</i>	rotation axis (0=x, 1=y, 2=z)
<i>th</i>	RCS thruster level (range -1...+1)

## Note

This method is functional even if the manual RCS input mode is set to linear.

Calling this method can have side effects if the RCS thrusters for the specified axis are also registered for other attitude axes.

## See also

[SetAttitudeRotLevel\(const VECTOR3&\)const](#), [GetAttitudeRotLevel](#), [SetAttitudeLinLevel](#)

17.57.3.269 void VESSEL::SetBankMomentScale ( double *scale* ) const

Sets the scaling factor for the yaw moment.

**Deprecated** This method has been replaced by [VESSEL::SetYawMomentScale](#).

## Parameters

<i>scale</i>	scale factor for slip angle moment.
--------------	-------------------------------------

## Note

The method is misnamed. It refers to the vessel's yaw moment.

## See also

[SetYawMomentScale](#)

17.57.3.270 void VESSEL::SetCameraCatchAngle ( double *cangle* ) const

Set the angle over which the cockpit camera auto-centers to default direction.

## Parameters

<i>cangle</i>	auto-center catchment angle [rad]
---------------	-----------------------------------

## Note

The cockpit camera auto-centers to its default ("forward") direction when it is close enough to this direction. This function can be used to specify the angle over which auto-centering occurs. Setting *cangle*=0 disables the auto-centering function. The default catchment angle is 5 degrees (5.0\*RAD). To reset the catchment angle globally for all cockpit views of the vessel, `SetCameraCatchAngle` would typically be used in [VESSEL2::clbkSetClassCaps\(\)](#). To reset the catchment angle for individual cockpit positions, the function would be used for the appropriate cockpit modes in [VESSEL2::clbkLoadPanel\(\)](#) and [VESSEL2::clbkLoadVC\(\)](#).

17.57.3.271 void VESSEL::SetCameraDefaultDirection ( const VECTOR3 & *cd* ) const

Set the default camera direction for internal (cockpit) view.

## Parameters

<i>cd</i>	new default direction in vessel coordinates
-----------	---

## Note

By default, the default direction is (0,0,1), i.e. forward. The supplied direction vector must be normalised to length 1. Calling this function automatically sets the current actual view direction to the default direction. This function can either be called during [VESSEL2::clbkSetClassCaps](#), to define the default camera direction globally for the vessel, or during [VESSEL2::clbkLoadGenericCockpit](#), [VESSEL2::clbkLoadPanel](#) and [VESSEL2::clbkLoadVC](#), to define different default directions for different instrument panels or virtual cockpit positions. In Orbiter, the user can return to the default direction by pressing the *Home* key on the cursor key pad.

## See also

[SetCameraDefaultDirection\(const VECTOR3&,double\)const](#), [GetCameraDefaultDirection](#), [VESSEL2::clbkSetClassCaps](#), [VESSEL2::clbkLoadGenericCockpit](#), [VESSEL2::clbkLoadPanel](#), [VESSEL2::clbkLoadVC](#)

17.57.3.272 void VESSEL::SetCameraDefaultDirection ( const VECTOR3 & *cd*, double *tilt* ) const

Set the default camera direction and tilt angle for internal (cockpit) view.

## Parameters

<i>cd</i>	new default direction in vessel coordinates
<i>tilt</i>	camera tilt angle around the default direction [rad]

## Note

This function allows to set the camera tilt angle in addition to the default direction. By default, the default direction is (0,0,1), i.e. forward, and the tilt angle is 0 (upright). The supplied direction vector must be normalised to length 1. The tilt angle should be in the range [-Pi,+Pi]. Calling this function automatically sets the current actual view direction to the default direction.

## See also

[SetCameraDefaultDirection\(const VECTOR3&\)const](#), [GetCameraDefaultDirection](#)

```
17.57.3.273 void VESSEL::SetCameraMovement ( const VECTOR3 & fpos, double fphi, double ftht, const VECTOR3 &  
lpos, double lphi, double ltht, const VECTOR3 & rpos, double rphi, double rtht ) const
```

Set both linear movement range and orientation of the cockpit camera when "leaning" forward, left and right.

## Parameters

<i>fpos</i>	offset vector when leaning forward [m]
<i>fphi</i>	camera rotation azimuth angle when leaning forward [rad]
<i>ftht</i>	camera rotation polar angle when leaning forward [rad]
<i>lpos</i>	offset vector when leaning left [m]
<i>lphi</i>	camera rotation azimuth angle when leaning left [rad]
<i>ltht</i>	camera rotation polar angle when leaning left [rad]
<i>rpos</i>	offset vector when leaning right [m]
<i>rphi</i>	camera rotation azimuth angle when leaning right [rad]
<i>rtht</i>	camera rotation polar angle when leaning right [rad]

## Note

This function is an extended version of [SetCameraShiftRange](#).

It is more versatile, because in addition to the linear camera movement vectors, it also allows to define the camera orientation (via azimuth and polar angle relative to default view direction). This allows to point the camera to a particular cockpit window, instrument panel, etc.

## See also

[SetCameraShiftRange](#), [SetCameraRotationRange](#)

## 17.57.3.274 void VESSEL::SetCameraOffset ( const VECTOR3 &amp; co ) const

Set the camera position for internal (cockpit) view.

## Parameters

<i>co</i>	camera offset in vessel coordinates [m]
-----------	---

## Note

The camera offset can be used to define the pilot's eye position in the spacecraft.

The default offset is (0,0,0).

This function is called typically either globally in [VESSEL2::clbkSetClassCaps](#), if the camera position doesn't change between views, or individually in [VESSEL2::clbkLoadGenericCockpit](#), [VESSEL2::clbkLoadPanel](#) and [VESSEL2::clbkLoadVC](#) for each defined view.

## See also

[GetCameraOffset](#)

17.57.3.275 void VESSEL::SetCameraRotationRange ( double *left*, double *right*, double *up*, double *down* ) const

Sets the range over which the cockpit camera can be rotated from its default direction.

## Parameters

<i>left</i>	rotation range to the left [rad]
<i>right</i>	rotation range to the right [rad]
<i>up</i>	rotation range up [rad]
<i>down</i>	rotation range down [rad]

**Note**

The meaning of the "left", "right", "up" and "down" directions is given by the orientation of the local vessel frame. For a default view direction of (0,0,1), "left" is a rotation towards the -x axis, "right" is a rotation towards the +x axis, "up" is a rotation towards the +y axis, and "down" is a rotation towards the -y axis.

All ranges must be  $\geq 0$ . The left and right ranges should be  $< \pi$ . The up and down ranges should be  $< \pi/2$ .

The default values are  $0.8\pi$  for left and right ranges, and  $0.4\pi$  for up and down ranges.

**See also**

[SetCameraShiftRange](#), [SetCameraMovement](#)

**17.57.3.276** `void VESSEL::SetCameraShiftRange ( const VECTOR3 & fpos, const VECTOR3 & lpos, const VECTOR3 & rpos ) const`

Set the linear movement range for the cockpit camera.

Defining a linear movement allows the user to move the head forward or sideways, e.g. to get a better look out of a window, or a closer view of a virtual cockpit instrument panel.

**Parameters**

<i>fpos</i>	offset vector when leaning forward [m]
<i>lpos</i>	offset vector when leaning left [m]
<i>rpos</i>	offset vector when leaning right [m]

**Note**

If a linear movement range is defined with this function, the user can 'lean' forward or sideways using the 'cockpit slew' keys. Supported keys are:

Name	default	action
CockpitCamDontLean	Ctrl+Alt+Down	return to default position
CockpitCamLeanForward	Ctrl+Alt+Up	lean forward
CockpitCamLeanLeft	Ctrl+Alt+Left	lean left
CockpitCamLeanRight	Ctrl+Alt+Right	lean right

The movement vectors are taken relative to the default cockpit position defined via `SetCameraOffset`.

This function should be called when initialising a cockpit mode (e.g. in `clbkLoadPanel` or `clbkLoadVC`). By default, Orbiter resets the linear movement range to zero whenever the cockpit mode changes.

In addition to the linear movement, the camera also turns left when leaning left, turns right when leaning right, and returns to default direction when leaning forward. For more control over camera rotation at the different positions, use `SetCameraMovement` instead.

**See also**

[SetCameraMovement](#), [SetCameraRotationRange](#)

**17.57.3.277** `void VESSEL::SetClipRadius ( double rad ) const`

Set the radius of the vessel's circumscribing sphere.

**Parameters**

<i>rad</i>	Radius of the circumscribing sphere of the vessel's visual representation [m].
------------	--

**Note**

This parameter describes the radius of the sphere around the vessel that is protected from clipping at the observer camera's near clipping plane. (The near clipping plane defines an area around the view camera within which no objects are rendered. The distance of the near clipping plane cannot be made arbitrarily small for technical reasons.)

By default, the clip radius is identical to the vessel's "Size" parameter. However, the size parameter is correlated to physical vessel properties and may therefore be smaller than the sphere that contains the vessel's complete visual representation. In that case, defining a clip radius that is larger than the size parameter can avoid visual artefacts.

The view camera's near clip plane distance is adjusted so that it does not intersect any nearby vessel's clip radius. However, there is a minimum near clip distance of 2.5m. This means that if the camera approaches a vessel to less than clip radius + 2.5, clipping may still occur.

Visual cockpit meshes are rendered in a separate pass and are not affected by the general near clip distance (they have a separate near clip distance of 10cm).

Setting `rad = 0` reverts to the default behaviour of using the vessel's "Size" parameter to determine the clip radius.

**See also**

[GetClipRadius](#), [SetSize](#)

**17.57.3.278 void VESSEL::SetCOG\_elev ( double *h* ) const**

Set the altitude of the vessel's centre of gravity over ground level when landed.

**Parameters**

<i>h</i>	elevation of the vessel's centre of gravity above the surface plane when landed [m].
----------	--

**Deprecated** This method is obsolete and should no longer be used. It has been replaced by [VESSEL::SetTouchdownPoints](#).

**17.57.3.279 void VESSEL::SetControlSurfaceLevel ( AIRCTRL\_TYPE *type*, double *level* ) const**

Updates the position of an aerodynamic control surface.

**Parameters**

<i>type</i>	control surface type (see <a href="#">Aerodynamic control surface types</a> )
<i>level</i>	new control surface position [-1...+1]

**Note**

Parameter *level* defines a *target* state for the surface. Control surfaces generally require a finite amount of time to move from the current to the target state.

This method affects the *permanent* setting of the control surface, while manual input via keyboard or joystick affects the *transient* setting. The total target state of the control surface is the sum of both settings, clamped to the range [-1...+1]

**See also**

[SetControlSurfaceLevel\(AIRCTRL\\_TYPE,double,bool\)const](#), [GetControlSurfaceLevel](#)

**17.57.3.280 void VESSEL::SetControlSurfaceLevel ( AIRCTRL\_TYPE *type*, double *level*, bool *direct* ) const**

Updates the position of an aerodynamic control surface.

## Parameters

<i>type</i>	control surface type (see <a href="#">Aerodynamic control surface types</a> )
<i>level</i>	new control surface position [-1...+1]
<i>direct</i>	application mode

## Note

If parameter *direct*==*true* then the specified level is applied directly, bypassing any reaction delays defined for the control surface.

If parameter *direct*==*false* then this method is equivalent to [SetControlSurfaceLevel\(AIRCTRL\\_TYPE, double\)const](#).

Bypassing the response delay can be useful for debugging autopilots etc. but should be avoided in production code, since it is unphysical. If you want to simulate fast-responding controls, create the surface with a small delay setting instead.

## See also

[SetControlSurfaceLevel\(AIRCTRL\\_TYPE, double\)const](#), [CreateControlSurface3](#)

17.57.3.281 void VESSEL::SetCrossSections ( const VECTOR3 & *cs* ) const

Defines the vessel's cross-sectional areas, projected in the directions of the vessel's principal axes.

## Parameters

<i>cs</i>	vector of cross-sectional areas of the vessel's projection along the x-axis into yz-plane, along the y-axis into the xz-plane, and along the z-axis into the xy plane, respectively [ $\text{m}^2$ ].
-----------	---

## See also

[GetCrossSections](#)

17.57.3.282 void VESSEL::SetCW ( double *cw\_z\_pos*, double *cw\_z\_neg*, double *cw\_x*, double *cw\_y* ) const

Set the vessel's wind resistance coefficients along its axis directions.

## Parameters

<i>cw_z_pos</i>	coefficient in positive z direction (forward)
<i>cw_z_neg</i>	coefficient in negative z direction (back)
<i>cw_x</i>	coefficient in lateral direction (left/right)
<i>cw_y</i>	coefficient in vertical direction (up/down)

## Note

**[Legacy aerodynamic flight model only]**

The cw coefficients are only used by the legacy flight model (if no airfoils are defined). In the presence of airfoils, drag calculations are performed on the basis of the airfoil parameters.

The first value (*cw\_z\_pos*) is the coefficient used if the vessel's airspeed z-component is positive (vessel moving forward). The second value is used if the z-component is negative (vessel moving backward).

Lateral and vertical components are assumed symmetric.

## See also

[GetCW](#), [CreateAirfoil](#)

17.57.3.283 void VESSEL::SetDefaultPropellantResource ( PROPELLANT\_HANDLE *ph* ) const

Define a "default" propellant resource.

This is used for the various legacy fuel-related API functions, and for the "Fuel" indicator in the generic panel-less HUD display.

## Parameters

<i>ph</i>	propellant resource handle
-----------	----------------------------

## Note

If this function is not called, the first propellant resource is used as default.

## See also

[CreatePropellantResource](#), [GetDefaultPropellantResource](#)

17.57.3.284 void VESSEL::SetDockMode ( int *mode* ) const

Set the docking approach mode for all docking ports.

## Parameters

<i>mode</i>	docking mode (see notes)
-------------	--------------------------

## Note

Defines the method Orbiter applies to establish a docking connection between two vessels. Supported values are:

- 0: use legacy (2006) method: snap to dock as soon as two docking ports are within 0.5m and closing.
- 1 (default): use new (2010) method: snap to dock as soon as one docking reference point passes through the reference plane of the other dock within 0.5m.

If the two docking vessels use different docking modes, the method used is unpredictable, depending on which vessel initiates the docking event.

17.57.3.285 void VESSEL::SetDockParams ( const VECTOR3 & *pos*, const VECTOR3 & *dir*, const VECTOR3 & *rot* ) const

Set the parameters for the vessel's primary docking port (port 0), or create a new dock if required.

## Parameters

<i>pos</i>	dock reference position in vessel coordinates [m]
<i>dir</i>	approach direction in vessel coordinates
<i>rot</i>	longitudinal rotation alignment vector

## Note

This function creates a new docking port if none was previously defined.

See [CreateDock](#) for additional notes on the parameters.

## See also

[SetDockParams\(DOCKHANDLE,const VECTOR3&,const VECTOR3&,const VECTOR3&\)const](#), [GetDockParams](#), [CreateDock](#), [DelDock](#), [DockCount](#), [Dock](#), [Undock](#)

17.57.3.286 void VESSEL::SetDockParams ( DOCKHANDLE *hDock*, const VECTOR3 & *pos*, const VECTOR3 & *dir*, const VECTOR3 & *rot* ) const

Reset the parameters for a vessel docking port.

## Parameters

<i>hDock</i>	dock handle
<i>pos</i>	new dock reference position [m]
<i>dir</i>	new approach direction
<i>rot</i>	new longitudinal rotation alignment vector

## Note

This function should not be called while the docking port is engaged.  
The *dir* and *rot* direction vectors should be normalised to length 1.

## See also

[SetDockParams\(const VECTOR3&,const VECTOR3&,const VECTOR3&\)](#), [const, GetDockParams, CreateDock, DelDock, DockCount, Dock, Undock](#)

**17.57.3.287** `bool VESSEL::SetElements ( OBJHANDLE hRef, const ELEMENTS & el, ORBITPARAM * prm = 0, double mjd_ref = 0, int frame = FRAME_ECL ) const`

Set vessel state (position and velocity) by means of a set of osculating orbital elements.

## Parameters

<i>hRef</i>	reference body handle
<i>el</i>	set of elements to be applied
<i>prm</i>	secondary orbital parameters
<i>mjd_ref</i>	reference date (in Modified Julian Date format) to which the <i>el.L</i> (mean longitude) value refers
<i>frame</i>	orientation of reference frame (see notes)

## Returns

If the vessel position resulting from applying the elements would be located below the surface of the reference body, the method does nothing and returns false. Otherwise it returns true.

## Note

This method resets the vessel's position and velocity according to the specified orbital elements.  
If the *prm* pointer is not set to NULL, the [ORBITPARAM](#) structure it points to will be filled with secondary orbital parameters derived from the primary elements *el*. Note that this is an output parameter, i.e. the resulting vessel state will not be influenced by initialising this structure prior to the function call.  
All parameters returned in the *prm* structure refer to the current date, rather than the reference date *mjd\_ref*. Therefore, the values of *el.L* and *prm->MnL* can be different.  
The elements can be supplied either in terms of the ecliptic frame (*frame* = FRAME\_ECL) or in the equatorial frame of the reference body (*frame* = FRAME\_EQU).  
*mjd\_ref* is an input parameter which defines the date to which the *el.L* (mean longitude) value refers. An exception is *mjd\_ref* = 0, which is interpreted as the current time (equivalent to *mjd\_ref* = [oapiGetSimMJD\(\)](#) ). Calling *SetElements* will always put a vessel in freeflight mode, even if it had been landed before.  
Currently, *SetElements* doesn't check for validity of the provided elements. Setting invalid elements, or elements which put the vessel below a planetary surface will produce undefined results.

## See also

[Basics of orbital mechanics, ELEMENTS, ORBITPARAM, GetElements\(ELEMENTS&,double&\)](#), [const, GetElements\(OBJHANDLE,ELEMENTS&,ORBITPARAM\\*,double,int\)](#)

**17.57.3.288** `void VESSEL::SetEmptyMass ( double m ) const`

Set the vessel's empty mass (excluding propellants).

## Parameters

<i>m</i>	vessel empty mass [kg].
----------	-------------------------

## Note

The empty mass combines all parts of the vessel except propellant resources defined via `CreatePropellantResource`.

Use `SetEmptyMass` to account for structural changes such as stage or booster separation, but not for fuel consumption, which is done directly by Orbiter.

## See also

[GetEmptyMass](#), [SetMassDistribution](#), [oapiSetEmptyMass](#), [CreatePropellantResource](#)

17.57.3.289 void VESSEL::SetEnableFocus ( bool *enable* ) const

Enable or disable the vessel's ability to receive the input focus.

## Parameters

<i>enable</i>	focus enabled status: true to allow the vessel to receive input focus, false otherwise.
---------------	---

## Note

The initial state is defined by the `EnableFocus` setting in the vessel's configuration file. If the entry is missing, the default is true.

If the input focus of the current focus vessel is disabled, it will continue to receive user input, until the focus is switched to another vessel.

Focus-enabled vessels can be selected by the user via the jump vessel dialog (F3).

Once a vessel has received the input focus, all user input via keyboard, mouse and joystick is directed to this vessel.

For some object types, such as jettisoned rocket stages, enabling input focus may not be useful.

## See also

[GetEnableFocus](#), [clbkFocusChanged](#), [oapiGetFocusObject](#), [oapiSetFocusObject](#)

17.57.3.290 void VESSEL::SetEngineLevel ( ENGINETYPE *eng*, double *level* ) const

Set the thrust level for an engine group.

**Deprecated** This method has been replaced by [VESSEL::SetThrusterGroupLevel](#).

## Parameters

<i>eng</i>	engine group identifier
<i>level</i>	thrust level [0..1]

## See also

[SetThrusterGroupLevel](#), [IncEngineLevel](#)

17.57.3.291 void VESSEL::SetExhaustScales ( EXHAUSTTYPE *exh*, WORD *id*, double *lscale*, double *wscale* ) const

**Deprecated** This method no longer performs any action. It has been replaced by the [VESSEL::AddExhaust](#) methods.

## See also

[AddExhaust\(THRUSTER\\_HANDLE,double,double,SURFHANDLE\)const](#), [AddExhaust\(THRUSTER\\_HANDLE,double,double,double,SURFHANDLE\)const](#), [AddExhaust\(THRUSTER\\_HANDLE,double,double,const VECTOR3&,const VECTOR3&,SURFHANDLE\)const](#)

17.57.3.292 void VESSEL::SetFuelMass ( double *mass* ) const

Reset the current mass of the vessel's default propellant resource.

## Parameters

<i>mass</i>	new propellant mass [kg].
-------------	---------------------------

## Note

mass must be between 0 and the maximum capacity of the propellant resource.  
If the vessel has not defined any propellant resources, this method has no effect.

## See also

[GetFuelMass](#), [SetPropellantMass](#), [SetMaxFuelMass](#), [SetDefaultPropellantResource](#)

17.57.3.293 void VESSEL::SetGlobalOrientation ( const VECTOR3 & *arot* ) const

Sets the vessel's orientation via Euler angles.

## Parameters

<i>arot</i>	vector containing the set of Euler angles [rad]
-------------	---

## Note

Given the rotation matrix **R** which transforms from the local (vessel) frame to the global (ecliptic) reference frame, the Euler angles expected by this method are defined as

$$\begin{aligned}\alpha &= \text{atan2}(R_{23}, R_{33}) \\ \beta &= -\text{asin}(R_{13}) \\ \gamma &= \text{atan2}(R_{12}, R_{11})\end{aligned}$$

## See also

[GetGlobalOrientation](#), [SetRotationMatrix](#)

17.57.3.294 bool VESSEL::SetGravityGradientDamping ( double *damp* ) const

Sets the vessel's damping coefficient for gravity field gradient-induced torque.

## Parameters

<i>damp</i>	Torque damping coefficient.
-------------	-----------------------------

## Returns

true if damping coefficient was applied, false if gravity gradient torque is disabled.

## Note

For a definition of the torque experienced by the vessel in an inhomogeneous gravity field, and the damping term that can be applied, see [GetGravityGradientDamping](#).

If gravity gradient torque has been disabled in the launchpad dialog, this function returns false and has no other effect.

## See also

[GetGravityGradientDamping](#), [SetEmptyMass](#), [SetPMI](#)

17.57.3.295 void VESSEL::SetHoverHoldAltitude ( double *alt*, bool *terrainalt* )

Set the target altitude for the hover hold altitude program and activate the program.

## Parameters

<i>alt</i>	target altitude [m]
<i>terrainalt</i>	true: hold true altitude; false: hold altitude relative to mean planet radius

## Note

If the hold hover altitude program is already active, the target altitude is modified. Otherwise, the program is activated with the specified target altitude.

This method is more versatile than `ActivateNavmode(NAVMODE_HOLDALT)`, which sets the target altitude to the current altitude at activation, and always refers to mean planet radius.

To deactivate the hover hold alt program, use `DeactivateNavmode(NAVMODE_HOLDALT)`

## See also

[GetHoverHoldAltitude](#), [ActivateNavmode](#), [DeactivateNavmode](#)

17.57.3.296 bool VESSEL::SetIDSChannel ( **DOCKHANDLE** *hDock*, **DWORD** *ch* ) const

Switch the channel number of one of the vessel's IDS (Instrument Docking System) transmitters.

## Parameters

<i>hDock</i>	docking port handle
<i>ch</i>	IDS channel [0..639]

## Returns

*false* indicates failure (IDS not enabled or input parameter out of range)

## Note

IDS transmitters can be tuned from 108.00 to 139.95 MHz in steps of 0.05 MHz. The frequency corresponding to a channel number *ch* is given by  $f = (108.0 + 0.05 \cdot ch)$  MHz.

## See also

[EnableIDS](#), [SetTransponderChannel](#), [SetNavChannel](#)

17.57.3.297 void VESSEL::SetISP ( **double** *isp* ) const

Sets the default Isp value for subsequently created thrusters.

## Parameters

<i>isp</i>	fuel-specific impulse [m/s]
------------	-----------------------------

## Note

The Isp value defines the amount of thrust [N] obtained by burning 1 kg of fuel per second.

Resetting the default Isp value affects only thrusters which are created subsequently, and which don't define individual Isp values.

Before the first call to `SetISP`, the initial value is read from the 'Isp' entry of the vessel definition file. If no entry exists, a value of 5e4 is used.

It is recommended to define individual Isp values during thruster creation instead of using `SetISP`.

17.57.3.298 void VESSEL::SetLiftCoeffFunc ( **LiftCoeffFunc** *lcf* ) const

Defines the callback function for aerodynamic lift calculation.

## Parameters

<i>lcf</i>	pointer to callback function (see notes)
------------	--

## Note

**[Legacy aerodynamic flight model only]**

This method defines callback function for lift calculation as a function of angle of attack for the legacy flight model. If the vessel uses the new flight model (i.e. defines at least one airfoil), then this value is ignored, and the airfoil parameters are used instead.

The interface of the callback function is defined as

```
typedef double (*LiftCoeffFunc)(double aoa)
```

where *aoa* is the angle of attack [rad], and the return value is the resulting lift coefficient.

The callback function must be able to process input *aoa* values in the range  $-\pi \dots +\pi$ .

The preferred method for defining lift and drag characteristics is via the `CreateAirfoil` method, which is much more versatile. Orbiter ignores the `SetLiftCoeffFunc` function if any airfoils have been created.

If neither airfoils are defined, nor this method is called, then the default behaviour is not to generate any aerodynamic lift.

## See also

[CreateAirfoil](#)

**17.57.3.299 void VESSEL::SetMaxFuelMass ( double *mass* ) const**

Set the maximum fuel capacity of the vessel's default propellant resource.

## Parameters

<i>mass</i>	max. propellant mass [kg].
-------------	----------------------------

## Note

If no propellant resources are defined for the vessel, a call to this method creates a new propellant resource with the specified capacity.

If the vessel already contains propellant resources, this method resets the maximum capacity of the vessel's default resource.

## See also

[SetPropellantMaxMass](#), [SetDefaultPropellantResource](#)

**17.57.3.300 void VESSEL::SetMaxWheelbrakeForce ( double *f* ) const**

Define the maximum force which can be provided by the vessel's wheel brake system.

## Parameters

<i>f</i>	maximum force [N]
----------	-------------------

## See also

[SetWheelbrakeLevel](#), [GetWheelbrakeLevel](#)

**17.57.3.301 void VESSEL::SetMeshVisibilityMode ( UINT *idx*, WORD *mode* ) const**

Set the visibility flags for a vessel mesh.

## Parameters

<i>idx</i>	mesh index ( $\geq 0$ )
<i>mode</i>	visibility mode flags (see <a href="#">Vessel mesh visibility flags</a> )

## Note

This method can be used to specify if a mesh is visible in particular camera modes. Some meshes may only be visible in external views, while others should only be visible in cockpit views.

Turning off the unnecessary rendering of meshes can improve the performance of the simulator.

*mode* can be a combination of the [Vessel mesh visibility flags](#).

The default mode after adding a mesh is MESHVIS\_EXTERNAL.

MESHVIS\_EXTPASS can't be used on its own, but as a modifier to any of the other visibility modes. If specified, it forces the mesh to be rendered in Orbiter's external render pass, even if it is labelled as internal (e.g. MESHVIS\_COCKPIT or MESHVIS\_VC). The significance of the external render pass is that it allows the mesh to be obscured by other objects in front of it. However, objects in the external render pass are clipped at a camera distance of 2.5m. Meshes that are rendered during the internal pass always cover all other objects, and have a smaller clipping distance.

Use the MESHVIS\_EXTPASS modifier for parts of the vessel that are visible from the cockpit, but are not close to the camera and may be obscured by other objects. An example is the Shuttle payload bay, which can be covered by payload objects.

## See also

[GetMeshVisibilityMode](#), [Vessel mesh visibility flags](#)

17.57.3.302 void VESSEL::SetMeshVisibleInternal ( *UINT idx*, *bool visible* ) const

Marks a mesh as visible from internal cockpit view.

## Parameters

<i>idx</i>	mesh index ( $\geq 0$ )
<i>visible</i>	visibility flag

**Deprecated** This method is obsolete and has been replaced by [VESSEL::SetMeshVisibilityMode](#).

## Note

By default, a vessel is not rendered when the camera is in internal (cockpit) view. This function can be used to force rendering of some or all of the vessel's meshes.

## See also

[SetMeshVisibilityMode](#)

17.57.3.303 bool VESSEL::SetNavChannel ( *DWORD n*, *DWORD ch* ) const

Sets the channel of a NAV radio receiver.

## Parameters

<i>n</i>	receiver index ( $\geq 0$ )
<i>ch</i>	channel ( $\geq 0$ )

## Returns

*false* on error (receiver index or channel out of range), *true* otherwise

**Note**

NAV radios can be tuned from 108.00 to 139.95 MHz in steps of 0.05 MHz, corresponding to channels 0 to 639.

**See also**

[InitNavRadios](#), [GetNavChannel](#)

**17.57.3.304 bool VESSEL::SetNavRecv ( DWORD *n*, DWORD *ch* ) const**

Sets the channel of a NAV radio receiver.

**Deprecated** This method has been replaced by [VESSEL::SetNavChannel](#)

**Parameters**

<i>n</i>	receiver index ( $\geq 0$ )
<i>ch</i>	channel ( $\geq 0$ )

**Returns**

*false* on error (index out of range), *true* otherwise

**17.57.3.305 void VESSEL::SetNosewheelSteering ( bool *activate* ) const****Parameters**

<i>activate</i>	<i>true</i> to activate, <i>false</i> to deactivate
-----------------	---

**Note**

With nose-wheel steering active, the yaw controls will apply a lateral force on the front touchdown-point when in ground contact.

By default, nose-wheel steering is inactive. This function should only be called for appropriate vessel types.

**See also**

[GetNosewheelSteering](#)

**17.57.3.306 void VESSEL::SetPitchMomentScale ( double *scale* ) const**

Sets the scaling factor for the pitch moment.

**Parameters**

<i>scale</i>	scale factor for pitch moment
--------------	-------------------------------

**Note**

The pitch moment is the angular moment around the vessel's lateral (x) axis occurring in atmospheric flight. It works toward reducing the pitch angle (angle of attack) between the vessel's longitudinal axis and the airstream vector.

The larger the scaling factor, the stronger the effect becomes ("stiff handling")

This value is only used with the old aerodynamic flight model, i.e. if not airfoils have been defined.

The default value is 0.

**See also**

[GetPitchMomentScale](#), [SetYawMomentScale](#), [CreateAirfoil](#)

**17.57.3.307 void VESSEL::SetPMI ( const VECTOR3 & *pmi* ) const**

Set the vessel's mass-normalised principal moments of inertia (PMI).

## Parameters

<i>pmi</i>	pmi Diagonal elements of the vessel's inertia tensor [ $\text{m}^2$ ]
------------	---

## Note

The inertia tensor describes the behaviour of a rigid body under angular acceleration. For more information and a definition of the PMI values, see [GetPMI](#).

## See also

[GetPMI](#)

17.57.3.308 void VESSEL::SetPropellantEfficiency ( PROPELLANT\_HANDLE *ph*, double *efficiency* ) const

Reset the efficiency factor of a fuel resource.

## Parameters

<i>ph</i>	propellant resource handle
<i>efficiency</i>	fuel efficiency factor ( $> 0$ )

## Note

The fuel efficiency rating, together with a thruster's Isp rating, determines how much fuel is consumed per second to obtain a given thrust:  $R = F/(e \text{ Isp})$  with fuel rate  $R$  [ $\text{kg/s}$ ], thrust  $F$  [ $\text{N}$ ], efficiency  $e$  and fuel-specific impulse Isp [ $\text{m/s}$ ].

## See also

[GetPropellantEfficiency](#), [CreatePropellantResource](#), [SetPropellantMaxMass](#), [SetPropellantMass](#)

17.57.3.309 void VESSEL::SetPropellantMass ( PROPELLANT\_HANDLE *ph*, double *mass* ) const

Reset the current mass of a propellant resource.

## Parameters

<i>ph</i>	propellant resource handle
<i>mass</i>	propellant mass ( $>= 0$ ) [ $\text{kg}$ ]

## Note

$0 \leq \text{mass} \leq \text{maxmass}$  is required, where maxmass is the maximum capacity of the propellant resource. This method should be used to simulate refuelling, fuel leaks, cross-feeding between tanks, etc. but not for normal fuel consumption by thrusters (which is handled internally by the Orbiter core).

## See also

[GetPropellantMass](#), [SetPropellantMaxMass](#), [GetTotalPropellantMass](#), [GetFuelMass](#), [SetPropellantEfficiency](#)

17.57.3.310 void VESSEL::SetPropellantMaxMass ( PROPELLANT\_HANDLE *ph*, double *maxmass* ) const

Reset the maximum capacity of a fuel resource.

## Parameters

<i>ph</i>	propellant resource handle
<i>maxmass</i>	max. fuel capacity ( $\geq 0$ ) [kg]

## Note

The actual fuel mass contained in the tank is not affected by this function, unless the new maximum propellant mass is less than the current fuel mass, in which case the fuel mass is reduced to the maximum capacity.

## See also

[GetPropellantMaxMass](#), [SetPropellantMass](#), [GetPropellantMass](#), [GetTotalPropellantMass](#), [GetFuelMass](#), [SetPropellantEfficiency](#)

**17.57.3.311 void VESSEL::SetReentryTexture ( SURFHANDLE *tex*, double *plimit* =  $6e7$ , double *lscale* = 1.0, double *wscale* = 1.0 ) const**

Select a previously registered texture to be used for rendering reentry flames.

## Parameters

<i>tex</i>	texture handle
<i>plimit</i>	friction power limit
<i>lscale</i>	texture length scaling factor
<i>wscale</i>	texture width scaling factor

## Note

The texture handle is obtained by a previous call to [oapiRegisterReentryTexture](#).  
If a custom texture is not explicitly set, Orbiter uses a default texture (reentry.dds) for rendering reentry flames.  
To suppress reentry flames altogether for a vessel, call [SetReentryTexture\(NULL\)](#).

## See also

[oapiRegisterReentryTexture](#)

**17.57.3.312 void VESSEL::SetRotationMatrix ( const MATRIX3 & *R* ) const**

Applies a rotation by replacing the vessel's local to global rotation matrix.

## Parameters

<i>R</i>	rotation matrix
----------	-----------------

## Note

The rotation matrix maps from the orientation of the vessel's local frame of reference to the orientation of the global frame (ecliptic at 2000.0).  
The user is responsible for providing a valid rotation matrix. The matrix must be orthogonal and normalised: the norms of all column vectors of *R* must be 1, and scalar products between any column vectors must be 0.

## See also

[GetRotationMatrix](#), [Local2Global](#)

**17.57.3.313 void VESSEL::SetRotDrag ( const VECTOR3 & *rd* ) const**

Set the vessel's atmospheric rotation resistance coefficients.

## Parameters

<i>rd</i>	drag coefficients for rotation around the 3 vessel axes
-----------	---

## Note

*rd* contains the components  $r_{x,y,z}$  against rotation around the local vessel axes in atmosphere, where angular deceleration due to atmospheric friction is defined as  $a_{x,y,z} = -w_{x,y,z} q S_y r_{x,y,z}$  with angular velocity  $w$ , dynamic pressure  $q$  and reference surface  $S_y$ , defined by the vessel's cross section projected along the vertical (y) axis.

## See also

[GetRotDrag](#)

17.57.3.314 void VESSEL::SetSize ( double *size* ) const

Set the vessel's mean radius.

## Parameters

<i>size</i>	vessel mean radius [m].
-------------	-------------------------

## Note

The size should correspond to the vessel's visual representation, for example the mesh used to show the vessel in the simulation window.

The size parameter is used by Orbiter to determine the camera distance at which the vessel is within visual range of the observer camera. It is also used for calculating various physical parameters.

If SetSize is not called during the vessel setup, the value from the Size entry in the vessel's configuration file is used.

## See also

[GetSize](#)

17.57.3.315 void VESSEL::SetSurfaceFrictionCoeff ( double *mu\_Ing*, double *mu\_Lat* ) const

Set friction coefficients for ground contact.

## Parameters

<i>mu_Ing</i>	friction coefficient in longitudinal direction.
<i>mu_Lat</i>	friction coefficient in lateral direction.

## Note

The coefficients of surface friction define the deceleration forces during sliding or rolling over a surface.  $\mu_{\leftarrow}$  is the coefficient acting in longitudinal (forward) direction,  $\mu_{\perp}$  the coefficient acting in lateral (sideways) direction. The friction forces are proportional to the coefficient and the weight of the vessel:

$$\mathbf{F}_{\text{friction}} = \mu \mathbf{G}$$

The higher the coefficient, the faster the vessel will come to a halt.

Typical parameters for a spacecraft equipped with landing wheels would be  $\mu_{\text{Ing}} = 0.1$  and  $\mu_{\text{Lat}} = 0.5$ . If the vessel hasn't got wheels,  $\mu_{\text{Ing}} = 0.5$ .

The coefficients should be adjusted for belly landings when the landing gear is retracted.

The longitudinal and lateral directions are defined by the touchdown points:

$$\mathbf{s}_{\text{Ing}} = \mathbf{p}_0 - (\mathbf{p}_1$$

$$\cdot \mathbf{p}_2)/2, \quad \mathbf{s}_{\text{Lat}} = \mathbf{p}_2 - \mathbf{p}_1$$

## See also

[SetTouchdownPoints](#)**17.57.3.316 void VESSEL::SetThrusterDir ( **THRUSTER\_HANDLE** *th*, **const VECTOR3 &** *dir* ) const**

Reset the force direction of a thruster.

## Parameters

<i>th</i>	thruster handle
<i>dir</i>	new thrust direction (vessel frame of reference)

## Note

This method can be used to realise a tilt of the rocket motor (e.g. for implementing a thruster gimbal mechanism)

## See also

[GetThrusterDir](#), [CreateThruster](#), [SetThrusterRef](#)**17.57.3.317 void VESSEL::SetThrusterGroupLevel ( **THGROUP\_HANDLE** *thg*, **double** *level* ) const**

Sets the thrust level for all thrusters in a group.

## Parameters

<i>thg</i>	thruster group identifier
<i>level</i>	new thrust level (range 0-1)

## See also

[SetThrusterGroupLevel\(THGROUP\\_TYPE,double\)const](#)**17.57.3.318 void VESSEL::SetThrusterGroupLevel ( **THGROUP\_TYPE** *thgt*, **double** *level* ) const**

Sets the thrust level for all thrusters in a standard group.

## Parameters

<i>thgt</i>	thruster group type (see <a href="#">Thruster and thruster-group parameters</a> )
<i>level</i>	new thrust level (range 0-1)

## Note

This method can only be used with standard thruster group types. Do not use with THGROUP\_USER.

## See also

[SetThrusterGroupLevel \(THGROUP\\_HANDLE,double\)const](#)**17.57.3.319 void VESSEL::SetThrusterIsp ( **THRUSTER\_HANDLE** *th*, **double** *isp* ) const**

Reset the fuel-specific impulse (isp) rating of a thruster, assuming no pressure dependence.

## Parameters

<i>th</i>	thruster handle
<i>isp</i>	new Isp rating [m/s]

## Note

The Isp value correlates the propellant mass flow rate  $dm/dt$  with the resulting thrust force  $F$ :  $F = Isp (dm/dt)$ . In the engineering literature, fuel-specific impulse is sometimes given in units of time, by dividing the Isp as defined above by the gravitational acceleration  $1g = 9.81 \text{ m/s}^2$ .

The specified Isp value is assumed to be independent of ambient atmospheric pressure. To define a pressure-dependent Isp value, use [SetThrusterIsp\(THRUSTER\\_HANDLE,double,double,double\)const](#).

## See also

[SetThrusterIsp\(THRUSTER\\_HANDLE,double,double,double\)const](#),  
[GetThrusterIsp\(THRUSTER\\_HANDLE\)const](#),  
[GetThrusterIsp\(THRUSTER\\_HANDLE,double\)const](#), [GetThrusterIsp0](#),  
[CreateThruster](#)

**17.57.3.320 void VESSEL::SetThrusterIsp ( THRUSTER\_HANDLE *th*, double *isp0*, double *isp\_ref*, double *p\_ref* = 101.4e3 ) const**

Reset the fuel-specific impulse (Isp) rating of a thruster including a pressure dependency.

## Parameters

<i>th</i>	thruster handle
<i>isp0</i>	vacuum Isp rating [m/s]
<i>isp_ref</i>	Isp rating at ambient pressure <i>p_ref</i> [m/s]
<i>p_ref</i>	reference pressure [Pa] for <i>isp_ref</i> (defaults to Earth sea level pressure)

## Note

See [SetThrusterIsp\(THRUSTER\\_HANDLE,double\)const](#) for a definition of the relationship between Isp, thrust and fuel mass flow rate.

## See also

[SetThrusterIsp\(THRUSTER\\_HANDLE,double\)const](#),  
[GetThrusterIsp\(THRUSTER\\_HANDLE\)const](#),  
[GetThrusterIsp\(THRUSTER\\_HANDLE,double\)const](#),  
[GetThrusterIsp0](#), [CreateThruster](#)

**17.57.3.321 void VESSEL::SetThrusterLevel ( THRUSTER\_HANDLE *th*, double *level* ) const**

Set thrust level for a thruster.

## Parameters

<i>th</i>	thruster handle
<i>level</i>	thrust level (0...1)

## Note

At level 1 the thruster generates maximum force, as defined by its *maxth* parameter. Certain thrusters are controlled directly by Orbiter via primary input controls (e.g. joystick throttle control for main thrusters), which may override this function.

## See also

[IncThrusterLevel](#), [GetThrusterLevel](#)

17.57.3.322 void VESSEL::SetThrusterLevel\_SingleStep ( **THRUSTER\_HANDLE** *th*, double *level* ) const

Set the thrust level of a thruster for the current time step only.

## Parameters

<i>th</i>	thruster handle
<i>level</i>	thrust level (0...1)

## Note

At level 1 the thruster generates maximum force, as defined by its *maxth* parameter. This method overrides the thruster's permanent thrust level for the current time step only, so it should normally only be used in the body of the [VESSEL2::clbkPreStep\(\)](#) method.

## See also

[SetThrusterLevel](#), [VESSEL2::clbkPreStep\(\)](#)

17.57.3.323 void VESSEL::SetThrusterMax0 ( **THRUSTER\_HANDLE** *th*, **double** *maxth0* ) const

Reset the maximum vacuum thrust rating of a thruster.

## Parameters

<i>th</i>	thruster handle
<i>maxth0</i>	new maximum vacuum thrust rating [N]

## Note

The max. thrust rating in the presence of atmospheric ambient pressure may be lower than the vacuum thrust if a pressure-dependent *Isp* value has been defined.

## See also

[GetThrusterMax0](#), [CreateThruster](#),  
[SetThrusterIsp\(THRUSTER\\_HANDLE,double\)const](#),  
[SetThrusterIsp\(THRUSTER\\_HANDLE,double,double,double\)const](#)

17.57.3.324 void VESSEL::SetThrusterRef ( **THRUSTER\_HANDLE** *th*, **const VECTOR3 &** *pos* ) const

Reset the thrust force attack point of a thruster.

## Parameters

<i>th</i>	thruster handle
<i>pos</i>	new force attack point [m]

## Note

*pos* is specified in the vessel reference system.

This method should be used whenever a thruster has been physically moved in the vessel's local frame of reference.

If the vessel's centre of gravity, i.e. the origin of its reference system, is moved with [ShiftCG\(\)](#), the thruster positions are updated automatically.

The attack point has no influence on the linear force exerted on the vessel by the thruster, but it affects the induced torque.

## See also

[GetThrusterRef](#), [CreateThruster](#), [ShiftCG](#), [SetThrusterDir](#)

17.57.3.325 void VESSEL::SetThrusterResource ( **THRUSTER\_HANDLE** *th*, **PROPELLANT\_HANDLE** *ph* ) const

Connect a thruster to a propellant resource.

## Parameters

<i>th</i>	thruster handle
<i>ph</i>	propellant resource handle

## Note

A thruster can only be connected to one propellant resource at a time. Setting a new resource disconnects from the previous resource.

To disconnect the thruster from its current tank, use *ph* = NULL.

## See also

[GetThrusterResource](#)

17.57.3.326 void VESSEL::SetTouchdownPoints ( const TOUCHDOWNVTX \* *tdvtx*, DWORD *ntdvt* ) const

Defines an arbitrary number of vessel surface contact points.

## Parameters

<i>tdvtx</i>	List of touchdown vertex points
<i>ntdvt</i>	length of touchdown vertex list

## Note

The touchdown points should define the vessel's convex hull that governs the interaction with planetary surfaces on impact.

*ntdvt*  $\geq 3$  is required

In addition to the vertex positions, stiffness and damping parameters can be provided to define the compressibility of individual points, e.g. for simulating gear suspension.

## See also

[GetTouchdownPointCount](#), [GetTouchdownPoint](#)

17.57.3.327 void VESSEL::SetTouchdownPoints ( const VECTOR3 & *pt1*, const VECTOR3 & *pt2*, const VECTOR3 & *pt3* ) const

Defines the three points defining the vessel's ground contact plane.

**Deprecated** This method has been replaced by [VESSEL::SetTouchdownPoints\(const TOUCHDOWNVTX\\*,DW←ORD\)const](#)

## Parameters

<i>pt1</i>	touchdown point of nose wheel (or equivalent)
<i>pt2</i>	touchdown point of left main wheel (or equivalent)
<i>pt3</i>	touchdown point of right main wheel (or equivalent)

## Note

The points are the positions at which the vessel's undercarriage (or equivalent) touches the surface, specified in local vessel coordinates.

The order of points is significant since it defines the direction of the normal. The points should be specified such that the cross product *pt3-pt1*  $\times$  *pt2-pt1* defines the horizon "up" direction for the landed vessel (given a left-handed coordinate system).

Modifying the touchdown points during the simulation while the vessel is on the ground can result in jumps due to instantaneous position changes (infinite acceleration). To avoid this, the

touchdown points should be modified gradually by small amounts over time (proportional to simulation time steps).

This method is retained only for backward compatibility. Vessels should now use [SetTouchdownPoints\(const TOUCHDOWNVTX\\*,DWORD\)const](#) to define a convex hull of touchdown points.

The touchdown stiffness and damping parameters are guessed according to the vessel empty mass. Therefore, SetTouchdownPoints should be called *after* defining the empty vessel mass with SetEmptyMass.

#### See also

[GetTouchdownPoints](#), [GetCOG\\_elev](#), [SetTouchdownPoints\(const TOUCHDOWNVTX\\*, DWORD\)const](#), [SetEmptyMass](#)

### 17.57.3.328 bool VESSEL::SetTransponderChannel ( DWORD *ch* ) const

Switch the channel number of the vessel's transponder.

#### Parameters

<i>ch</i>	transponder channel [0..639]
-----------	------------------------------

#### Returns

*false* indicates failure (transponder not enabled or input parameter out of range)

#### Note

Transponders can be tuned from 108.00 to 139.95 MHz in steps of 0.05 MHz. The frequency corresponding to a channel number *ch* is given by  $f = (108.0 + 0.05 \cdot ch)$  MHz.

#### See also

[EnableTransponder](#), [SetNavChannel](#)

### 17.57.3.329 void VESSEL::SetTrimScale ( double *scale* ) const

Sets the scaling factor for the pitch trim control.

#### Parameters

<i>scale</i>	pitch trim scaling factor
--------------	---------------------------

#### Note

This method is used only in combination with the old flight model, that is, if the vessel doesn't define any airfoils. In the new flight model, this has been replaced by [CreateControlSurface](#) (AIRCTRL\_ELEVATORTRIM, ...). If *scale* is set to zero (default) the vessel does not have a pitch trim control.

#### See also

[GetTrimScale](#), [SetPitchMomentScale](#), [SetYawMomentScale](#), [CreateAirfoil](#), [CreateControlSurface](#)

### 17.57.3.330 void VESSEL::SetVisibilityLimit ( double *vislimit*, double *spotlimit* = -1 ) const

Defines the vessel's range of visibility.

## Parameters

<i>vislimit</i>	apparent size limit for vessel visibility
<i>spotlimit</i>	apparent size limit for vessel "spot" representation.

## Note

This function can be used to define the distance up to which a vessel is visible, independent of screen resolution.

The *vislimit* value is the limiting apparent size (as a fraction of the render window vertical) up to which the vessel is regarded visible. Thus, the vessel is visible if the following condition is satisfied:  $S(d \tan a)^{-1} > \text{vislimit}$  where  $S$  is the vessel size,  $d$  is its camera distance, and  $a$  is the camera aperture.

If the defined visibility limit exceeds the distance at which the vessel can be rendered as a mesh at the given screen resolution, it will simply be represented by a circular spot whose size is reduced linearly (to reach zero at the limiting distance).

If the vessel is to be visible beyond its geometric size (e.g. due to light beacons etc.) then the *spotlimit* value can be used to define the limiting distance due to the vessel's geometry, while *vislimit* defines the total visibility range including all enhancing factors such as beacons.

*spotlimit*  $\leq$  *vislimit* is required. If *spotlimit*  $< 0$  (default), then *spotlimit* = *vislimit* is assumed.

If *SetVisibilityLimit* is not called, then the default value is *vislimit* = *spotlimit* = 1e-3.

## See also

[SetSize](#), [SetClipRadius](#)

17.57.3.331 void VESSEL::SetWheelbrakeLevel ( double *level*, int *which* = 0, bool *permanent* = true ) const

Apply the wheel brake.

## Parameters

<i>level</i>	wheelbrake level [0..1]
<i>which</i>	0 = both, 1 = left, 2 = right main gear
<i>permanent</i>	<i>true</i> sets the level permanently, <i>false</i> only applies to current time step

## See also

[SetMaxWheelbrakeForce](#), [GetWheelbrakeLevel](#)

17.57.3.332 void VESSEL::SetWingAspect ( double *aspect* ) const

Set the wing aspect ratio (wingspan<sup>2</sup> / wing area)

## Parameters

<i>aspect</i>	wing aspect ratio
---------------	-------------------

## Note

**[Legacy aerodynamic flight model only]**

This function defines the wing aspect ratio for the legacy flight model. If the vessel uses the new flight model (i.e. defines at least one airfoil), then this value is ignored, and the airfoil parameters are used instead.

The aspect ratio is used in the calculation of induced drag.

## See also

[GetWingAspect](#), [SetWingEffectiveness](#), [CreateAirfoil](#)

17.57.3.333 void VESSEL::SetWingEffectiveness ( double *eff* ) const

Set the wing form factor for aerodynamic lift and drag calculations.

## Parameters

<i>eff</i>	wing form factor
------------	------------------

## Note

**[Legacy aerodynamic flight model only]**

This function defines the wing form factor for the legacy flight model. If the vessel uses the new flight model (i.e. defines at least one airfoil), then this value is ignored, and the airfoil parameters are used instead.

The form factor, together with the aspect ratio, determines the amount of induced drag for given lift. Higher values of the form factor result in lower drag.

Typical values for *eff* are: ~3.1 for elliptic wings, ~2.8 for tapered wings, ~2.5 for rectangular wings.

## See also

[GetWingEffectiveness](#), [SetWingAspect](#), [CreateAirfoil](#)

17.57.3.334 void VESSEL::SetYawMomentScale ( double *scale* ) const

Sets the scaling factor for the yaw moment.

## Parameters

<i>scale</i>	scale factor for yaw angle moment.
--------------	------------------------------------

## Note

The yaw moment is the angular moment around the vessel's vertical (y) axis occurring in atmospheric flight. It works toward reducing the slip angle between the vessel's longitudinal axis and the airstream vector.

This value is only used with the old aerodynamic flight model, i.e. if not airfoils have been defined.

The default value is 0.

## See also

[SetPitchMomentScale](#), [GetYawMomentScale](#), [CreateAirfoil](#)

17.57.3.335 void VESSEL::ShiftCentreOfMass ( const VECTOR3 & *shift* )

Register a shift in the centre of mass after a structural change (e.g. stage separation).

## Parameters

<i>shift</i>	centre of mass displacement vector [ <b>m</b> ]
--------------	---

## Note

This function should be called after a vessel has undergone a structural change which resulted in a shift of the vessel's centre of gravity (CG). Note that in Orbiter, a vessel's CG coincides by definition always with the origin (0,0,0) of its local reference frame. Therefore, in order to achieve a shift of the CG by a vector **S**, this function shifts the vessel's global position by +**S**. This allows to shift the meshes by -**S**, thus retaining their global position. The net result is unchanged mesh positions in the global frame, but a shift of the local frame of reference (and thus CG) of +**S**.

The camera position is shifted to take into account the new CG. An external camera view performs a smooth transition.

The shift of meshes (and any other reference positions defined in the local vessel frame, such as docking ports, etc.) is not performed by this function but must be executed separately. A more convenient way to implement a transition of the centre of mass is the function [ShiftCG](#), which automatically takes care of translating meshes, docking ports, etc.

## See also

[ShiftCG](#)

**17.57.3.336 void VESSEL::ShiftCG ( const VECTOR3 & *shift* )**

Shift the centre of gravity of a vessel.

## Parameters

<i>shift</i>	centre of gravity displacement vector [ <b>m</b> ]
--------------	--

## Note

This function should be called after a vessel has undergone a structural change which resulted in a shift of the vessel's centre of gravity (CG). Note that in Orbiter, a vessel's CG coincides by definition always with the origin (0,0,0) of its local reference frame. Therefore, in order to achieve a shift of the CG by *shift*, this function performs the following actions:

- Calls [ShiftCentreOfMass](#) (+shift) to align the vessel's global position with the new CG position.
- Calls [ShiftMeshes](#) (-shift) to compensate the mesh positions
- Applies equivalent shift to all
  - thruster positions,
  - docking ports,
  - attachment points,
  - explicitly defined light source positions,
  - and to the cockpit camera position

The net effect is a shift of the vessel frame of reference (and thus the CG by +shift, while the mesh positions remain in place in the global frame).

## See also

[ShiftCentreOfMass](#), [ShiftMeshes](#)

17.57.3.337 bool VESSEL::ShiftMesh ( *UINT idx*, *const VECTOR3 & ofs* ) const

Shift the position of a mesh relative to the vessel's local coordinate system.

## Parameters

<i>idx</i>	mesh list index ( $\geq 0$ )
<i>ofs</i>	translation vector [ <b>m</b> ]

## Returns

*true* on success, *false* indicates error (index out of range).

## Note

This function does not define an animation (i.e. gradual transition), but resets the mesh position instantly.

## See also

[ShiftMeshes](#), [GetMeshOffset](#)

17.57.3.338 void VESSEL::ShiftMeshes ( *const VECTOR3 & ofs* ) const

Shift the position of all meshes relative to the vessel's local coordinate system.

## Parameters

<i>ofs</i>	translation vector [ <b>m</b> ]
------------	---------------------------------

**Note**

This function is useful when resetting a vessel's centre of gravity, in combination with [ShiftCentreOfMass](#).  
A more convenient way to shift the centre of gravity is a call to [ShiftCG](#).

**See also**

[ShiftMesh](#), [GetMeshOffset](#), [ShiftCentreOfMass](#), [ShiftCG](#)

**17.57.3.339 bool VESSEL::ThrusterGroupDefined ( THGROUP\_TYPE *thgt* ) const**

Indicates if a default thruster group is defined by the vessel.

**Parameters**

<i>thgt</i>	thruster group enumeration type (see <a href="#">Thruster and thruster-group parameters</a> )
-------------	---

**Returns**

*true* if the group contains any thrusters, *false* otherwise.

**Note**

This method only works for default groups. Do not use with THGROUP\_USER.  
A group is considered to be "defined" if it contains at least one thruster.

**See also**

[GetGroupThrusterCount](#)

**17.57.3.340 int VESSEL::ToggleAttitudeMode ( ) const**

Switch between linear and rotational RCS mode.

**Returns**

New RCS mode index

**Note**

If the RCS is disabled, this method does nothing and returns 0.  
During playback, this method does nothing and returns the current RCS mode.

**See also**

[SetAttitudeMode](#), [GetAttitudeMode](#)

**17.57.3.341 bool VESSEL::ToggleNavmode ( int *mode* )**

Toggles a navigation mode on/off.

## Parameters

<i>mode</i>	navigation mode identifier (see <a href="#">Navigation mode identifiers</a> )
-------------	---

## Returns

*true* if the specified navigation mode could be changed, *false* if it remains unchanged.

## See also

[Navigation mode identifiers](#), [ActivateNavmode](#), [DeactivateNavmode](#), [GetNavmodeState](#)

17.57.3.342 void VESSEL::TriggerPanelRedrawArea ( int *panel\_id*, int *area\_id* )

Triggers a redraw notification for a panel area.

## Parameters

<i>panel_id</i>	panel identifier ( $>=0$ )
<i>area_id</i>	area identifier ( $>=0$ )

## Note

The redraw notification is ignored if the requested panel is not currently displayed or if the calling vessel does not have the input focus.

## See also

[TriggerRedrawArea](#)

17.57.3.343 void VESSEL::TriggerRedrawArea ( int *panel\_id*, int *vc\_id*, int *area\_id* )

Triggers a redraw notification to either a 2D panel or a virtual cockpit.

## Parameters

<i>panel_id</i>	identifier for the panel to receive the redraw message
<i>vc_id</i>	identifier for the virtual cockpit to receive the redraw message
<i>area_id</i>	area identifier

## Note

This function can be used to combine the functionality of the [TriggerPanelRedrawArea\(\)](#) and [VCTriggerRedrawArea\(\)](#) methods. Depending on the current cockpit mode, Orbiter sends the redraw request to either [ovcPanelRedrawEvent\(\)](#) or [ovcVCRRedrawEvent\(\)](#).

This method can only be used if the panel and virtual cockpit areas share a common area identifier.

If the calling vessel doesn't have input focus (and therefore doesn't own the cockpit display) this method has no effect.

## See also

[TriggerPanelRedrawArea](#)

17.57.3.344 bool VESSEL::Undock ( *UINT n*, const **OBJHANDLE** *exclude* = 0 ) const

Release a docked vessel from a docking port.

**Parameters**

<i>n</i>	docking port index ( $\geq 0$ or ALLDOCKS)
<i>exclude</i>	optional handle of a vessel to be excluded from undocking

**Returns**

*true* if at least one vessel was released from a port.

**Note**

If *n* is set to ALLDOCKS, all docking ports are released simultaneously.

If *exclude* is nonzero, this vessel will not be undocked. This is useful for implementing remote undocking in combination with ALLDOCKS.

**See also**

[Dock](#), [GetDockHandle](#), [GetDockStatus](#), [DockCount](#)

**17.57.3.345 void VESSEL::UnregisterAnimation ( ) const**

Unlogs an animation request.

**Note**

This stops a request for animation callback calls from a previous [RegisterAnimation](#).

The call to [UnregisterAnimation](#) should not be placed in the body of [VESSEL2::clbkAnimate](#), since it may be lost if the vessel's visual doesn't exist.

**See also**

[RegisterAnimation](#), [VESSEL2::clbkAnimate](#)

**17.57.3.346 int VESSEL::Version ( ) const [inline]**

Returns the version number of the vessel interface class.

**Returns**

version number

**Note**

The following interface versions are currently in use:

- class [VESSEL](#): version 0
- class [VESSEL2](#): version 1
- class [VESSEL3](#): version 2

**See also**

[VESSEL2](#), [VESSEL3](#)

The documentation for this class was generated from the following file:

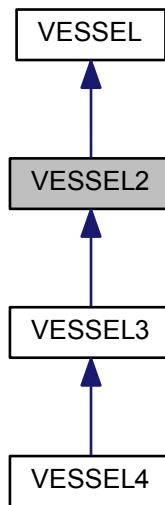
- Orbitersdk/include/[VesselAPI.h](#)

## 17.58 VESSEL2 Class Reference

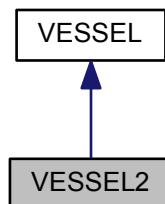
Callback extensions to the [VESSEL](#) class.

```
#include <VesselAPI.h>
```

Inheritance diagram for VESSEL2:



Collaboration diagram for VESSEL2:



### Public Member Functions

- [VESSEL2 \(OBJHANDLE hVessel, int fmodel=1\)](#)  
*Creates a [VESSEL2](#) interface for a vessel object.*
- [virtual void clbkSetClassCaps \(FILEHANDLE cfg\)](#)  
*Initialisation of vessel capabilities.*
- [virtual void clbkSaveState \(FILEHANDLE scn\)](#)  
*Called when the vessel needs to save its current status to a scenario file.*

- virtual void `clbkLoadStateEx` (FILEHANDLE scn, void \*status)  
*Called when the vessel needs to load its initial state from a scenario file.*
- virtual void `clbkSetStateEx` (const void \*status)  
*Set state parameters during vessel creation.*
- virtual void `clbkPostCreation` ()  
*Called after a vessel has been created and its state has been set.*
- virtual void `clbkFocusChanged` (bool getfocus, OBJHANDLE hNewVessel, OBJHANDLE hOldVessel)  
*Called after a vessel gained or lost input focus.*
- virtual void `clbkPreStep` (double simt, double simdt, double mjd)  
*Time step notification before state update.*
- virtual void `clbkPostStep` (double simt, double simdt, double mjd)  
*Time step notification after state update.*
- virtual bool `clbkPlaybackEvent` (double simt, double event\_t, const char \*event\_type, const char \*event)  
*Playback event notification.*
- virtual void `clbkVisualCreated` (VISHANDLE vis, int refcount)  
*Called after a vessel visual has been created by the renderer.*
- virtual void `clbkVisualDestroyed` (VISHANDLE vis, int refcount)  
*Called before a vessel visual is destroyed.*
- virtual void `clbkDrawHUD` (int mode, const HUDPAINTSPEC \*hps, HDC hDC)  
*HUD redraw notification.*
- virtual void `clbkRCSMode` (int mode)  
*Reaction Control System mode change notification.*
- virtual void `clbkADCtrlMode` (DWORD mode)  
*Aerodynamic control surface mode change notification.*
- virtual void `clbkHUDMode` (int mode)  
*HUD mode change notification.*
- virtual void `clbkMFDMode` (int mfd, int mode)  
*MFD mode change modification.*
- virtual void `clbkNavMode` (int mode, bool active)  
*Navigation mode change notification.*
- virtual void `clbkDockEvent` (int dock, OBJHANDLE mate)  
*Docking event notification.*
- virtual void `clbkAnimate` (double simt)  
*Manual animation notification.*
- virtual int `clbkConsumeDirectKey` (char \*kstate)  
*Keyboard status notification.*
- virtual int `clbkConsumeBufferedKey` (DWORD key, bool down, char \*kstate)  
*Keyboard event notification.*
- virtual bool `clbkLoadGenericCockpit` ()  
*Generic cockpit view mode request notification.*
- virtual bool `clbkLoadPanel` (int id)  
*2-D instrument panel view mode request notification*
- virtual bool `clbkPanelMouseEvent` (int id, int event, int mx, int my)  
*Mouse event notification for 2-D panel views.*
- virtual bool `clbkPanelRedrawEvent` (int id, int event, SURFHANDLE surf)  
*Redraw event notification for 2-D panel views.*
- virtual bool `clbkLoadVC` (int id)  
*3-D virtual cockpit view mode request notification*
- virtual bool `clbkVCMouseEvent` (int id, int event, VECTOR3 &p)  
*Mouse event notification for 3-D virtual cockpit views.*
- virtual bool `clbkVCRedrawEvent` (int id, int event, SURFHANDLE surf)  
*Redraw event notification for 3-D virtual cockpit views.*

## Additional Inherited Members

### 17.58.1 Detailed Description

Callback extensions to the [VESSEL](#) class.

The [VESSEL2](#) class adds a variety of callback functions to the [VESSEL](#) interface (clbk\*). These are called by Orbiter to notify the vessel about different types of events and allow it to react to them. The [VESSEL2](#) class implements these as virtual functions which act as placeholders to be overwritten by derived classes whenever a non-default behaviour is required.

#### Examples:

[clbkLoadStateEx.cpp](#), [clbkSetStateEx.cpp](#), and [VESSEL2.cpp](#).

### 17.58.2 Constructor & Destructor Documentation

#### 17.58.2.1 VESSEL2::VESSEL2 ( [OBJHANDLE](#) *hVessel*, [int](#) *fmodel* = 1 )

Creates a [VESSEL2](#) interface for a vessel object.

An instance of a vessel class derived from [VESSEL2](#) is typically called during the initialisation of a vessel module (during ovcInit) to create an interface to the vessel instance controlled by the module. However, a [VESSEL2](#) instance for any existing vessel can be created by any module.

#### Parameters

<i>hVessel</i>	vessel object handle
<i>fmodel</i>	requested level of realism (0=simple, 1=realistic)

#### Note

This function creates an interface to an *existing* vessel. It does not create a new vessel. New vessels are created with the [oapiCreateVessel](#) and [oapiCreateVesselEx](#) functions.

The [VESSEL2](#) interface instance created in ovcInit should be deleted in ovcExit.

#### See also

[oapiCreateVessel](#), [oapiCreateVesselEx](#), [ovcInit](#)

### 17.58.3 Member Function Documentation

#### 17.58.3.1 virtual void VESSEL2::clbkADCtrMode ( [DWORD](#) *mode* ) [virtual]

Aerodynamic control surface mode change notification.

Called when user input mode for aerodynamic control surfaces (elevator, rudder, aileron) changes.

#### Parameters

<i>mode</i>	control mode
-------------	--------------

#### Default action:

None.

#### Note

The returned control mode contains bit flags as follows:

- bit 0: elevator enabled/disabled

- bit 1: rudder enabled/disabled
- bit 2: ailerons enabled/disabled

Therefore, mode=0 indicates control surfaces disabled, mode=7 indicates fully enabled.

#### See also

[The frame update loop and vessel module callback functions](#)

### 17.58.3.2 virtual void VESSEL2::clbkAnimate ( double *simt* ) [virtual]

Manual animation notification.

Called at each simulation time step if the module has registered at least one animation notification request and if the vessel's visual exists.

#### Parameters

<i>simt</i>	simulation time [s]
-------------	---------------------

Default action:

None.

#### Note

This callback allows the module to animate the vessel's visual representation (moving undercarriage, cargo bay doors, etc.)

It is only called as long as the vessel has registered an animation request (between matching [VESSEL::RegisterAnimation](#) and [VESSEL::UnregisterAnimation](#) calls) and if the vessel's visual exists.

This callback is *not* used for the "semi-automatic" animation mechanism ([VESSEL::CreateAnimation](#), [VESSEL::AddAnimationComponent](#))

#### See also

[VESSEL::RegisterAnimation](#), [VESSEL::UnregisterAnimation](#), [VESSEL::CreateAnimation](#), [VESSEL::AddAnimationComponent](#)

### 17.58.3.3 virtual int VESSEL2::clbkConsumeBufferedKey ( DWORD *key*, bool *down*, char \* *kstate* ) [virtual]

Keyboard event notification.

This callback function notifies the vessel of a buffered key event (key pressed or key released).

#### Parameters

<i>key</i>	key scan code (see OAPI_KEY_* constants in <a href="#">OrbiterAPI.h</a> )
<i>down</i>	true if key was pressed, false if key was released
<i>kstate</i>	current keyboard state

#### Returns

The function should return 1 if Orbiter's default processing of the key event should be skipped, 0 otherwise.

Default action:

None, returns 0.

**Note**

The key state (kstate) can be used to test for key modifiers (Shift, Ctrl, etc.). The KEYMOD\_xxx macros defined in [OrbiterAPI.h](#) are useful for this purpose.

This function may be called repeatedly during a single frame, if multiple key events have occurred in the last time step.

**See also**

[clbkConsumeDirectKey](#), The frame update loop and vessel module callback functions

**17.58.3.4 virtual int VESSEL2::clbkConsumeDirectKey ( char \* *kstate* ) [virtual]**

Keyboard status notification.

Called at each simulation time step to allow the module to query the current keyboard status. This callback can be used to install a custom keyboard interface for the vessel.

**Parameters**

<i>kstate</i>	Keyboard state
---------------	----------------

**Returns**

A nonzero return value will completely disable default processing of the key state for the current time step. To disable the default processing of selected keys only, use the RESETKEY macro (see [OrbiterAPI.h](#)) and return 0.

**Default action:**

None, returns 0.

**Note**

The keystate contains the current keyboard state. Use the KEYDOWN macro in combination with the key identifiers as defined in [OrbiterAPI.h](#) (OAPI\_KEY\_\*) to check for particular keys being pressed. Example:

```
if (KEYDOWN (kstate, OAPI_KEY_F10)) {
    // perform action
    RESETKEY (kstate, OAPI_KEY_F10);
    // optional: prevent default processing of the key
}
```

This function should be used where a key state, rather than a key event is required, for example when engaging thrusters or similar. To test for key events (key pressed, key released) use [clbkConsumeBufferedKey\(\)](#) instead.

**See also**

[clbkConsumeBufferedKey](#), The frame update loop and vessel module callback functions

**17.58.3.5 virtual void VESSEL2::clbkDockEvent ( int *dock*, OBJHANDLE *mate* ) [virtual]**

Docking event notification.

Called after a docking or undocking event at one of the vessel's docking ports.

**Parameters**

<i>dock</i>	docking port index
<i>mate</i>	handle to docked vessel, or NULL for undocking event

Default action:

None.

**Note**

*dock* is the index ( $>= 0$ ) of the vessel's docking port at which the docking/undocking event takes place.  
*mate* is a handle to the vessel docking at the port, or NULL to indicate an undocking event.

**17.58.3.6 virtual void VESSEL2::clbkDrawHUD ( int *mode*, const HUDPAINTSPEC \* *hps*, HDC *hDC* ) [virtual]**

HUD redraw notification.

Called when the vessel's head-up display (HUD) needs to be redrawn (usually at each time step, unless the HUD is turned off). Overwriting this function allows to implement vessel-specific modifications of the HUD display (or to suppress the HUD altogether).

**Parameters**

<i>mode</i>	HUD mode (see <code>HUD_*</code> constants in <a href="#">OrbiterAPI.h</a> )
<i>hps</i>	pointer to a <code>HUDPAINTSPEC</code> structure
<i>hDC</i>	GDI drawing device context

Default action:

Draws a standard HUD display with Orbiter's default display layout.

**Deprecated** This method contains a device-dependent drawing context and may not work with all graphics clients.  
 It has been superseded by [VESSEL3::clbkDrawHUD](#).

**Note**

For vessels derived from `VESSEL3` orbiter will not call this method, but will call the `VESSEL3::clbkDrawHUD` method instead. The `VESSEL3` version uses a generic *Sketchpad* drawing context instead of a `HDC`.

**See also**

[VESSEL3::clbkDrawHUD](#), [The frame update loop and vessel module callback functions](#)

**17.58.3.7 virtual void VESSEL2::clbkFocusChanged ( bool *getfocus*, OBJHANDLE *hNewVessel*, OBJHANDLE *hOldVessel* ) [virtual]**

Called after a vessel gained or lost input focus.

**Parameters**

<i>getfocus</i>	true if the vessel gained focus, false if it lost focus
<i>hNewVessel</i>	handle of vessel gaining focus
<i>hOldVessel</i>	handle of vessel losing focus

Default action:

None.

**Note**

Whenever the input focus is switched to a new vessel (e.g. via user selection F3), this method is called for both the vessel losing focus (getfocus=false) and the vessel gaining focus (getfocus=true).

In both calls, hNewVessel and hOldVessel are the vessel handles for the vessel gaining and the vessel losing focus, respectively.

This method is also called at the beginning of the simulation for the initial focus object. In this case hOldVessel is NULL.

**17.58.3.8 virtual void VESSEL2::clbkHUDMode ( int mode ) [virtual]**

HUD mode change notification.

Called after a change of the vessel's HUD (head-up-display) mode.

**Parameters**

<i>mode</i>	new HUD mode
-------------	--------------

**Default action:**

None.

**Note**

For currently supported HUD modes see `HUD_*` constants in [OrbiterAPI.h](#)  
mode `HUD_NONE` indicates that the HUD has been turned off.

**See also**

[Section HUD mode identifiers](#) for a list of default mode identifiers, [The frame update loop and vessel module callback functions](#)

**17.58.3.9 virtual bool VESSEL2::clbkLoadGenericCockpit ( ) [virtual]**

Generic cockpit view mode request notification.

Called when the vessel's generic "glass cockpit" view (consisting of two "floating" [MFD](#) instruments and a HUD, displayed on top of the 3-D render window) is selected by the user pressing F8, or by a function call.

**Returns**

The function should return true if it supports generic cockpit view, false otherwise.

**Default action:**

Sets camera direction to "forward" (0,0,1) and returns true.

**Note**

The generic cockpit view is available for all vessel types by default, unless this function is overwritten to return false.

Only disable the generic view if the vessel supports either 2-D instrument panels (see `clbkLoadPanel`) or a virtual cockpit (see `clbkLoadVC`). If no valid cockpit view at all is available for a vessel, Orbiter will crash.

Even if the vessel supports panels or virtual cockpits, you shouldn't normally disable the generic view, because it provides the best performance on slower computers.

**See also**

[clbkLoadPanel](#), [clbkLoadVC](#), [The frame update loop and vessel module callback functions](#)

**17.58.3.10 virtual bool VESSEL2::clbkLoadPanel ( int *id* ) [virtual]**

2-D instrument panel view mode request notification

Called when Orbiter tries to switch the cockpit view to a 2-D instrument panel.

## Parameters

<i>id</i>	panel identifier ( $\geq 0$ )
-----------	-------------------------------

## Returns

The function should return true if it supports the requested panel, false otherwise.

## Default action:

None, returns false.

## Note

In the body of this function the module should define the panel background bitmap and panel capabilities, e.g. the position of MFDs and other instruments, active areas (mouse hotspots) etc.

A vessel which implements panels must at least support panel id 0 (the main panel). If any panels register neighbour panels (see `oapiSetPanelNeighbours`), all the neighbours must be supported, too.

This is a legacy function. The preferred method is now [VESSEL3::clbkLoadPanel2D](#)

## See also

[VESSEL3::clbkLoadPanel2D](#), [oapiRegisterPanelBackground](#), [oapiRegisterPanelArea](#), [oapiRegisterMFD](#), [clbkLoadGenericCockpit](#), [clbkLoadVC](#)

17.58.3.11 void VESSEL2::clbkLoadStateEx ( FILEHANDLE *scn*, void \* *status* ) [virtual]

Called when the vessel needs to load its initial state from a scenario file.

## Parameters

<i>scn</i>	scenario file handle
<i>status</i>	pointer to VESSELSTATUSx structure ( $x \geq 2$ )

## Default action:

Loads the generic vessel state parameters.

## Note

This callback function allows to read custom vessel status parameters from a scenario file.

The function should define a loop which parses lines from the scenario file via `oapiReadScenario_nextline`.

You should not call the base class `clbkLoadStateEx` to parse generic parameters, because this will skip over any custom scenario entries. Instead, any lines which the module parser does not recognise should be forwarded to Orbiter's default scenario parser via [VESSEL::ParseScenarioLineEx](#).

## See also

[VESSELSTATUS2](#), [ParseScenarioLineEx](#), [oapiReadScenario\\_nextline](#), [The frame update loop and vessel module callback functions](#)

## Examples:

[clbkLoadStateEx.cpp](#).

17.58.3.12 virtual bool VESSEL2::clbkLoadVC ( int *id* ) [virtual]

3-D virtual cockpit view mode request notification

Called when Orbiter tries to switch the cockpit view to a 3-D virtual cockpit mode (for example in response to the user switching cockpit modes with F8).

**Parameters**

<i>id</i>	virtual cockpit identifier ( $\geq 0$ )
-----------	---

**Returns**

true if the vessel supports the requested virtual cockpit, false otherwise.

**Default action:**

None, returning false (i.e. virtual cockpit mode not supported).

**Note**

Multiple virtual cockpit camera positions (e.g. for pilot and co-pilot) can be defined. In this case, the body of clbkLoadVC should examine the value of *id* and set the VC parameters accordingly. Multiple positions are defined by specifying the neighbour positions of the current position via a call to oapiVCSetNeighbours. In the body of this function the module should define **MFD** display targets (with oapiVCRegisterMFD) and other active areas (with oapiVCRegisterArea) for the requested virtual cockpit.

**See also**

[clbkLoadGenericCockpit](#), [clbkLoadPanel](#), [oapiVCSetNeighbours](#), [oapiVCRegisterArea](#), [The frame update loop and vessel module callback functions](#)

**17.58.3.13 virtual void VESSEL2::clbkMFDMode ( int *mfd*, int *mode* ) [virtual]**

**MFD** mode change modification.

Called when the user has switched one of the **MFD** (multi-functional display) instruments to a different display mode.

**Parameters**

<i>mfd</i>	<b>MFD</b> instrument identifier
<i>mode</i>	new <b>MFD</b> mode identifier

**Default action:**

None.

**Note**

This callback function can be used to refresh the **MFD** button labels after the **MFD** mode has changed, or if a mode requires a dynamic label update.

The mode parameter can be one of the **MFD** mode identifiers **MFD\_\*** listed in [OrbiterAPI.h](#), or **MFD\_REF**↔**RESHBUTTONS**. The latter is sent as a result of a call to oapiRefreshMFDButtons. It indicates not a mode change, but the need to refresh the button labels within a mode (i.e. a mode that dynamically changed its labels).

**See also**

[Section MFD mode identifiers](#) for a list of default mode identifiers, [The frame update loop and vessel module callback functions](#)

**17.58.3.14 virtual void VESSEL2::clbkNavMode ( int *mode*, bool *active* ) [virtual]**

Navigation mode change notification.

Called when an automated "navigation mode" is activated or deactivated for a vessel. Most navigation modes engage the vessel's RCS to attain a specific attitude, including pro/retrograde, normal to the orbital plane, level with the local horizon, etc.

**Parameters**

<i>mode</i>	navmode identifier
<i>active</i>	true if activated, false if deactivated

**Default action:**

None.

**See also**

[Section Navigation mode identifiers](#) for a list of available navigation modes.

**17.58.3.15 virtual bool VESSEL2::clbkPanelMouseEvent ( int *id*, int *event*, int *mx*, int *my* ) [virtual]**

Mouse event notification for 2-D panel views.

Called when a mouse-activated panel area receives a mouse event.

**Parameters**

<i>id</i>	panel area identifier
<i>event</i>	mouse event (see <a href="#">Mouse event identifiers</a> )
<i>mx,my</i>	relative mouse position in area at event

**Returns**

The function should return true if it processes the event, false otherwise.

**Default action:**

None, returns false.

**Note**

Mouse events are only sent for areas which requested notification during definition (see [oapiRegisterPanelArea](#)).

**See also**

[clbkPanelRedrawEvent](#), [The frame update loop and vessel module callback functions](#)

**17.58.3.16 virtual bool VESSEL2::clbkPanelRedrawEvent ( int *id*, int *event*, SURFHANDLE *surf* ) [virtual]**

Redraw event notification for 2-D panel views.

Called when a registered panel area needs to be redrawn.

**Parameters**

<i>id</i>	panel area identifier
<i>event</i>	redraw event (see <a href="#">Panel redraw event identifiers</a> )
<i>surf</i>	area surface handle

**Returns**

The function should return true if it processes the event, false otherwise.

**Default action:**

None, returns false.

**Note**

This callback function is only called for areas which were not registered with the PANEL\_REDRAW\_NEVER flag.

All redrawable panel areas receive a PANEL\_REDRAW\_INIT redraw notification when the panel is created, in addition to any registered redraw notification events.

The surface handle *surf* contains either the current area state, or the area background, depending on the flags passed during area registration.

The surface handle may be used for blitting operations, or to receive a Windows device context (DC) for Windows-style redrawing operations.

**See also**

[oapiGetDC](#), [oapiReleaseDC](#), [oapiTriggerPanelRedrawArea](#), [clbkPanelMouseEvent](#), [The frame update loop and vessel module callback functions](#)

**17.58.3.17 virtual bool VESSEL2::clbkPlaybackEvent ( double *simt*, double *event\_t*, const char \* *event\_type*, const char \* *event* ) [virtual]**

Playback event notification.

Called during playback of a recording session when a custom event tag in the vessel's articulation stream is encountered.

**Parameters**

<i>simt</i>	current simulation time [s]
<i>event_t</i>	recorded event time [s]
<i>event_type</i>	event tag string
<i>event</i>	event data string

**Returns**

Should return true if the event type is recognised and processed, false otherwise.

**Default action:**

Do nothing, return false.

**Note**

This function can be used to process any custom vessel events that have been recorded with [VESSEL::RecordEvent](#) during a recording session.

**17.58.3.18 virtual void VESSEL2::clbkPostCreation ( ) [virtual]**

Called after a vessel has been created and its state has been set.

**Default action:**

None.

**Calling sequence:**

This function is called during vessel creation after *clbkSetStateEx* or *clbkLoadStateEx* have been called and before the vessel enters the update loop, i.e. before its *clbkPreStep* is invoked for the first time. Vessels that are created at the start of the simulation (i.e. are listed in the scenario) call their *clbkPostCreation* after all scenario vessels have been created.

**Note**

This function can be used to perform the final setup steps for the vessel, such as animation states and instrument panel states. When this function is called, the vessel state (e.g. position, thruster levels, etc.) have been defined.

**See also**

[The frame update loop and vessel module callback functions](#)

**17.58.3.19 virtual void VESSEL2::clbkPostStep ( double *simt*, double *simdt*, double *mjd* ) [virtual]**

Time step notification after state update.

Called at each simulation time step after the state has been updated to the current simulation time. This function allows to define actions which need to be controlled continuously.

**Parameters**

<i>simt</i>	current simulation run time [s]
<i>simdt</i>	last time step length [s]
<i>mjd</i>	absolute simulation time (days) in Modified Julian Date format.

**Default action:**

None.

**Note**

This function, if implemented, is called at each frame for each instance of this vessel class, and is therefore time-critical. Avoid any unnecessary calculations here which may degrade performance.

**See also**

[clbkPreStep, The frame update loop and vessel module callback functions](#)

**17.58.3.20 void VESSEL2::clbkPreStep ( double *simt*, double *simdt*, double *mjd* ) [virtual]**

Time step notification before state update.

Called at each simulation time step before the state is updated to the current simulation time. This function allows to define actions which need to be controlled continuously.

**Parameters**

<i>simt</i>	next simulation run time [s]
<i>simdt</i>	step length over which the current state will be integrated [s]
<i>mjd</i>	next absolute simulation time (days) in Modified Julian Date format

**Default action:**

None

**Note**

This function is called at each frame of the simulation, after the integration step length has been determined, but before the time integration is applied to the current simulation state.

This method is useful when the step length Dt is required in advance of the time integration, for example to apply a force that produces a given Dv, since the AddForce request will be applied in the next update. Using clbkPostStep for this purpose would be wrong, because its Dt parameter refers to the previous step length.

**See also**

[clbkPostStep, The frame update loop and vessel module callback functions](#)

### 17.58.3.21 virtual void VESSEL2::clbkRCSMode ( int mode ) [virtual]

Reaction Control System mode change notification.

Called when a vessel's RCS (reaction control system) mode changes. Usually the RCS consists of a set of small thrusters arranged so as to allow controlled attitude changes. In Orbiter, the RCS can be driven in either rotational mode (to change the vessel's angular velocity) or in linear mode (to change its linear velocity), or be switched off.

#### Parameters

<i>mode</i>	new RCS mode: 0=disabled, 1=rotational, 2=linear
-------------	--

#### Default action:

None.

#### Note

This callback function is invoked when the user switches RCS mode via the keyboard ("/" or "Ctrl-/" on numerical keypad) or after a call to [VESSEL::SetAttitudeMode](#) or [VESSEL::ToggleAttitudeMode](#).

Not all vessel types may support a reaction control system. In that case, the callback function can be ignored by the module.

#### See also

[The frame update loop and vessel module callback functions](#)

### 17.58.3.22 virtual void VESSEL2::clbkSaveState ( FILEHANDLE scn ) [virtual]

Called when the vessel needs to save its current status to a scenario file.

#### Parameters

<i>scn</i>	scenario file handle
------------	----------------------

#### Default action:

Saves the generic vessel state parameters.

#### Note

clbkSaveState is called by Orbiter at the end of a simulation session while creating the save scenario for the current simulation state.

This function only needs to be overloaded if the vessel must save nonstandard parameters.

If clbkSaveState is overloaded, generic state parameters will only be written if the base class [VESSEL2::clbkSaveState](#) is called.

To write custom parameters to the scenario file, use the [oapiWriteLine](#) function.

#### See also

[The frame update loop and vessel module callback functions](#)

### 17.58.3.23 virtual void VESSEL2::clbkSetClassCaps ( FILEHANDLE cfg ) [virtual]

Initialisation of vessel capabilities.

Called after vessel creation, this function allows to set vessel class capabilities and parameters. This can include definition of physical properties (size, mass, docking ports, etc.), creation of propellant resources and engines, aerodynamic parameters, including airfoil definitions, lift and drag properties, or active control surfaces.

**Parameters**

<i>cfg</i>	handle for the vessel class configuration file
------------	--

**Default action:**

None.

**Note**

This function is called after the vessel has been created, but before its state is read from the scenario file. This means that its state (position, velocity, fuel level, etc.) is undefined at this point.

Use this function to set vessel class capabilities, not vessel state parameters.

Orbiter will scan the vessel class configuration file for generic parameters (like mass or size) after `clbkSetClassCaps` returns. This allows to override generic caps defined in the module by editing the configuration file.

The configuration file handle is also passed to `clbkSetClassCaps`, to allow reading of vessel class-specific parameters from file.

**See also**

[The frame update loop and vessel module callback functions](#)

**17.58.3.24 void VESSEL2::clbkSetStateEx ( const void \* *status* ) [virtual]**

Set state parameters during vessel creation.

**Parameters**

<i>status</i>	pointer to a VESSELSTATUSx structure
---------------	--------------------------------------

**Default action:**

Invokes Orbiter's default state initialisation.

**Calling sequence:**

This function is called when the vessel is being created with `oapiCreateVesselEx`, after its `clbkSetClassCaps` has been invoked and before its `clbkPostCreation` method is invoked. Vessels that are created during simulation start as a result of parsing the scenario file invoke `clbkLoadStateEx` instead.

**Note**

This callback function receives the VESSELSTATUSx structure passed to `oapiCreateVesselEx`. It must therefore be able to process the interface version used by those functions.

This function remains valid even if future versions of Orbiter introduce new VESSELSTATUSx interfaces.

If an overloaded method does not call [VESSEL2::clbkSetStateEx](#), no default state initialisation is performed. Default state initialisation can also be done by calling [VESSEL::DefSetStateEx](#).

**Examples:**

[clbkSetStateEx.cpp](#).

**17.58.3.25 virtual bool VESSEL2::clbkVCMouseEvent ( int *id*, int *event*, VECTOR3 & *p* ) [virtual]**

Mouse event notification for 3-D virtual cockpit views.

Called when a mouse-activated virtual cockpit area receives a mouse event.

## Parameters

<i>id</i>	area identifier
<i>event</i>	mouse event (see <a href="#">Mouse event identifiers</a> )
<i>p</i>	parameter vector (area type-dependent, see notes)

## Returns

The function should return true if it processes the event, false otherwise.

## Default action:

None, returning false.

## Note

To generate a mouse-activated area in a virtual cockpit, you must do the following when registering the area during clbkLoadVC:

- register the area with a call to oapiVCRegisterArea with a mouse mode other than PANEL\_MOUSE\_IGNORE.
- define a mouse-click area in the vessel's local frame. Use one of the oapiVCRegisterAreaClickmode\_XXX functions. You can define spherical or quadrilateral click areas.

Parameter *p* returns information about the mouse position at the mouse event. The type of information returned depends on the area type for which the event was generated:

- spherical area:
  - *p.x* is distance of mouse event from area centre
  - *p.y* and *p.z* not used
- quadrilateral area:
  - *p.x* and *p.y* are the area-relative mouse x and y positions (top left = (0,0), bottom right = (1,1))
  - *p.z* not used

## See also

[clbkLoadVC](#), [clbkPanelMouseEvent](#), [oapiVCRegisterArea](#), [The frame update loop and vessel module callback functions](#)

17.58.3.26 virtual bool VESSEL2::clbkVCRedrawEvent ( int *id*, int *event*, SURFHANDLE *surf* ) [virtual]

Redraw event notification for 3-D virtual cockpit views.

Called when a registered virtual cockpit area needs to be redrawn.

## Parameters

<i>id</i>	area identifier
<i>event</i>	redraw event (see <a href="#">Panel redraw event identifiers</a> )
<i>surf</i>	associated texture handle

## Returns

The function should return true if it processes the event, false otherwise.

## Default action:

None, returning false.

**Note**

To allow an area of the virtual cockpit to be redrawn dynamically, the area must be registered with oapiVCRegisterArea during clbkLoadVC, using a redraw mode other than PANEL\_REDRAW\_NEVER.

When registering the area with oapiVCRegisterArea, you must also provide a handle to the texture onto which the redrawn surface is mapped. This texture must be part of the virtual cockpit mesh, and it must be listed in the mesh file with the 'D' ("dynamic") flag (see 3DModel.pdf).

"Redrawing" an area is not limited to dynamically updating textures. It may also involve mesh transforms (e.g. to animate levers and switches rendered in 3D).

**See also**

[The frame update loop and vessel module callback functions](#)

**17.58.3.27 virtual void VESSEL2::clbkVisualCreated ( **VISHANDLE** *vis*, int *refcount* ) [virtual]**

Called after a vessel visual has been created by the renderer.

**Parameters**

<i>vis</i>	handle for the newly created visual
<i>refcount</i>	visual reference count

**Default action:**

None.

**Note**

The logical interface to a vessel exists as long as the vessel is present in the simulation. However, the visual interface exists only when the vessel is within visual range of the camera. Orbiter creates and destroys visuals as required. This enhances simulation performance in the presence of a large number of objects in the simulation.

Whenever Orbiter creates a vessel's visual it reverts to its initial configuration (e.g. as defined in the mesh file). The module can use this function to update the visual to the current state, wherever dynamic changes are required.

More than one visual representation of an object may exist. The refcount parameter defines how many visual interfaces to the object exist.

**See also**

[The frame update loop and vessel module callback functions](#)

**17.58.3.28 virtual void VESSEL2::clbkVisualDestroyed ( **VISHANDLE** *vis*, int *refcount* ) [virtual]**

Called before a vessel visual is destroyed.

**Parameters**

<i>vis</i>	handle for the visual to be destroyed
<i>refcount</i>	visual reference count

**Default action:**

None.

**Note**

Orbiter calls this function before it destroys a visual representation of the vessel. This may be in response to the destruction of the actual vessel, but in general simply means that the vessel has moved out of visual range of the current camera location.

**See also**

[The frame update loop and vessel module callback functions](#)

The documentation for this class was generated from the following files:

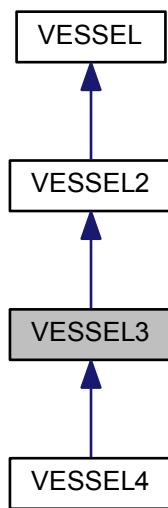
- Orbitersdk/include/[VesselAPI.h](#)
- Orbitersdk/doxygen/API\_reference/examples.cpp

## 17.59 VESSEL3 Class Reference

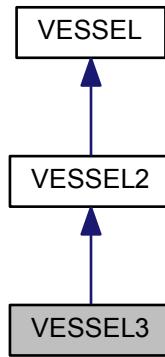
Callback extensions to the [VESSEL](#) class.

```
#include <VesselAPI.h>
```

Inheritance diagram for VESSEL3:



Collaboration diagram for VESSEL3:



#### Public Member Functions

- **VESSEL3 (OBJHANDLE hVessel, int fmodel=1)**  
*Creates a VESSEL3 interface for a vessel object.*
- int **SetPanelBackground (PANELHANDLE hPanel, SURFHANDLE \*hSurf, DWORD nsurf, MESHHANDLE hMesh, DWORD width, DWORD height, DWORD baseline=0, DWORD scrollflag=0)**  
*Set the background surface for a 2-D instrument panel.*
- int **SetPanelScaling (PANELHANDLE hPanel, double defscale, double extscale)**  
*Set scaling factors for 2-D instrument panel.*
- int **RegisterPanelMFDGeometry (PANELHANDLE hPanel, int MFD\_id, int nmesh, int ngroup)**  
*Define an MFD display in the panel mesh.*
- int **RegisterPanelArea (PANELHANDLE hPanel, int id, const RECT &pos, const RECT &texpos, int draw\_event, int mouse\_event, int bkmode)**  
*Register an area of the panel to receive mouse and redraw events.*
- int **RegisterPanelArea (PANELHANDLE hPanel, int id, const RECT &pos, int draw\_event, int mouse\_event, SURFHANDLE surf=NULL, void \*context=NULL)**  
*Register an area of the panel to receive mouse and redraw events.*
- virtual bool **clbkPanelMouseEvent (int id, int event, int mx, int my, void \*context)**  
*Mouse event notification for 2-D panel views.*
- virtual bool **clbkPanelRedrawEvent (int id, int event, SURFHANDLE surf, void \*context)**  
*Redraw event notification for 2-D panel views.*
- virtual int **clbkGeneric (int msgid=0, int prm=0, void \*context=NULL)**  
*Generic multi-purpose callback function.*
- virtual bool **clbkLoadPanel2D (int id, PANELHANDLE hPanel, DWORD viewW, DWORD viewH)**  
*Request for a 2D instrument panel definition in cockpit view.*
- virtual bool **clbkDrawHUD (int mode, const HUDPAINTSPEC \*hps, oapi::Sketchpad \*skp)**  
*HUD redraw notification.*
- virtual void **clbkRenderHUD (int mode, const HUDPAINTSPEC \*hps, SURFHANDLE hDefaultTex)**  
*HUD render notification.*
- virtual void **clbkGetRadiationForce (const VECTOR3 &mflux, VECTOR3 &F, VECTOR3 &pos)**  
*Returns force due to radiation pressure.*

## Additional Inherited Members

### 17.59.1 Detailed Description

Callback extensions to the [VESSEL](#) class.

The [VESSEL3](#) class extends [VESSEL2](#) with additional functionality. Developers should use this class for new projects. Existing vessel addons can make use of the new features by switching the base class from [VESSEL2](#) to [VESSEL3](#).

### 17.59.2 Constructor & Destructor Documentation

#### 17.59.2.1 [VESSEL3::VESSEL3 \( OBJHANDLE hVessel, int fmodel = 1 \)](#)

Creates a [VESSEL3](#) interface for a vessel object.

#### See also

[VESSEL2](#)

### 17.59.3 Member Function Documentation

#### 17.59.3.1 [virtual bool VESSEL3::clbkDrawHUD \( int mode, const HUDPAINTSPEC \\* hps, oapi::Sketchpad \\* skp \) \[virtual\]](#)

HUD redraw notification.

Called when the vessel's head-up display (HUD) needs to be redrawn (usually at each time step, unless the HUD is turned off). Overwriting this function allows to implement vessel-specific modifications of the HUD display (or to suppress the HUD altogether).

#### Parameters

<i>mode</i>	HUD mode (see <code>HUD_*</code> constants in <a href="#">OrbiterAPI.h</a> )
<i>hps</i>	pointer to a <code>HUDPAINTSPEC</code> structure (see notes)
<i>skp</i>	drawing context instance

#### Returns

Overloaded methods should return *true*. If the return value is *false*, orbiter assumes that this method is disabled and will try [VESSEL2::clbkDrawHUD](#).

#### Default action:

Draws a standard HUD display with Orbiter's default display layout and returns *true*.

#### Note

If a vessel overwrites this method, Orbiter will draw the default HUD only if the base class [VESSEL3::clbkDrawHUD](#) is called.

*hps* points to a `HUDPAINTSPEC` structure containing information about the HUD drawing surface. It has the following format:

```
typedef struct {
    int W, H;
    int CX, CY;
    double Scale;
    int Markersize;
} HUDPAINTSPEC;
```

where *W* and *H* are width and height of the HUD drawing surface in pixels, *CX* and *CY* are the x and y coordinates of the HUD centre (the position of the "forward marker", which is not guaranteed to be in the

middle of the drawing surface or even within the drawing surface!), Scale represents an angular aperture of 1 deg. expressed in HUD pixels, and Markersize is a "typical" size which can be used to scale objects like direction markers.

The device context passed to clbkDrawHUD contains the appropriate settings for the current HUD display (font, pen, colours). If you need to change any of the GDI settings, make sure to restore the defaults before calling the base class clbkDrawHUD. Otherwise the default display will be corrupted.

clbkDrawHUD can be used to implement entirely new vessel- specific HUD modes. In this case, the module would maintain its own record of the current HUD mode, and ignore the mode parameter passed to clbkDrawHUD.

In glass cockpit and 2-D panel mode, the HUD display can be a combination of drawn elements (via clbkDrawHUD) and rendered elements (via [clbkRenderHUD](#)). In VC mode, the HUD is always drawn.

To disable all default HUD display elements, a derived vessel should overload both clbkDrawHUD and clbkRenderHUD.

#### See also

[clbkRenderHUD](#), Section [HUD mode identifiers](#) for a list of default mode identifiers, [The frame update loop and vessel module callback functions](#)

#### 17.59.3.2 virtual int VESSEL3::clbkGeneric ( int *msgid* = 0, int *prm* = 0, void \* *context* = NULL ) [virtual]

Generic multi-purpose callback function.

##### Parameters

<i>msgid</i>	message identifier (see <a href="#">Generic vessel message identifiers</a> )
<i>prm</i>	message parameter
<i>context</i>	pointer to additional message data

##### Returns

Result flag.

#### 17.59.3.3 virtual void VESSEL3::clbkGetRadiationForce ( const VECTOR3 & *mflux*, VECTOR3 & *F*, VECTOR3 & *pos* ) [virtual]

Returns force due to radiation pressure.

##### Parameters

in	<i>mflux</i>	momentum flux vector [N/m <sup>2</sup> ] at current spacecraft position, transformed into vessel frame
out	<i>F</i>	radiation force vector [ <b>N</b> ] in vessel frame
out	<i>pos</i>	force attack point [ <b>m</b> ] in vessel frame

##### Default action:

Sets  $F = mflux * size^2 * a$ , where  $a$  (albedo coefficient) is fixed to 1.5. Sets  $pos = (0,0,0)$ . This simple formula ignores any attitude-dependent variations in surface area, and any non-radial force components due to oblique reflections. Does not induce any torque. For more sophisticated treatment, vessels should re-implement this method.

##### Note

This method is called by orbiter when perturbation forces due to radiation pressure need to be evaluated. The implementation should take into account geometric factors (cross sections), surface factors (absorption, reflection) and spacecraft attitude relative to the sun.

The momentum flux parameter, *mflux*, takes into account shadow effects from the closest planet, or from the closest moon and its parent planet, if applicable.

If the returned force attack point *pos* is not set to the centre of gravity, (0,0,0), then a torque may be induced as well as a linear force.

If the vessel contains multiple distinct surfaces, the returned force should be the vector sum of all individual contributions, and the returned position should be the weighted barycentre of all individual contributions w.r.t. the vessel centre of gravity.

**17.59.3.4 virtual bool VESSEL3::clbkLoadPanel2D ( int *id*, PANELHANDLE *hPanel*, DWORD *viewW*, DWORD *viewH* ) [virtual]**

Request for a 2D instrument panel definition in cockpit view.

#### Parameters

<i>id</i>	panel identifier ( $\geq 0$ )
<i>hPanel</i>	panel handle
<i>viewW</i>	viewport width [pixel]
<i>viewH</i>	viewport height [pixel]

#### Returns

The function should return *true* if it supports the requested panel, false otherwise.

#### Default action:

None, returns false.

#### Note

This method replaces [VESSEL2::clbkLoadPanel](#). It defines the panels via SURFHANDLES instead of bitmaps.

#### See also

[The frame update loop and vessel module callback functions](#)

**17.59.3.5 virtual bool VESSEL3::clbkPanelMouseEvent ( int *id*, int *event*, int *mx*, int *my*, void \* *context* ) [virtual]**

Mouse event notification for 2-D panel views.

Called when a mouse-activated panel area receives a mouse event.

#### Parameters

<i>id</i>	panel area identifier
<i>event</i>	mouse event (see <a href="#">Mouse event identifiers</a> )
<i>mx,my</i>	relative mouse position in area at event
<i>context</i>	user-supplied pointer to context data (defined in <a href="#">RegisterPanelArea</a> )

#### Returns

The function should return true if it processes the event, false otherwise.

#### Default action:

None, returns false.

#### Note

If a vessel class overloads this method, it should return true. On a *false* return, Orbiter will try [VESSEL2::clbkPanelMouseEvent](#) instead.

Mouse events are only sent for areas which requested notification during definition (see [RegisterPanelArea](#)).

## See also

[RegisterPanelArea](#), [The frame update loop and vessel module callback functions](#)

17.59.3.6 `virtual bool VESSEL3::clbkPanelRedrawEvent ( int id, int event, SURFHANDLE surf, void * context )`  
 [virtual]

Redraw event notification for 2-D panel views.

Called when a registered panel area needs to be redrawn.

## Parameters

<i>id</i>	panel area identifier
<i>event</i>	redraw event (see <a href="#">Panel redraw event identifiers</a> )
<i>surf</i>	area surface handle
<i>context</i>	user-supplied pointer to context data (defined in <a href="#">RegisterPanelArea</a> )

## Returns

The function should return true if it processes the event, false otherwise.

## Default action:

None, returns false.

## Note

This callback function is only called for areas which were not registered with the PANEL\_REDRAW\_NEVER flag.

If a vessel class overloads this method, it should return true. On a *false* return, Orbiter will try [VESSEL2::clbkPanelRedrawEvent](#) instead.

All redrawable panel areas receive a PANEL\_REDRAW\_INIT redraw notification when the panel is created, in addition to any registered redraw notification events.

The surface handle *surf* contains either the current area state, or the area background, depending on the flags passed during area registration.

The surface handle may be used for blitting operations, or to receive a Windows device context (DC) for Windows-style redrawing operations.

## See also

[RegisterPanelArea](#), [oapiGetDC](#), [oapiReleaseDC](#), [oapiTriggerPanelRedrawArea](#), [, The frame update loop and vessel module callback functions](#)

17.59.3.7 `virtual void VESSEL3::clbkRenderHUD ( int mode, const HUDPANTSPEC * hps, SURFHANDLE hDefaultTex )`  
 [virtual]

HUD render notification.

Called when the vessel's head-up display (HUD) needs to be rendered (usually at each time step, unless the HUD is turned off). Overwriting this function allows to implement vessel-specific modifications of the HUD display (or to suppress the HUD altogether).

## Parameters

<i>mode</i>	HUD mode (see <i>HUD_*</i> constants in <a href="#">OrbiterAPI.h</a> )
-------------	--

<i>hps</i>	pointer to a <b>HUDPAINTSPEC</b> structure
<i>hDefaultTex</i>	handle for default HUD texture

#### Default action:

Renders a standard HUD display with Orbiter's default display layout.

#### Note

This function is only called in glass cockpit or 2-D panel mode, not in VC (virtual cockpit mode).

In glass cockpit or 2-D panel mode, the programmer has a choice of using **clbkRenderHUD** or **clbkDrawHUD** to display vessel-specific HUD elements. The use of **clbkRenderHUD** is preferred, because it provides smoother animation, better performance and is better supported by external render engines.

To disable all default HUD display, a derived vessel class should overload both **clbkRenderHUD** and **clbkDrawHUD**.

To render custom HUD elements, the **oapiRenderHUD** function should be called from within this callback function.

#### See also

**clbkDrawHUD**, **oapiRenderHUD**, Section **HUD mode identifiers** for a list of default mode identifiers, **The frame update loop and vessel module callback functions**

**17.59.3.8 int VESSEL3::RegisterPanelArea ( PANELHANDLE *hPanel*, int *id*, const RECT & *pos*, const RECT & *texpos*, int *draw\_event*, int *mouse\_event*, int *bkmode* )**

Register an area of the panel to receive mouse and redraw events.

**Deprecated** This method has been superseded by **VESSEL4::RegisterPanelArea**.

#### Parameters

<i>hPanel</i>	panel handle
<i>id</i>	area identifier
<i>pos</i>	area boundary coordinates (mesh coordinates)
<i>texpos</i>	area boundary (texture coordinates)
<i>draw_event</i>	event flags for redraw event triggers (see <b>Panel redraw event identifiers</b> )
<i>mouse_event</i>	event flags for mouse event triggers (see <b>Mouse event identifiers</b> )
<i>bkmode</i>	flag for texture background provided to redraw callback function (see <b>Panel area texture mapping identifiers</b> )

#### Returns

Always returns 0.

#### Note

This method activates a rectangular area of the panel for receiving mouse and redraw events. *pos* specifies the borders of the area in 'logical' coordinates (0,0,width,height) as specified by **SetPanelBackground**. Registered mouse events within this area will trigger a call to **VESSEL2::clbkPanelMouseEvent**.

If the area needs to be able to update the panel texture, it should pass an appropriate redraw flag in *draw\_event*, and specify the texture coordinates of the redraw area in *texpos*.

If the panel contains multiple background textures, only the first texture can be redrawn with this function. To redraw other textures in the background texture array, use **VESSEL4::RegisterPanelArea** instead.

For backward compatibility, this method automatically adds the **PANEL\_REDRAW\_GDI** and **PANEL\_REDRAW\_SKETCHPAD** flags to *draw\_event*. If GDI and/or Sketchpad access to the area drawing surface is not required, using **VESSEL4::RegisterPanelArea** can improve graphics performance.

## See also

[VESSEL4::RegisterPanelArea](#)

17.59.3.9 int **VESSEL3::RegisterPanelArea** ( **PANELHANDLE hPanel**, **int id**, **const RECT & pos**, **int draw\_event**, **int mouse\_event**, **SURFHANDLE surf = NULL**, **void \* context = NULL** )

Register an area of the panel to receive mouse and redraw events.

## Parameters

<i>hPanel</i>	panel handle
<i>id</i>	area identifier
<i>pos</i>	area boundary coordinates (mesh coordinates)
<i>draw_event</i>	event flags for redraw event triggers (see <a href="#">Panel redraw event identifiers</a> )
<i>mouse_event</i>	event flags for mouse event triggers (see <a href="#">Mouse event identifiers</a> )
<i>surf</i>	surface handle passed to the redraw callback function
<i>context</i>	user-defined data passed to the mouse and redraw callback functions

## Returns

Always returns 0.

## Note

This version passes the provided surface handle directly to the redraw callback, rather making a copy of the area. This is useful if the area either doesn't need to modify any surfaces, or blits parts of the same surface (e.g. a texture that contains both the panel background and various elements (switches, dials, etc.) to be copied on top.

Since the surface returned to the redraw function is not restricted to the registered area, it is the responsibility of the caller not to draw outside the area.

The area boundaries defined in *pos* are only used for generating mouse events. If the area does not process mouse events (PANEL\_MOUSE\_IGNORE), the *pos* parameter is ignored.

The PANEL\_REDRAW\_GDI and PANEL\_REDRAW\_SKETCHPAD flags can not be used in the *draw\_event* parameter. If GDI or Sketchpad access is required during redraw events, either the surface *surf* must have been created with the appropriate attributes, or [VESSEL4::RegisterPanelArea](#) should be used instead.

## See also

[VESSEL4::RegisterPanelArea](#), [oapiCreateSurfaceEx](#)

17.59.3.10 int **VESSEL3::RegisterPanelMFDGeometry** ( **PANELHANDLE hPanel**, **int MFD\_id**, **int nmesh**, **int ngroup** )

Define an [MFD](#) display in the panel mesh.

## Parameters

<i>hPanel</i>	panel handle
<i>MFD_id</i>	MFD identifier ( $\geq 0$ )
<i>nmesh</i>	panel mesh index ( $\geq 0$ )
<i>ngroup</i>	mesh group index ( $\geq 0$ )

## Returns

Always returns 0.

**Note**

This method reserves a mesh group for rendering the contents of an [MFD](#) display. The group should define a square area (typically consisting of 4 nodes and 2 triangles) with appropriate texture coordinates. When rendering the panel, the texture for this group is set to the current contents of the [MFD](#) display.

The order of mesh groups defines the rendering order. To render the [MFD](#) display on top of the panel, define it as the last group in the mesh. Alternatively, the [MFD](#) can be rendered first, if the panel texture contains a transparent area through which to view the [MFD](#).

**17.59.3.11** `int VESSEL3::SetPanelBackground ( PANELHANDLE hPanel, SURFHANDLE * hSurf, DWORD nsurf, MESHHANDLE hMesh, DWORD width, DWORD height, DWORD baseline = 0, DWORD scrollflag = 0 )`

Set the background surface for a 2-D instrument panel.

**Parameters**

<i>hPanel</i>	panel handle
<i>hSurf</i>	array of surface handles
<i>nsurf</i>	number of surfaces
<i>hMesh</i>	mesh handle defining the billboard geometry
<i>width</i>	panel width [pixel]
<i>height</i>	panel height [pixel]
<i>baseline</i>	base line for edge attachment
<i>scrollflag</i>	panel attachment and scrolling bitflags

**Returns**

Always returns 0.

**Note**

This method should be applied in the body of [clbkLoadPanel2D](#).

The mesh defines the size and layout of the billboard mesh used for rendering the panel surface. Its vertex coordinates are interpreted as transformed, i.e. in terms of screen coordinates (pixels). The z-coordinate should be zero. Normals are ignored. Texture coordinates define which part of the surfaces are rendered.

The groups are rendered in the order they appear in the mesh. Later groups cover earlier ones. Therefore the groups should be arranged from backmost to frontmost elements.

In the simplest case, the mesh consists of a single rectangular area (4 nodes, 2 triangles) and a single surface, but can be more elaborate.

The texture indices of the mesh groups (TexIdx) are interpreted as indices into the hSurf list (zero-based).

This method increases the reference counters for the surfaces, so the caller should release them at some point.

The surfaces can contain an alpha channel to handle transparency.

**17.59.3.12** `int VESSEL3::SetPanelScaling ( PANELHANDLE hPanel, double defscale, double extscale )`

Set scaling factors for 2-D instrument panel.

**Parameters**

<i>hPanel</i>	panel handle
<i>defscale</i>	default scale factor
<i>extscale</i>	additional scale factor

**Returns**

Always returns 0.

**Note**

The scaling factors define the scaling between mesh coordinates and screen pixels.

`defscale` is the default factor, `extscale` is an additional scale which can be selected by the user via the mouse wheel.

Examples: `scale=1`: one mesh unit corresponds to one screen pixel, `scale=viewW/panelW`: panel fits screen width

The documentation for this class was generated from the following file:

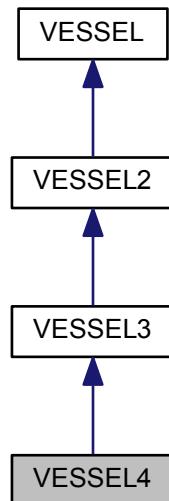
- Orbitersdk/include/[VesselAPI.h](#)

## 17.60 VESSEL4 Class Reference

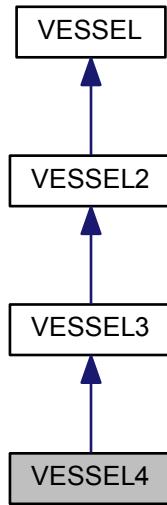
Extensions to the [VESSEL](#) class.

```
#include <VesselAPI.h>
```

Inheritance diagram for VESSEL4:



Collaboration diagram for VESSEL4:



#### Public Member Functions

- **VESSEL4 (OBJHANDLE hVessel, int fmodel=1)**  
*Creates a [VESSEL4](#) interface for a vessel object.*
- int **RegisterPanelArea (PANELHANDLE hPanel, int id, const RECT &pos, int texidx, const RECT &texpos, int draw\_event, int mouse\_event, int bkmode)**  
*Register an area of the panel to receive mouse and redraw events.*
- int **RegisterMFDMode (const MFDMODESPECEX &spec)**  
*Register a user-defined [MFD](#) mode for the vessel.*
- bool **UnregisterMFDMode (int mode)**  
*Unregister a previously registered vessel-specific [MFD](#) mode.*
- virtual int **clbkNavProcess (int mode)**  
*Processing of navigation autopilot programmes.*

#### Additional Inherited Members

##### 17.60.1 Detailed Description

Extensions to the [VESSEL](#) class.

The [VESSEL4](#) class extends [VESSEL3](#) with additional functionality. Developers should use this class for new projects. Existing vessel addons can make use of the new features by switching the base class to [VESSEL4](#).

##### 17.60.2 Constructor & Destructor Documentation

###### 17.60.2.1 VESSEL4::VESSEL4 ( OBJHANDLE hVessel, int fmodel = 1 )

Creates a [VESSEL4](#) interface for a vessel object.

See also

[VESSEL3](#)

### 17.60.3 Member Function Documentation

#### 17.60.3.1 virtual int VESSEL4::clbkNavProcess ( int mode ) [virtual]

Processing of navigation autopilot programmes.

Parameters

<i>mode</i>	Bit-flags for active nav programmes (see <a href="#">Navigation mode bitflags</a> )
-------------	---

Returns

Modified nav programme bitflags (see notes)

Default action:

Does nothing and returns *mode* (i.e. leaves all navmode processing to the default Orbiter core routines).

Note

This method is called at each frame while at least one nav programme is active. It is only called once per frame even if multiple programmes are active. Check the *mode* parameter to see which.

The module is free to process all, a subset, or none of the active programmes. The return value indicates to Orbiter which of the programmes have been processed: clear the flags for all processed programmes, and leave the flags for any skipped programmes.

You cannot set any flags in the return value that were not set already in the input parameter. Activating/deactivating navmodes should be done via [VESSEL::ActivateNavmode](#), [VESSEL::DeactivateNavmode](#), [VESSEL::ToggleNavmode](#)

#### 17.60.3.2 int VESSEL4::RegisterMFDMode ( const MFDMODESPECEX & spec )

Register a user-defined [MFD](#) mode for the vessel.

Parameters

<i>spec</i>	<a href="#">MFD</a> mode specifications
-------------	---

Note

This method is similar to the global [oapiRegisterMFDMode](#) function, but it registers the [MFD](#) mode only for an individual vessel instance. This allows to create vessel-specific [MFD](#) modes directly in the vessel module. Typically this method would be called in the vessel constructor.

[MFDMODESPECEX](#) is a struct defining the parameters of the new mode:

```
typedef struct {
    char *name;      // points to the name of the new mode
    DWORD key;       // mode selection key
    void *context;   // mode-specific context pointer
    int (*msgproc)(UINT,UINT,WPARAM,LPARAM); // address of MFD message parser
} MFDMODESPEC;
```

See also

[VESSEL4::UnregisterMFDMode](#), [oapiRegisterMFDMode](#)

#### 17.60.3.3 int VESSEL4::RegisterPanelArea ( **PANELHANDLE** *hPanel*, int *id*, const **RECT** & *pos*, int *texidx*, const **RECT** & *texpos*, int *draw\_event*, int *mouse\_event*, int *bkmode* )

Register an area of the panel to receive mouse and redraw events.

## Parameters

<i>hPanel</i>	panel handle
<i>id</i>	area identifier
<i>pos</i>	area boundary coordinates (mesh coordinates)
<i>texidx</i>	background texture index
<i>texpos</i>	area boundary (texture coordinates)
<i>draw_event</i>	event flags for redraw event triggers (see <a href="#">Panel redraw event identifiers</a> )
<i>mouse_event</i>	event flags for mouse event triggers (see <a href="#">Mouse event identifiers</a> )
<i>bkmode</i>	flag for texture background provided to redraw callback function (see <a href="#">Panel area texture mapping identifiers</a> )

## Returns

Always returns 0.

## Note

This method activates a rectangular area of the panel for receiving mouse and redraw events.

*pos* specifies the borders of the area in 'logical' coordinates (0,0,width,height) as specified by [SetPanelBackground](#). Registered mouse events within this area will trigger a call to [VESSEL2::clbkPanelMouseEvent](#). *texidx* is the index of the panel background texture the area texture should be copied into, in the order the textures were specified in the array passed to [VESSEL3::SetPanelBackground](#). If only a single texture is used for the panel, *texidx* should be set to 0. If the area doesn't need to be redrawn (PANEL\_REDRAW\_NEVER), this parameter is ignored.

If the area texture should allow GDI and/or Sketchpad access during redraw events, the PANEL\_REDRAW\_GDI and/or PANEL\_REDRAW\_SKETCHPAD flags should be added to *draw\_event*. If only blitting access is required, these flags should be omitted for improved performance.

17.60.3.4 `bool VESSEL4::UnregisterMFDMode ( int mode )`

Unregister a previously registered vessel-specific [MFD](#) mode.

## Parameters

<i>mode</i>	mode identifier, as returned by <a href="#">VESSEL4::RegisterMFDMode</a>
-------------	--

## Returns

*true* on success (mode was successfully unregistered).

## See also

[VESSEL4::RegisterMFDMode](#)

The documentation for this class was generated from the following file:

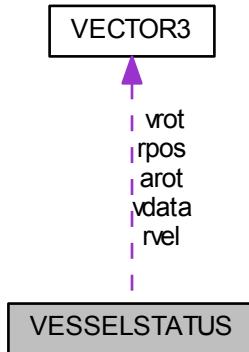
- Orbitersdk/include/[VesselAPI.h](#)

## 17.61 VESSELSTATUS Struct Reference

Vessel status parameters (version 1)

```
#include <OrbiterAPI.h>
```

Collaboration diagram for VESSELSTATUS:



#### Public Attributes

- **VECTOR3 rpos**  
*position relative to rbody in ecliptic frame [m]*
- **VECTOR3 rvel**  
*velocity relative to rbody in ecliptic frame [m/s]*
- **VECTOR3 vrot**  
*rotation velocity about principal axes in ecliptic frame [rad/s]*
- **VECTOR3 arot**  
*vessel orientation against ecliptic frame*
- **double fuel**  
*fuel level [0..1]*
- **double eng\_main**  
*main/retro engine setting [-1..1]*
- **double eng\_hover**  
*hover engine setting [0..1]*
- **OBJHANDLE rbody**  
*handle of reference body*
- **OBJHANDLE base**  
*handle of docking or landing target*
- **int port**  
*index of designated docking or landing port*
- **int status**  
*flight status indicator*
- **VECTOR3 vdata [10]**  
*additional vector parameters*
- **double fdata [10]**  
*additional floating point parameters (not used)*
- **DWORD flag [10]**  
*additional integer and bitflag parameters*

### 17.61.1 Detailed Description

Vessel status parameters (version 1)

Defines vessel status parameters at a given time. This is version 1 of the vessel status interface. It is retained for backward compatibility, but new modules should use [VESSELSTATUS2](#) instead to exploit the latest vessel capabilities such as individual thruster and propellant resource settings.

### 17.61.2 Member Data Documentation

#### 17.61.2.1 DWORD VESSELSTATUS::flag[10]

additional integer and bitflag parameters

flag[0]&1:

- 0: ignore eng\_main and eng\_hovr entries, do not change thruster settings
- 1: set THGROUP\_MAIN and THGROUP\_RETRO thruster groups from eng\_main, and THGROUP\_HOVER from eng\_hovr.

flag[0]&2:

- 0: ignore fuel level, do not change fuel levels
- 1: set fuel level of first propellant resource from fuel

#### Note

flag[1] - flag[9]: not used

#### 17.61.2.2 int VESSELSTATUS::status

flight status indicator

#### Note

- 0=active (freeflight)
- 1=inactive (landed)

#### 17.61.2.3 VECTOR3 VESSELSTATUS::vdata[10]

additional vector parameters

#### Note

- vdata[0]: contains landing parameters if status == 1: vdata[0].x = longitude, vdata[0].y = latitude, vdata[0].z = heading of landed vessel
- vdata[1] - vdata[9]: not used

The documentation for this struct was generated from the following file:

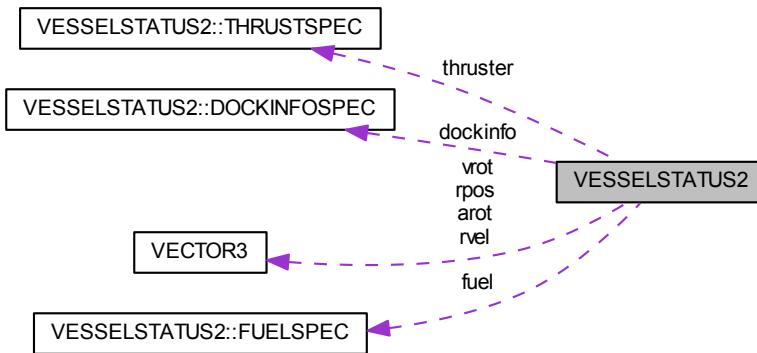
- Orbitersdk/include/[OrbiterAPI.h](#)

## 17.62 VESSELSTATUS2 Struct Reference

Vessel status parameters (version 2)

```
#include <OrbiterAPI.h>
```

Collaboration diagram for VESSELSTATUS2:



## Classes

- struct [DOCKINFOSPEC](#)  
*dock info list*
- struct [FUELSPEC](#)  
*propellant list*
- struct [THRUSTSPEC](#)  
*thruster definition list*

## Public Attributes

- DWORD [version](#)  
*interface version identifier (2)*
- DWORD [flag](#)  
*bit flags*
- [OBJHANDLE rbody](#)  
*handle of reference body*
- [OBJHANDLE base](#)  
*handle of docking or landing target*
- int [port](#)  
*index of designated docking or landing port*
- int [status](#)  
*flight status indicator*
- [VECTOR3 rpos](#)  
*position relative to reference body (rbody) in ecliptic frame [m]*
- [VECTOR3 rvel](#)  
*velocity relative to reference body in ecliptic frame [m/s]*
- [VECTOR3 vrot](#)  
*angular velocity around principal axes in ecliptic frame [rad/s]*
- [VECTOR3 arot](#)  
*vessel orientation against ecliptic frame*

- double **surf\_lng**  
*longitude of vessel position in equatorial coordinates of rbody [rad]*
- double **surf\_lat**  
*latitude of vessel position in equatorial coordinates of rbody [rad]*
- double **surf\_hdg**  
*vessel heading on the ground [rad]*
- DWORD **nfuel**  
*number of entries in the fuel list*
- struct **VESSELSTATUS2::FUELSPEC** \* **fuel**
- DWORD **nthruster**  
*number of entries in the thruster list*
- struct **VESSELSTATUS2::THRUSTSPEC** \* **thruster**
- DWORD **ndockinfo**  
*number of entries in the dockinfo list*
- struct **VESSELSTATUS2::DOCKINFOSPEC** \* **dockinfo**
- DWORD **xpdr**  
*transponder channel [0...640]*

### 17.62.1 Detailed Description

Vessel status parameters (version 2)

Defines vessel status parameters at a given time. This is version 2 of the vessel status interface and replaces the earlier **VESSELSTATUS** structure. Functions using **VESSELSTATUS** are still supported for backward compatibility.

#### Note

The version specification is an input parameter for all function calls (including **GetStatus**) and must be set by the user to tell Orbiter which interface to use.

#### See also

[VESSEL::GetStatusEx](#)

### 17.62.2 Member Data Documentation

#### 17.62.2.1 VECTOR3 VESSELSTATUS2::arot

vessel orientation against ecliptic frame

**arot** ( $\alpha, \beta, \gamma$ ) contains angles of rotation [rad] around  $x, y, z$  axes in ecliptic frame to produce this rotation matrix **R** for mapping from the vessel's local frame of reference to the global frame of reference:

$$R = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos \alpha & \sin \alpha \\ 0 & -\sin \alpha & \cos \alpha \end{bmatrix} \begin{bmatrix} \cos \beta & 0 & -\sin \beta \\ 0 & 1 & 0 \\ \sin \beta & 0 & \cos \beta \end{bmatrix} \begin{bmatrix} \cos \gamma & \sin \gamma & 0 \\ -\sin \gamma & \cos \gamma & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

such that  $\mathbf{r}_{\text{global}} = \mathbf{R} \mathbf{r}_{\text{local}} + \mathbf{p}$   
where **p** is the vessel's global position.

#### 17.62.2.2 DWORD VESSELSTATUS2::flag

bit flags

The meaning of the bitflags in flag depends on whether the **VESSELSTATUS2** structure is used to get (**GetStatus**) or set (**SetStatus**) a vessel status. The following flags are currently defined:

flags:

- VS\_FUELRESET
  - Get - not used
  - Set - reset all fuel levels to zero, independent of the fuel list.
- VS\_FUELLIST
  - Get - request a list of current fuel levels in fuel. The module is responsible for deleting the list after use.
  - Set - set fuel levels for all resources listed in fuel.
- VS\_THRUSTRESET
  - Get - not used
  - Set - reset all thruster levels to zero, independent of the thruster list
- VS\_THRUSTLIST
  - Get - request a list of current thrust levels in thruster. The module is responsible for deleting the list after use.
  - Set - set thrust levels for all thrusters listed in thruster.
- VS.DockInfoList
  - Get - request a docking port status list in dockinfo. The module is responsible for deleting the list after use.
  - Set - initialise docking status for all docking ports in dockinfo.

See also

[VESSEL::GetStatusEx](#)

17.62.2.3 int VESSELSTATUS2::status

flight status indicator

Note

- 0=active (freeflight)
- 1=inactive (landed)

17.62.2.4 double VESSELSTATUS2::surf\_hdg

vessel heading on the ground [rad]

Note

currently only defined if the vessel is landed (status=1)

17.62.2.5 double VESSELSTATUS2::surf\_lat

latitude of vessel position in equatorial coordinates of rbody [rad]

Note

currently only defined if the vessel is landed (status=1)

### 17.62.2.6 double VESSELSTATUS2::surf\_lng

longitude of vessel position in equatorial coordinates of rbody [rad]

#### Note

currently only defined if the vessel is landed (status=1)

The documentation for this struct was generated from the following file:

- Orbitersdk/include/OrbiterAPI.h

## 17.63 oapi::GraphicsClient::VIDEODATA Struct Reference

Structure containing default video options, as stored in Orbiter.cfg.

```
#include <GraphicsAPI.h>
```

#### Public Attributes

- bool **fullscreen**  
*fullscreen mode flag*
- bool **forceenum**  
*enforce device enumeration flag*
- bool **trystencil**  
*stencil buffer flag*
- bool **novsync**  
*no vsync flag*
- bool **pageflip**  
*allow page flipping in fullscreen*
- int **deviceidx**  
*video device index*
- int **modeidx**  
*video mode index*
- int **winw**  
*window width*
- int **winh**  
*window height*

### 17.63.1 Detailed Description

Structure containing default video options, as stored in Orbiter.cfg.

The documentation for this struct was generated from the following file:

- Orbitersdk/include/GraphicsAPI.h

## 18 File Documentation

### 18.1 Orbitersdk/include/CelBodyAPI.h File Reference

Contains interface classes for celestial bodies: [CELBODY](#) and [CELBODY2](#).

## Classes

- class [CELBODY](#)

*This is the base class for celestial body classes.*

- class [CELBODY2](#)

*Extension to [CELBODY](#) class.*

- class [ATMOSPHERE](#)

*Defines the physical atmospheric properties for a celestial body.*

- struct [ATMOSPHERE::PRM\\_IN](#)

*Input parameters for atmospheric data calculation.*

- struct [ATMOSPHERE::PRM\\_OUT](#)

*Output parameters for atmospheric data calculation.*

## Macros

- `#define EPHEM_TRUEPOS 0x01`

*true body position*

- `#define EPHEM_TRUEVEL 0x02`

*true body velocity*

- `#define EPHEM_BARYPOS 0x04`

*barycentric position*

- `#define EPHEM_BARYVEL 0x08`

*barycentric velocity*

- `#define EPHEM_BARYISTRUE 0x10`

*body has no child objects*

- `#define EPHEM_PARENTBARY 0x20`

*ephemerides are computed in terms of the barycentre of the parent body's system*

- `#define EPHEM_POLAR 0x40`

*data is returned in polar format*

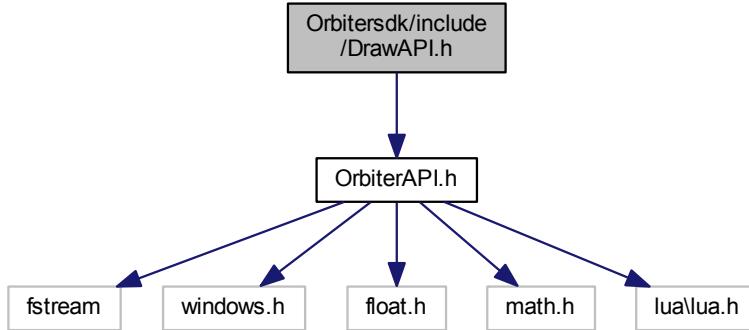
### 18.1.1 Detailed Description

Contains interface classes for celestial bodies: [CELBODY](#) and [CELBODY2](#).

## 18.2 Orbitersdk/include/DrawAPI.h File Reference

2-D surface drawing support interface.

```
#include "OrbiterAPI.h"
Include dependency graph for DrawAPI.h:
```



## Classes

- union [oapi::IVECTOR2](#)  
*Integer-valued 2-D vector type.*
- class [oapi::DrawingTool](#)  
*Base class for various 2-D drawing resources (fonts, pens, brushes, etc.)*
- class [oapi::Font](#)  
*A font resource for drawing text. A font has a defined size, typeface, slant, weight, etc. Fonts can be selected into a [Sketchpad](#) and then apply to all subsequent Text calls.*
- class [oapi::Pen](#)  
*A pen is a resource used for drawing lines and the outlines of closed figures such as rectangles, ellipses and polygons.*
- class [oapi::Brush](#)  
*A brush is a drawing resource for filling closed figures (rectangles, ellipses, polygons).*
- class [oapi::Sketchpad](#)  
*A Sketchpad object defines an environment for drawing onto 2-D surfaces.*

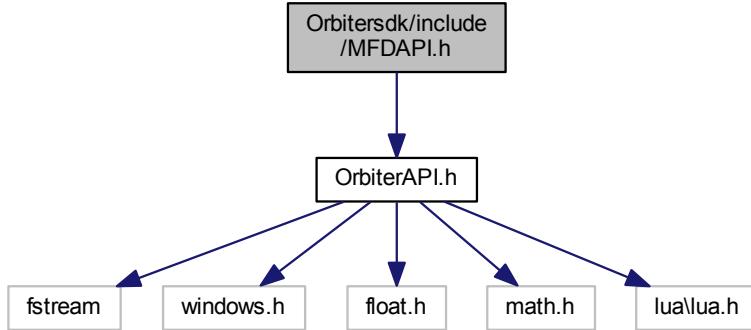
### 18.2.1 Detailed Description

2-D surface drawing support interface.

## 18.3 Orbitersdk/include/MFDAPI.h File Reference

Class interfaces for [MFD](#) instruments and [MFD](#) modes.

```
#include "OrbiterAPI.h"
Include dependency graph for MFDAPI.h:
```



## Classes

- class [MFD](#)

*This class acts as an interface for user defined MFD (multi functional display) modes.*

- class [MFD2](#)

*Extended [MFD](#) class.*

- class [GraphMFD](#)

*This class is derived from [MFD](#) and provides a template for [MFD](#) modes containing 2D graphs.*

- class [ExternMFD](#)

*[ExternMFD](#) provides support for defining an [MFD](#) display in a plugin module.*

### 18.3.1 Detailed Description

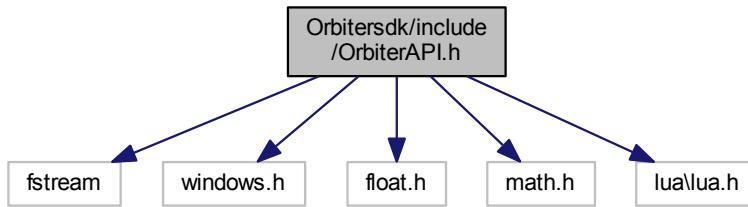
Class interfaces for [MFD](#) instruments and [MFD](#) modes.

## 18.4 OrbiterSDK/include/OrbiterAPI.h File Reference

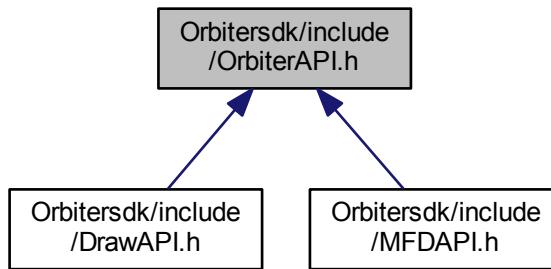
General API interface functions.

```
#include <fstream>
#include <windows.h>
#include <float.h>
#include <math.h>
#include "lua\lua.h"
```

Include dependency graph for OrbiterAPI.h:



This graph shows which files directly or indirectly include this file:



## Classes

- union [VECTOR3](#)  
*3-element vector*
- union [VECTOR4](#)  
*4-element vector*
- union [MATRIX3](#)  
*3x3-element matrix*
- struct [COLOUR4](#)  
*colour definition*
- struct [NTVERTEX](#)  
*vertex definition including normals and texture coordinates*
- struct [MESHGROUP](#)  
*Defines a mesh group (subset of a mesh).*
- struct [MESHGROUPEX](#)  
*extended mesh group definition*
- struct [GROUPEDITSPEC](#)  
*Structure used by `oapiEditMeshGroup` to define the group elements to be replaced or modified.*
- struct [GROUPREQUESTSPEC](#)

- Structure used by [oapiGetMeshGroup](#) containing data buffers to be filled with vertex and index data.*
- struct [MATERIAL](#)  
*material definition*
  - struct [ELEMENTS](#)  
*Kepler orbital elements.*
  - struct [ORBITPARAM](#)  
*Secondary orbital parameters derived from the primary [ELEMENTS](#).*
  - struct [ATMCONST](#)  
*Planetary atmospheric constants structure.*
  - struct [ATMPARAM](#)  
*Atmospheric parameters structure.*
  - struct [ENGINESTATUS](#)  
*Engine status.*
  - struct [EXHAUSTSPEC](#)  
*Engine exhaust render parameters.*
  - struct [PARTICLESTREAMSPEC](#)  
*Particle stream parameters.*
  - class [LightEmitter](#)  
*Base class for defining a light source that can illuminate other objects.*
  - class [PointLight](#)  
*Class for isotropic point light source.*
  - class [SpotLight](#)  
*Class for directed spot light sources.*
  - struct [NAVDATA](#)  
*Navigation transmitter data.*
  - struct [BEACONLIGHTSPEC](#)  
*vessel beacon light parameters*
  - struct [VESSELSTATUS](#)  
*Vessel status parameters (version 1)*
  - struct [VESSELSTATUS2](#)  
*Vessel status parameters (version 2)*
  - struct [VESSELSTATUS2::FUELSPEC](#)  
*propellant list*
  - struct [VESSELSTATUS2::THRUSTSPEC](#)  
*thruster definition list*
  - struct [VESSELSTATUS2::DOCKINFOSPEC](#)  
*dock info list*
  - struct [LISTENTRY](#)  
*Entry specification for selection list entry.*
  - struct [HELPCONTEXT](#)  
*Context information for an Orbiter ingame help page.*
  - struct [MESHGROUP\\_TRANSFORM](#)  
*This structure defines an affine mesh group transform (translation, rotation or scaling).*
  - struct [ANIMATIONCOMP](#)  
*Animation component definition.*
  - struct [ANIMATION](#)  
*Animation definition.*
  - union [HUDPARAM](#)  
*Mode-specific parameters for HUD mode settings.*
  - class [LaunchpadItem](#)  
*Base class to define launchpad items.*

## Macros

- `#define DLLEXPORT __declspec(dllexport)`
- `#define DLLIMPORT __declspec(dllimport)`
- `#define DLLCLBK extern "C" __declspec(dllexport)`
- `#define OAPIFUNC DLLIMPORT`
- `#define RENDERTGT_NONE ((SURFHANDLE)-1)`
  - no surface*
- `#define RENDERTGT_MAINWINDOW 0`
- `#define OAPISURFACE_TEXTURE 0x0001`
  - Surface can be used as a texture (e.g. by associating it with a mesh)*
- `#define OAPISURFACE_RENDERTARGET 0x0002`
  - Surface can be rendered to by the graphics device.*
- `#define OAPISURFACE_GDI 0x0004`
  - A HDC context can be requested from the surface for GDI drawing.*
- `#define OAPISURFACE_SKETCHPAD 0x0008`
  - A Sketchpad context can be requested from the surface for Sketchpad drawing.*
- `#define OAPISURFACE_MIPMAPS 0x0010`
  - Create a full chain of mipmaps for the surface. If loaded from file, add any missing mipmap levels.*
- `#define OAPISURFACE_NOMIPMAPS 0x0020`
  - Don't create mipmaps. If loaded from file, ignore any mipmap levels present.*
- `#define OAPISURFACE_ALPHA 0x0040`
  - Create an alpha channel for the surface. If loaded from file, add an alpha channel if required.*
- `#define OAPISURFACE_NOALPHA 0x0080`
  - Don't create an alpha channel. If loaded from file, strip any existing alpha channel.*
- `#define OAPISURFACE_UNCOMPRESS 0x0100`
  - Create an uncompressed surface. If loaded from file, uncompress if required.*
- `#define OAPISURFACE_SYSMEM 0x0200`
  - Create the surface in system (host) memory.*
- `#define OAPISURFACE_RENDER3D 0x0400`
  - Create a surface that can act as a target for rendering a 3D scene.*
- `#define GRPEDIT_SETUSERFLAG 0x00001`
  - replace the group's UsrFlag entry with the value in the GROUPEDITSPEC structure.*
- `#define GRPEDIT_ADDUSERFLAG 0x00002`
  - Add the UsrFlag value to the group's UsrFlag entry.*
- `#define GRPEDIT_DELUSERFLAG 0x00004`
  - Remove the UsrFlag value from the group's UsrFlag entry.*
- `#define GRPEDIT_VTXCRDX 0x00008`
  - Replace vertex x-coordinates.*
- `#define GRPEDIT_VTXCRDY 0x00010`
  - Replace vertex y-coordinates.*
- `#define GRPEDIT_VTXCRDZ 0x00020`
  - Replace vertex z-coordinates.*
- `#define GRPEDIT_VTXCRD (GRPEDIT_VTXCRDX | GRPEDIT_VTXCRDY | GRPEDIT_VTXCRDZ)`
  - Replace vertex coordinates.*
- `#define GRPEDIT_VTXNMLX 0x00040`
  - Replace vertex x-normals.*
- `#define GRPEDIT_VTXNMLY 0x00080`
  - Replace vertex y-normals.*
- `#define GRPEDIT_VTXNMLZ 0x00100`
  - Replace vertex z-normals.*

- `#define GRPEDIT_VTXNML (GRPEDIT_VTXNMLX | GRPEDIT_VTXNMLY | GRPEDIT_VTXNMLZ)`  
*Replace vertex normals.*
- `#define GRPEDIT_VTXTEXU 0x00200`  
*Replace vertex texture u-coordinates.*
- `#define GRPEDIT_VTXTEXV 0x00400`  
*Replace vertex texture v-coordinates.*
- `#define GRPEDIT_VTXTEX (GRPEDIT_VTXTEXU | GRPEDIT_VTXTEXV)`  
*Replace vertex texture coordinates.*
- `#define GRPEDIT_VTX (GRPEDIT_VTXCRD | GRPEDIT_VTXNML | GRPEDIT_VTXTEX)`  
*Replace vertices.*
- `#define GRPEDIT_VTXCRDADDX 0x00800`  
*Add to vertex x-coordinates.*
- `#define GRPEDIT_VTXCRDADDY 0x01000`  
*Add to vertex y-coordinates.*
- `#define GRPEDIT_VTXCRDADDZ 0x02000`  
*Add to vertex z-coordinates.*
- `#define GRPEDIT_VTXCRDADD (GRPEDIT_VTXCRDADDX | GRPEDIT_VTXCRDADDY | GRPEDIT_VTXCRDADDZ)`  
*Add to vertex coordinates.*
- `#define GRPEDIT_VTXNMLADDX 0x04000`  
*Add to vertex x-normals.*
- `#define GRPEDIT_VTXNMLADDY 0x08000`  
*Add to vertex y-normals.*
- `#define GRPEDIT_VTXNMLADDZ 0x10000`  
*Add to vertex z-normals.*
- `#define GRPEDIT_VTXNMLADD (GRPEDIT_VTXNMLADDX | GRPEDIT_VTXNMLADDY | GRPEDIT_VTXNMLADDZ)`  
*Add to vertex normals.*
- `#define GRPEDIT_VTXTEXADDU 0x20000`  
*Add to vertex texture u-coordinates.*
- `#define GRPEDIT_VTXTEXADDV 0x40000`  
*Add to vertex texture v-coordinates.*
- `#define GRPEDIT_VTXTEXADD (GRPEDIT_VTXTEXADDU | GRPEDIT_VTXTEXADDV)`  
*Add to vertex texture coordinates.*
- `#define GRPEDIT_VTXADD (GRPEDIT_VTXCRDADD | GRPEDIT_VTXNMLADD | GRPEDIT_VTXTEXADD)`
- `#define GRPEDIT_VTXMOD (GRPEDIT_VTX | GRPEDIT_VTXADD)`
- `#define EXHAUST_CONSTANTLEVEL 0x0001`  
*exhaust level is constant*
- `#define EXHAUST_CONSTANTPOS 0x0002`  
*exhaust position is constant*
- `#define EXHAUST_CONSTANTDIR 0x0004`  
*exhaust direction is constant*
- `#define BEACONSHAPE_COMPACT 0`  
*compact beacon shape*
- `#define BEACONSHAPE_DIFFUSE 1`  
*diffuse beacon shape*
- `#define BEACONSHAPE_STAR 2`  
*star-shaped beacon*
- `#define VS_FUELRESET 0x00000001`  
*set all propellant levels to zero*

- `#define VS_FUELLIST 0x00000002`  
*list of propellant levels is provided*
- `#define VS_THRUSTRESET 0x00000004`  
*set all thruster levels to zero*
- `#define VS_THRUSTLIST 0x00000008`  
*list of thruster levels is provided*
- `#define VS_DOCKINFOLIST 0x00000010`  
*list of docked objects is provided*
- `#define LISTENTRY_SUBITEM 0x01`  
*list entry has subitems*
- `#define LISTENTRY_INACTIVE 0x02`  
*list entry can not be selected*
- `#define LISTENTRY_SEPARATOR 0x04`  
*entry is followed by a separator*
- `#define LIST_UPENTRY 0x01`  
*list has parent list*
- `#define LISTCLBK_CANCEL 0x00`  
*user cancelled the selection list*
- `#define LISTCLBK_SELECT 0x01`  
*user selected an item*
- `#define LISTCLBK_SUBITEM 0x02`  
*user steps down to subitem*
- `#define LISTCLBK_UPLIST 0x03`  
*user steps up to parent list*
- `#define LOCALVERTEXLIST ((UINT)(-1))`  
*flags animation component as explicit vertex list*
- `#define MAKEGROUPARRAY(x) ((UINT*)x)`  
*casts a vertex array into a group*
- `#define MFD_SHOWMODELABELS 0x0001`
- `#define MFD_TRANSPARENT_WHEN_OFF 0x0002`
- `#define AIRCTRL_AXIS_AUTO 0`  
*Constants to define the rotation axis and direction of aerodynamic control surfaces.*
- `#define AIRCTRL_AXIS_YPOS 1`  
*y-axis (vertical), positive rotation*
- `#define AIRCTRL_AXIS_YNEG 2`  
*y-axis (vertical), negative rotation*
- `#define AIRCTRL_AXIS_XPOS 3`  
*x-axis (transversal), positive rotation*
- `#define AIRCTRL_AXIS_XNEG 4`  
*x-axis (transversal), negative rotation*
- `#define OBJTP_INVALID 0`
- `#define OBJTP_GENERIC 1`
- `#define OBJTP_CBODY 2`
- `#define OBJTP_STAR 3`
- `#define OBJTP_PLANET 4`
- `#define OBJTP_VESSEL 10`
- `#define OBJTP_SURFBASE 20`
- `#define EVENT_VESSEL_INSMESH 0`  
*Insert a mesh (context: mesh index)*
- `#define EVENT_VESSEL_DELMESH 1`  
*Delete a mesh (context: mesh index, or -1 for all)*

- `#define EVENT_VESSEL_MESHVISMODE 2`  
*Set mesh visibility mode (context: mesh index)*
- `#define EVENT_VESSEL_RESETANIM 3`  
*Reset animations.*
- `#define EVENT_VESSEL_CLEARANIM 4`  
*Clear all animations (context: `UINT` (1=reset animations, 0=leave animations at current state))*
- `#define EVENT_VESSEL_DELANIM 5`  
*Delete an animation (context: animation index)*
- `#define EVENT_VESSEL_NEWANIM 6`  
*Create a new animation (context: animation index)*
- `#define EVENT_VESSEL_MESHOF5 7`  
*Shift a mesh (context: mesh index)*
- `#define EVENT_VESSEL_MODMESHGROUP 8`  
*A mesh group has been modified.*
- `#define NAVMODE_KILLROT 1`  
*"Kill rotation" mode*
- `#define NAVMODE_HLEVEL 2`  
*"Hold level with horizon" mode*
- `#define NAVMODE_PROGRADE 3`  
*"Prograde" mode*
- `#define NAVMODE_RETROGRADE 4`  
*"Retrograde" mode*
- `#define NAVMODE_NORMAL 5`  
*"Normal to orbital plane" mode*
- `#define NAVMODE_ANTINORMAL 6`  
*"Anti-normal to orbital plane" mode*
- `#define NAVMODE_HOLDALT 7`  
*"Hold altitude" mode*
- `#define NAVBIT_KILLROT 0x01`
- `#define NAVBIT_HLEVEL 0x02`
- `#define NAVBIT_PROGRADE 0x04`
- `#define NAVBIT_RETROGRADE 0x08`
- `#define NAVBIT_NORMAL 0x10`
- `#define NAVBIT_ANTINORMAL 0x20`
- `#define NAVBIT_HOLDALT 0x40`
- `#define MANCTRL_ATTMODE 0`  
*current attitude mode*
- `#define MANCTRL_REVMODE 1`  
*reverse of current attitude mode*
- `#define MANCTRL_ROTMODE 2`  
*rotational attitude modes only*
- `#define MANCTRL_LINMODE 3`  
*linear attitude modes only*
- `#define MANCTRL_ANYMODE 4`  
*rotational and linear modes*
- `#define MANCTRL_KEYBOARD 0`  
*keyboard input*
- `#define MANCTRL_JOYSTICK 1`  
*joystick input*
- `#define MANCTRL_ANYDEVICE 2`  
*input from any device*

- `#define COCKPIT_GENERIC 1`
- `#define COCKPIT_PANELS 2`
- `#define COCKPIT_VIRTUAL 3`
- `#define CAM_COCKPIT 0`
- `#define CAM_TARGETRELATIVE 1`
- `#define CAM_ABSDIRECTION 2`
- `#define CAM_GLOBALFRAME 3`
- `#define CAM_TARGETTOOBJECT 4`
- `#define CAM_TARGETFROMOBJECT 5`
- `#define CAM_GROUNDOBSERVER 6`
- `#define PROP_ORBITAL 0x0F`
- `#define PROP_ORBITAL_ELEMENTS 0x00`
- `#define PROP_ORBITAL_FIXEDSTATE 0x01`
- `#define PROP_ORBITAL_FIXEDSURF 0x02`
- `#define PROP_SORBITAL 0xF0`
- `#define PROP_SORBITAL_ELEMENTS (0x0 << 4)`
- `#define PROP_SORBITAL_FIXEDSTATE (0x1 << 4)`
- `#define PROP_SORBITAL_FIXEDSURF (0x2 << 4)`
- `#define PROP_SORBITAL_DESTROY (0x3 << 4)`
- `#define USRINPUT_NEEDANSWER 1`
- `#define RCS_NONE 0`
  - None (RCS off)*
- `#define RCS_ROT 1`
  - Rotational mode.*
- `#define RCS_LIN 2`
  - Linear (translational) mode.*
- `#define HUD_NONE 0`
  - No mode (turn HUD off)*
- `#define HUD_ORBIT 1`
  - Orbit HUD mode.*
- `#define HUD_SURFACE 2`
  - Surface HUD mode.*
- `#define HUD_DOCKING 3`
  - Docking HUD mode.*
- `#define MFD_REFRESHBUTTONS -1`
  - Refresh MFD buttons.*
- `#define MFD_NONE 0`
  - No mode (turn MFD off)*
- `#define MFD_ORBIT 1`
  - Orbit MFD mode.*
- `#define MFD_SURFACE 2`
  - Surface MFD mode.*
- `#define MFD_MAP 3`
  - Map MFD mode.*
- `#define MFD_HSI 4`
  - HSI (horizontal situation indicator) MFD mode.*
- `#define MFD_LANDING 5`
  - VTOL support MFD mode.*
- `#define MFD_DOCKING 6`
  - Docking support MFD mode.*
- `#define MFD_OPLANEALIGN 7`
  - Orbital plane alignment MFD mode.*

- `#define MFD_OSYNC 8`  
*Orbit synchronisation MFD mode.*
- `#define MFD_TRANSFER 9`  
*Transfer orbit MFD mode.*
- `#define MFD_COMMs 10`  
*Communications MFD mode.*
- `#define MFD_USERTYPE 64`  
*User-defined MFD mode.*
- `#define BUILTIN_MFD_MODES 10`  
*Number of built-in MFD modes.*
- `#define MAXMFD 12`  
*Max. number of MFD displays per panel.*
- `#define MFD_LEFT 0`  
*Left default MFD display.*
- `#define MFD_RIGHT 1`  
*Right default MFD display.*
- `#define MFD_USER1 2`  
*User-defined MFD display 1.*
- `#define MFD_USER2 3`  
*User-defined MFD display 2.*
- `#define MFD_USER3 4`  
*User-defined MFD display 3.*
- `#define MFD_USER4 5`  
*User-defined MFD display 4.*
- `#define MFD_USER5 6`  
*User-defined MFD display 5.*
- `#define MFD_USER6 7`  
*User-defined MFD display 6.*
- `#define MFD_USER7 8`  
*User-defined MFD display 7.*
- `#define MFD_USER8 9`  
*User-defined MFD display 8.*
- `#define MFD_USER9 10`  
*User-defined MFD display 9.*
- `#define MFD_USER10 11`  
*User-defined MFD display 10.*
- `#define PANEL_LEFT 0`  
*left neighbour*
- `#define PANEL_RIGHT 1`  
*right neighbour*
- `#define PANEL_UP 2`  
*above neighbour*
- `#define PANEL_DOWN 3`  
*below neighbour*
- `#define PANEL_REDRAW_NEVER 0x0000`  
*Don't generate redraw events.*
- `#define PANEL_REDRAW_ALWAYS 0x0001`  
*Generate event at each frame.*
- `#define PANEL_REDRAW_MOUSE 0x0002`  
*Generate event on mouse event.*
- `#define PANEL_REDRAW_INIT 0x0003`

- `#define PANEL_REDRAW_USER 0x0004`
  - Initialisation event.*
- `#define PANEL_REDRAW_GDI 0x1000`
  - User-generated event.*
- `#define PANEL_REDRAW_SKETCHPAD 0x2000`
  - Allow GDI access during redraw events.*
- `#define PANEL_MOUSE_IGNORE 0x00`
  - Don't generate mouse events.*
- `#define PANEL_MOUSE_LBUTTONDOWN 0x01`
  - Left button down event.*
- `#define PANEL_MOUSE_RBUTTONDOWN 0x02`
  - Right button down event.*
- `#define PANEL_MOUSE_LBUTTONUP 0x04`
  - Left button release event.*
- `#define PANEL_MOUSE_RBUTTONUP 0x08`
  - Right button release event.*
- `#define PANEL_MOUSE_LBAPPED 0x10`
  - Left button down (continuous)*
- `#define PANEL_MOUSE_RBAPPED 0x20`
  - Right button down (continuous)*
- `#define PANEL_MOUSE_DOWN 0x03`
  - Composite down event.*
- `#define PANEL_MOUSE_UP 0x0C`
  - Composite release event.*
- `#define PANEL_MOUSE_PRESSED 0x30`
  - Composite down (continuous)*
- `#define PANEL_MOUSE_ONREPLAY 0x40`
  - Create mouse events during replay.*
- `#define PANEL_MAP_NONE 0x00`
  - area texture is undefined (i.e. should be completely redrawn)*
- `#define PANEL_MAP_BACKGROUND 0x01`
  - area texture contains a copy of the panel background*
- `#define PANEL_MAP_CURRENT 0x02`
  - area texture contains a copy of the current panel state*
- `#define PANEL_MAP_BGONREQUEST 0x03`
  - area texture is undefined, but panel background can be requested*
- `#define PANEL_MAP_DIRECT 0x04`
  - provide the entire input surface to redraw functions without clipping*
- `#define PANEL_ATTACH_BOTTOM 0x0001`
- `#define PANEL_ATTACH_TOP 0x0002`
- `#define PANEL_ATTACH_LEFT 0x0004`
- `#define PANEL_ATTACH_RIGHT 0x0008`
- `#define PANEL_MOVEOUT_BOTTOM 0x0010`
- `#define PANEL_MOVEOUT_TOP 0x0020`
- `#define PANEL_MOVEOUT_LEFT 0x0040`
- `#define PANEL_MOVEOUT_RIGHT 0x0080`
- `#define SURF_NO_CK 0xFFFFFFFF`
- `#define SURF_PREDEF_CK 0xFFFFFFF`
- `#define SURF_NO_ROTATION ((DWORD)-1)`
- `#define SURF_HMIRROR ((DWORD)-2)`
- `#define SURF_VMIRROR ((DWORD)-3)`

- `#define SURF_ROTATE_90 ((DWORD)-4)`
- `#define SURF_ROTATE_180 ((DWORD)-5)`
- `#define SURF_ROTATE_270 ((DWORD)-6)`
- `#define DLG_ALLOWMULTI 0x1`
- `#define DLG_CAPTIONCLOSE 0x2`
- `#define DLG_CAPTIONHELP 0x4`
- `#define DLG_CB_TWOSTATE 0x1`
- `#define OAPI_MSG_MFD_OPENED 1`
- `#define OAPI_MSG_MFD_CLOSED 2`
- `#define OAPI_MSG_MFD_UPDATE 3`
- `#define OAPI_MSG_MFD_OPENEDEX 4`
- `#define VMSG_LUAINTERPRETER 0x0001`
  - initialise Lua interpreter*
- `#define VMSG_LUAINSTANCE 0x0002`
  - create Lua vessel instance*
- `#define VMSG_USER 0x1000`
  - base index for user-defined messages*
- `#define MESHVIS_NEVER 0x00`
  - Mesh is never visible.*
- `#define MESHVIS_EXTERNAL 0x01`
  - Mesh is visible in external views.*
- `#define MESHVIS_COCKPIT 0x02`
  - Mesh is visible in all internal (cockpit) views.*
- `#define MESHVIS_ALWAYS (MESHVIS_EXTERNAL|MESHVIS_COCKPIT)`
  - Mesh is always visible.*
- `#define MESHVIS_VC 0x04`
  - Mesh is only visible in virtual cockpit internal views.*
- `#define MESHVIS_EXTPASS 0x10`
  - Visibility modifier: render mesh during external pass, even for internal views.*
- `#define MESHPROPERTY_MODULATEMATALPHA 1`
- `#define TRANSMITTER_NONE 0`
- `#define TRANSMITTER_VOR 1`
- `#define TRANSMITTER_VTOL 2`
- `#define TRANSMITTER_ILS 3`
- `#define TRANSMITTER_IDS 4`
- `#define TRANSMITTER_XPDR 5`
- `#define OBJPRM_PLANET_SURFACEMAXLEVEL 0x0001`
  - Max. resolution level for planet surface rendering. (Parameter type: DWORD)*
- `#define OBJPRM_PLANET_SURFACERIPPLE 0x0002`
  - Flag for ripple effect on reflective surfaces (Parameter type: bool)*
- `#define OBJPRM_PLANET_HAZEEXTENT 0x0003`
  - Bleed-in factor of atmospheric haze into planet disc. (Parameter type: double; range: 0-0.9)*
- `#define OBJPRM_PLANET_HAZEDENSITY 0x0004`
  - Density at which the horizon haze is rendered (basic density is calculated from atmospheric density) Default: 1.0. (Parameter type: double)*
- `#define OBJPRM_PLANET_HAZESHIFT 0x0005`
- `#define OBJPRM_PLANET_HAZECOLOUR 0x0006`
- `#define OBJPRM_PLANET_FOGPARAM 0x0007`
- `#define OBJPRM_PLANET_SHADOWCOLOUR 0x0008`
- `#define OBJPRM_PLANET_HASCLOUDS 0x0009`
- `#define OBJPRM_PLANET_CLOUDALT 0x000A`
- `#define OBJPRM_PLANET_CLOUDROTATION 0x000B`
- `#define OBJPRM_PLANET_CLOUDSHADOWCOL 0x000C`

- **OBJPRM\_PLANET\_CLOUDMICROTEX** 0x000D  
*Depth of cloud shadows (parameter type: float)*
- **OBJPRM\_PLANET\_CLOUDMICROALTMIN** 0x000E
- **OBJPRM\_PLANET\_CLOUDMICROALTMAX** 0x000F
- **OBJPRM\_PLANET\_HASRINGS** 0x0010
- **OBJPRM\_PLANET\_RINGMINRAD** 0x0011
- **OBJPRM\_PLANET\_RINGMAXRAD** 0x0012
- **OBJPRM\_PLANET\_ATTENUATIONALT** 0x0013
- **OBJPRM\_PLANET\_TILEENGINE** 0x0014  
*Altitude [m] up to which an atmosphere attenuates light cast from the sun on a spacecraft. (Parameter type: double)*
- **OBJPRM\_PLANET\_CLOUDTILEENGINE** 0x0015  
*Planet tile engine version (1 or 2) (Parameter type: int)*
- **OBJPRM\_PLANET\_ATMTINTCOLOUR** 0x0016  
*Planet cloud tile engine version (1 or 2) (Parameter type: int)*
- **OBJPRM\_PLANET\_CLOUDMAXLEVEL** 0x0017  
*Atmospheric tint colour. This colour is mixed into the surface textures when seen through an atmospheric layer. (Parameter type: VECTOR3)*
- **OBJPRM\_PLANET\_CLOUDOVERSATURATE** 0x0018  
*Max. resolution level for cloud layer rendering (Parameter type: int)*
- **OBJPRM\_PLANET\_HORIZONEXCESS** 0x0019  
*Enhance cloud brightness? (Parameter type: bool)*
- **OBJPRM\_PLANET\_TILEBBEXCESS** 0x0020  
*Extend horizon visibility radius (avoid disappearing mountaintop artefacts) (Parameter type: double)*
- **OAPI\_KEY\_ESCAPE** 0x01  
*Extend tile bounding box (avoid disappearing tiles for irregular shaped bodies) (Parameter type: double)*
- **OAPI\_KEY\_1** 0x02  
*Escape key.*
- **OAPI\_KEY\_2** 0x03  
*'1' key on main keyboard*
- **OAPI\_KEY\_3** 0x04  
*'2' key on main keyboard*
- **OAPI\_KEY\_4** 0x05  
*'3' key on main keyboard*
- **OAPI\_KEY\_5** 0x06  
*'4' key on main keyboard*
- **OAPI\_KEY\_6** 0x07  
*'5' key on main keyboard*
- **OAPI\_KEY\_7** 0x08  
*'6' key on main keyboard*
- **OAPI\_KEY\_8** 0x09  
*'7' key on main keyboard*
- **OAPI\_KEY\_9** 0x0A  
*'8' key on main keyboard*
- **OAPI\_KEY\_0** 0x0B  
*'9' key on main keyboard*
- **OAPI\_KEY\_MINUS** 0x0C  
*'0' key on main keyboard*
- **OAPI\_KEY\_EQUALS** 0x0D  
*'-' key on main keyboard*
- **OAPI\_KEY\_BACK** 0x0E  
*'=' key on main keyboard*

- `#define OAPI_KEY_TAB 0x0F`  
*tab key*
- `#define OAPI_KEY_Q 0x10`  
*'Q' key*
- `#define OAPI_KEY_W 0x11`  
*'W' key*
- `#define OAPI_KEY_E 0x12`  
*'E' key*
- `#define OAPI_KEY_R 0x13`  
*'R' key*
- `#define OAPI_KEY_T 0x14`  
*'T' key*
- `#define OAPI_KEY_Y 0x15`  
*'Y' key*
- `#define OAPI_KEY_U 0x16`  
*'U' key*
- `#define OAPI_KEY_I 0x17`  
*'I' key*
- `#define OAPI_KEY_O 0x18`  
*'O' key*
- `#define OAPI_KEY_P 0x19`  
*'P' key*
- `#define OAPI_KEY_LBRACKET 0x1A`  
*[' (left bracket) key*
- `#define OAPI_KEY_RBRACKET 0x1B`  
*'] (right bracket) key*
- `#define OAPI_KEY_RETURN 0x1C`  
*'Enter' key on main keyboard*
- `#define OAPI_KEY_LCONTROL 0x1D`  
*Left 'Ctrl' key.*
- `#define OAPI_KEY_A 0x1E`  
*'A' key*
- `#define OAPI_KEY_S 0x1F`  
*'S' key*
- `#define OAPI_KEY_D 0x20`  
*'D' key*
- `#define OAPI_KEY_F 0x21`  
*'F' key*
- `#define OAPI_KEY_G 0x22`  
*'G' key*
- `#define OAPI_KEY_H 0x23`  
*'H' key*
- `#define OAPI_KEY_J 0x24`  
*'J' key*
- `#define OAPI_KEY_K 0x25`  
*'K' key*
- `#define OAPI_KEY_L 0x26`  
*'L' key*
- `#define OAPI_KEY_SEMICOLON 0x27`  
*'; (semicolon) key*

- `#define OAPI_KEY_APOSTROPHE 0x28`  
*' (apostrophe) key*
- `#define OAPI_KEY_GRAVE 0x29`  
*accent grave*
- `#define OAPI_KEY_LSHIFT 0x2A`  
*Left 'Shift' key.*
- `#define OAPI_KEY_BACKSLASH 0x2B`  
*'\'' (Backslash) key*
- `#define OAPI_KEY_Z 0x2C`  
*'Z' key*
- `#define OAPI_KEY_X 0x2D`  
*'X' key*
- `#define OAPI_KEY_C 0x2E`  
*'C' key*
- `#define OAPI_KEY_V 0x2F`  
*'V' key*
- `#define OAPI_KEY_B 0x30`  
*'B' key*
- `#define OAPI_KEY_N 0x31`  
*'N' key*
- `#define OAPI_KEY_M 0x32`  
*'M' key*
- `#define OAPI_KEY_COMMA 0x33`  
*',' (comma) key*
- `#define OAPI_KEY_PERIOD 0x34`  
*'.' key on main keyboard*
- `#define OAPI_KEY_SLASH 0x35`  
*'/' key on main keyboard*
- `#define OAPI_KEY_RSHIFT 0x36`  
*Right 'Shift' key.*
- `#define OAPI_KEY_MULTIPLY 0x37`
- `#define OAPI_KEY_LALT 0x38`  
*left Alt*
- `#define OAPI_KEY_SPACE 0x39`  
*'Space' key*
- `#define OAPI_KEY_CAPITAL 0x3A`  
*caps lock key*
- `#define OAPI_KEY_F1 0x3B`  
*F1 function key.*
- `#define OAPI_KEY_F2 0x3C`  
*F2 function key.*
- `#define OAPI_KEY_F3 0x3D`  
*F3 function key.*
- `#define OAPI_KEY_F4 0x3E`  
*F4 function key.*
- `#define OAPI_KEY_F5 0x3F`  
*F5 function key.*
- `#define OAPI_KEY_F6 0x40`  
*F6 function key.*
- `#define OAPI_KEY_F7 0x41`  
*F7 function key.*

- `#define OAPI_KEY_F8 0x42`  
*F8 function key.*
- `#define OAPI_KEY_F9 0x43`  
*F9 function key.*
- `#define OAPI_KEY_F10 0x44`  
*F10 function key.*
- `#define OAPI_KEY_NUMLOCK 0x45`  
*'Num Lock' key*
- `#define OAPI_KEY_SCROLL 0x46`  
*Scroll lock.*
- `#define OAPI_KEY_NUMPAD7 0x47`  
*'7' key on numeric keypad*
- `#define OAPI_KEY_NUMPAD8 0x48`  
*'8' key on numeric keypad*
- `#define OAPI_KEY_NUMPAD9 0x49`  
*'9' key on numeric keypad*
- `#define OAPI_KEY_SUBTRACT 0x4A`  
*'-' key on numeric keypad*
- `#define OAPI_KEY_NUMPAD4 0x4B`  
*'4' key on numeric keypad*
- `#define OAPI_KEY_NUMPAD5 0x4C`  
*'5' key on numeric keypad*
- `#define OAPI_KEY_NUMPAD6 0x4D`  
*'6' key on numeric keypad*
- `#define OAPI_KEY_ADD 0x4E`  
*'+' key on numeric keypad*
- `#define OAPI_KEY_NUMPAD1 0x4F`  
*'1' key on numeric keypad*
- `#define OAPI_KEY_NUMPAD2 0x50`  
*'2' key on numeric keypad*
- `#define OAPI_KEY_NUMPAD3 0x51`  
*'3' key on numeric keypad*
- `#define OAPI_KEY_NUMPAD0 0x52`  
*'0' key on numeric keypad*
- `#define OAPI_KEY_DECIMAL 0x53`  
*'.' key on numeric keypad*
- `#define OAPI_KEY_OEM_102 0x56`  
*| < > on UK/German keyboards*
- `#define OAPI_KEY_F11 0x57`  
*F11 function key.*
- `#define OAPI_KEY_F12 0x58`  
*F12 function key.*
- `#define OAPI_KEY_NUMPADENTER 0x9C`  
*Enter on numeric keypad.*
- `#define OAPI_KEY_RCONTROL 0x9D`  
*right Control key*
- `#define OAPI_KEY_DIVIDE 0xB5`  
*'/' key on numeric keypad*
- `#define OAPI_KEY_SYSRQ 0xB7`  
*SysRq/PrtScn key.*
- `#define OAPI_KEY_RALT 0xB8`

- `right Alt`
- `#define OAPI_KEY_PAUSE 0xC5`
  - Break/Pause key.*
- `#define OAPI_KEY_HOME 0xC7`
  - Home on cursor keypad.*
- `#define OAPI_KEY_UP 0xC8`
  - up-arrow on cursor keypad*
- `#define OAPI_KEY_PRIOR 0xC9`
  - PgUp on cursor keypad.*
- `#define OAPI_KEY_LEFT 0xCB`
  - left-arrow on cursor keypad*
- `#define OAPI_KEY_RIGHT 0xCD`
  - right-arrow on cursor keypad*
- `#define OAPI_KEY_END 0xCF`
  - End on cursor keypad.*
- `#define OAPI_KEY_DOWN 0xD0`
  - down-arrow on cursor keypad*
- `#define OAPI_KEY_NEXT 0xD1`
  - PgDn on cursor keypad.*
- `#define OAPI_KEY_INSERT 0xD2`
  - Insert on cursor keypad.*
- `#define OAPI_KEY_DELETE 0xD3`
  - Delete on cursor keypad.*
- `#define KEYDOWN(buf, key) (buf[key] & 0x80)`
- `#define RESETKEY(buf, key) (buf[key] = 0)`
- `#define KEYMOD_LSHIFT(buf) (KEYDOWN(buf,OAPI_KEY_LSHIFT))`
- `#define KEYMOD_RSHIFT(buf) (KEYDOWN(buf,OAPI_KEY_RSHIFT))`
- `#define KEYMOD_SHIFT(buf) (KEYMOD_LSHIFT(buf) || KEYMOD_RSHIFT(buf))`
- `#define KEYMOD_LCONTROL(buf) (KEYDOWN(buf,OAPI_KEY_LCONTROL))`
- `#define KEYMOD_RCONTROL(buf) (KEYDOWN(buf,OAPI_KEY_RCONTROL))`
- `#define KEYMOD_CONTROL(buf) (KEYMOD_LCONTROL(buf) || KEYMOD_RCONTROL(buf))`
- `#define KEYMOD_LALT(buf) (KEYDOWN(buf,OAPI_KEY_LALT))`
- `#define KEYMOD_RALT(buf) (KEYDOWN(buf,OAPI_KEY_RALT))`
- `#define KEYMOD_ALT(buf) (KEYMOD_LALT(buf) || KEYMOD_RALT(buf))`
- `#define OAPI_LKEY_CockpitRotateLeft 0`
  - rotate camera left in cockpit view*
- `#define OAPI_LKEY_CockpitRotateRight 1`
  - rotate camera right in cockpit view*
- `#define OAPI_LKEY_CockpitRotateUp 2`
  - rotate camera up in cockpit view*
- `#define OAPI_LKEY_CockpitRotateDown 3`
  - rotate camera down in cockpit view*
- `#define OAPI_LKEY_CockpitDontLean 4`
  - return to default cockpit camera position*
- `#define OAPI_LKEY_CockpitLeanForward 5`
  - move cockpit camera forward*
- `#define OAPI_LKEY_CockpitLeanLeft 6`
  - move cockpit camera left*
- `#define OAPI_LKEY_CockpitLeanRight 7`
  - move cockpit camera right*
- `#define OAPI_LKEY_CockpitResetCam 8`

- `#define OAPI_LKEY_PanelShiftLeft 9`  
*rotate and shift cockpit camera back to default*  
*shift 2D instrument panel left*
- `#define OAPI_LKEY_PanelShiftRight 10`  
*shift 2D instrument panel right*
- `#define OAPI_LKEY_PanelShiftUp 11`  
*shift 2D instrument panel up*
- `#define OAPI_LKEY_PanelShiftDown 12`  
*shift 2D instrument panel down*
- `#define OAPI_LKEY_PanelSwitchLeft 13`  
*switch to left neighbour panel*
- `#define OAPI_LKEY_PanelSwitchRight 14`  
*switch to right neighbour panel*
- `#define OAPI_LKEY_PanelSwitchUp 15`  
*switch to upper neighbour panel*
- `#define OAPI_LKEY_PanelSwitchDown 16`  
*switch to lower neighbour panel*
- `#define OAPI_LKEY_TrackRotateLeft 17`  
*turn track view camera left*
- `#define OAPI_LKEY_TrackRotateRight 18`  
*turn track view camera right*
- `#define OAPI_LKEY_TrackRotateUp 19`  
*turn track view camera up*
- `#define OAPI_LKEY_TrackRotateDown 20`  
*turn track view camera down*
- `#define OAPI_LKEY_TrackAdvance 21`  
*advance track view camera towards target*
- `#define OAPI_LKEY_TrackRetreat 22`  
*retreat track view camera from target*
- `#define OAPI_LKEY_GroundTiltLeft 23`  
*tilt camera left in ground view*
- `#define OAPI_LKEY_GroundTiltRight 24`  
*tilt camera right in ground view*
- `#define OAPI_LKEY_GroundTiltUp 25`  
*tilt camera up in ground view*
- `#define OAPI_LKEY_GroundTiltDown 26`  
*tilt camera down in ground view*
- `#define OAPI_LKEY_IncMainThrust 27`  
*increment thrust of main thrusters*
- `#define OAPI_LKEY_DecMainThrust 28`  
*decrement thrust of main thrusters*
- `#define OAPI_LKEY_KillMainRetro 29`  
*kill main and retro thrusters*
- `#define OAPI_LKEY_FullMainThrust 30`  
*temporary full main thrust*
- `#define OAPI_LKEY_FullRetroThrust 31`  
*temporary full retro thrust*
- `#define OAPI_LKEY_IncHoverThrust 32`  
*increment thrust of hover thrusters*
- `#define OAPI_LKEY_DecHoverThrust 33`  
*decrement thrust of hover thrusters*

- `#define OAPI_LKEY_RCSEnable` 34  
*enable/disable RCS (reaction control system)*
- `#define OAPI_LKEY_RCSMode` 35  
*toggle linear/rotational RCS mode*
- `#define OAPI_LKEY_RCSPitchUp` 36  
*rotational RCS: pitch up*
- `#define OAPI_LKEY_RCSPitchDown` 37  
*rotational RCS: pitch down*
- `#define OAPI_LKEY_RCSYawLeft` 38  
*rotational RCS: yaw left*
- `#define OAPI_LKEY_RCSYawRight` 39  
*rotational RCS: yaw right*
- `#define OAPI_LKEY_RCSBankLeft` 40  
*rotational RCS: bank left*
- `#define OAPI_LKEY_RCSBankRight` 41  
*rotational RCS: bank right*
- `#define OAPI_LKEY_RCSUp` 42  
*linear RCS: accelerate up (+y)*
- `#define OAPI_LKEY_RCSDown` 43  
*linear RCS: accelerate down (-y)*
- `#define OAPI_LKEY_RCSLeft` 44  
*linear RCS: accelerate left (-x)*
- `#define OAPI_LKEY_RCSRRight` 45  
*linear RCS: accelerate right (+x)*
- `#define OAPI_LKEY_RCSForward` 46  
*linear RCS: accelerate forward (+z)*
- `#define OAPI_LKEY_RCSBack` 47  
*linear RCS: accelerate backward (-z)*
- `#define OAPI_LKEY_LPRCSPitchUp` 48  
*rotational RCS: pitch up 10%*
- `#define OAPI_LKEY_LPRCSPitchDown` 49  
*rotational RCS: pitch down 10%*
- `#define OAPI_LKEY_LPRCSYawLeft` 50  
*rotational RCS: yaw left 10%*
- `#define OAPI_LKEY_LPRCSYawRight` 51  
*rotational RCS: yaw right 10%*
- `#define OAPI_LKEY_LPRCSBankLeft` 52  
*rotational RCS: bank left 10%*
- `#define OAPI_LKEY_LPRCSBankRight` 53  
*rotational RCS: bank right 10%*
- `#define OAPI_LKEY_LPRCSUp` 54  
*linear RCS: accelerate up 10% (+y)*
- `#define OAPI_LKEY_LPRCSDown` 55  
*linear RCS: accelerate down 10% (-y)*
- `#define OAPI_LKEY_LPRCSLeft` 56  
*linear RCS: accelerate left 10% (-x)*
- `#define OAPI_LKEY_LPRCSRRight` 57  
*linear RCS: accelerate right 10% (+x)*
- `#define OAPI_LKEY_LPRCSForward` 58  
*linear RCS: accelerate forward 10% (+z)*
- `#define OAPI_LKEY_LPRCSBack` 59

- `#define OAPI_LKEY_NMHoldAltitude 60`  
*linear RCS: accelerate backward 10% (-z)*
- `#define OAPI_LKEY_NMHoldLevel 61`  
*toggle navmode: hold altitude*
- `#define OAPI_LKEY_NMHLevel 62`  
*toggle navmode: level with horizon*
- `#define OAPI_LKEY_NMPrograde 63`  
*toggle navmode: prograde*
- `#define OAPI_LKEY_NMRetrograde 64`  
*toggle navmode: retrograde*
- `#define OAPI_LKEY_NMNormal 65`  
*toggle navmode: normal to orbital plane*
- `#define OAPI_LKEY_NMAntinormal 66`  
*toggle navmode: antinormal to orbital plane*
- `#define OAPI_LKEY_NMKillrot 67`  
*toggle navmode: kill rotation*
- `#define OAPI_LKEY_Undock 68`  
*undock from docked vessel*
- `#define OAPI_LKEY_IncElevatorTrim 69`  
*increment elevator trim setting*
- `#define OAPI_LKEY_DecElevatorTrim 70`  
*decrement elevator trim setting*
- `#define OAPI_LKEY_WheelbrakeLeft 71`  
*apply wheelbrake left*
- `#define OAPI_LKEY_WheelbrakeRight 72`  
*apply wheelbrake right*
- `#define OAPI_LKEY_HUD 73`  
*toggle HUD on/off*
- `#define OAPI_LKEY_HUDMode 74`  
*switch through HUD modes*
- `#define OAPI_LKEY_HUDReference 75`  
*query reference object for HUD display*
- `#define OAPI_LKEY_HUDTarget 76`  
*query target object for HUD display*
- `#define OAPI_LKEY_HUDColour 77`  
*switch through HUD colours*
- `#define OAPI_LKEY_IncSimSpeed 78`  
*increase simulation speed x10*
- `#define OAPI_LKEY_DecSimSpeed 79`  
*decrease simulation speed x0.1*
- `#define OAPI_LKEY_IncFOV 80`  
*increment field of view*
- `#define OAPI_LKEY_DecFOV 81`  
*decrement field of view*
- `#define OAPI_LKEY_StepIncFOV 82`  
*increment field of view by 10 deg*
- `#define OAPI_LKEY_StepDecFOV 83`  
*decrement field of view by 10 deg*
- `#define OAPI_LKEY_MainMenu 84`  
*open main menu*
- `#define OAPI_LKEY_DlgHelp 85`  
*open help dialog*

- **#define OAPI\_LKEY\_DlgCamera** 85  
*open camera dialog*
- **#define OAPI\_LKEY\_DlgSimspeed** 86  
*open simulation speed dialog*
- **#define OAPI\_LKEY\_DlgCustomCmd** 87  
*open custom command dialog*
- **#define OAPI\_LKEY\_DlgVisHelper** 88  
*open visual helper dialog*
- **#define OAPI\_LKEY\_DlgRecorder** 89  
*open flight recorder dialog*
- **#define OAPI\_LKEY\_DlgInfo** 90  
*open object info dialog*
- **#define OAPI\_LKEY\_DlgMap** 91  
*open map dialog*
- **#define OAPI\_LKEY\_ToggleCamInternal** 92  
*switch between cockpit and external camera*
- **#define OAPI\_LKEY\_ToggleTrackMode** 93  
*switch between track camera modes*
- **#define OAPI\_LKEY\_TogglePanelMode** 94  
*switch between cockpit modes*
- **#define OAPI\_LKEY\_TogglePlanetarium** 95  
*toggle celestial marker display on/off*
- **#define OAPI\_LKEY\_ToggleRecPlay** 96  
*toggle flight recorder/playback on/off*
- **#define OAPI\_LKEY\_Pause** 97  
*toggle simulation pause on/off*
- **#define OAPI\_LKEY\_Quicksave** 98  
*quick-save current simulation state*
- **#define OAPI\_LKEY\_Quit** 99  
*quit simulation session*
- **#define OAPI\_LKEY\_DlgSelectVessel** 100  
*open vessel selection dialog*
- **#define OAPI\_LKEY\_SelectPrevVessel** 101  
*switch focus to previous vessel*
- **#define OAPI\_LKEY\_DlgCapture** 102  
*open screen capture dialog*
- **#define LKEY\_COUNT** 103  
*number of logical key definitions*

## Typedefs

- **typedef void \* OBJHANDLE**  
*Handle for objects (vessels, stations, planets)*
- **typedef void \* SUPERVESSELHANDLE**  
*Handle for vessel superstructures.*
- **typedef void \* VISHANDLE**  
*Handle for visuals.*
- **typedef void \* MESHHANDLE**  
*Handle for meshes.*
- **typedef int \* DEVMESSHHANDLE**

- **typedef void \* SURFHANDLE**  
*Handle for graphics-client-specific meshes.*
- **typedef void \* PANELHANDLE**  
*Handle for bitmap surfaces and textures (panels and panel items)*
- **typedef void \* FILEHANDLE**  
*Handle for 2D instrument panels.*
- **typedef void \* FILEHANDLE**  
*Handle for file streams.*
- **typedef void \* INTERPRETERHANDLE**  
*Handle for script interpreters.*
- **typedef void \* THRUSTER\_HANDLE**  
*Handle for thrusters.*
- **typedef void \* THGROUP\_HANDLE**  
*Handle for logical thruster groups.*
- **typedef void \* PROPELLANT\_HANDLE**  
*Propellant resource handle.*
- **typedef void \* PSTREAM\_HANDLE**  
*Handle for particle streams.*
- **typedef void \* DOCKHANDLE**  
*Handle for vessel docking ports.*
- **typedef void \* ATTACHMENTHANDLE**  
*Handle for vessel passive attachment points.*
- **typedef void \* AIRFOILHANDLE**  
*Handle for vessel airfoils.*
- **typedef void \* CTRLSURFHANDLE**  
*Handle for vessel aerodynamic control surfaces.*
- **typedef void \* NAVHANDLE**  
*Handle for a navigation radio transmitter (VOR, ILS, IDS, XPDR)*
- **typedef void \* ANIMATIONCOMPONENT\_HANDLE**  
*Handle for animation components.*
- **typedef void \* LAUNCHPADITEM\_HANDLE**  
*Handle for custom items added to Launchpad "Extra" list.*
- **typedef void \* NOTEHANDLE**  
*Handle for onscreen annotation objects.*
- **typedef void \* ELEVHANDLE**  
*Handle for elevation query managers.*
- **typedef bool(\* Listentry\_clbk) (char \*name, DWORD idx, DWORD flag, void \*usrdata)**  
*Callback function for list entry selections.*
- **typedef double(\* LiftCoeffFunc) (double aoa)**
- **typedef void(\* AirfoilCoeffFunc) (double aoa, double M, double Re, double \*cl, double \*cm, double \*cd)**
- **typedef void(\* AirfoilCoeffFuncEx) (VESSEL \*v, double aoa, double M, double Re, void \*context, double \*cl, double \*cm, double \*cd)**
- **typedef int(\* KeyFunc) (const char \*keybuf)**
- **typedef void(\* LoadMeshClbkFunc) (MESHHANDLE hMesh, bool firstload)**  
*Callback function used by `oapiLoadMeshGlobal(const char*, LoadMeshClbkFunc)`*
- **typedef void(\* CustomFunc) (void \*context)**

## Enumerations

- enum **FileAccessMode** { **FILE\_IN**, **FILE\_OUT**, **FILE\_APP**, **FILE\_IN\_ZEROONFAIL** }
- enum **PathRoot** { **ROOT**, **CONFIG**, **SCENARIOS**, **TEXTURES**, **TEXTURES2**, **MESHS**, **MODULES** }
- enum **REFFRAME** { **FRAME\_GLOBAL**, **FRAME\_LOCAL**, **FRAME\_REFLOCAL**, **FRAME\_HORIZON** }
- Identifiers for frames of reference.*
- enum **ENGINETYPE** { **ENGINE\_MAIN**, **ENGINE\_RETRO**, **ENGINE\_HOVER**, **ENGINE\_ATTITUDE** }
- Thruster group identifiers (obsolete)*
- enum **EXHAUSTTYPE** { **EXHAUST\_MAIN**, **EXHAUST\_RETRO**, **EXHAUST\_HOVER**, **EXHAUST\_CUSTOM** }
- enum **THGROUP\_TYPE** { **THGROUP\_MAIN**, **THGROUP\_RETRO**, **THGROUP\_HOVER**, **THGROUP\_ATT\_PITCHUP**, **THGROUP\_ATT\_PITCHDOWN**, **THGROUP\_ATT\_YAWLEFT**, **THGROUP\_ATT\_YAWRIGHT**, **THGROUP\_ATT\_BANKLEFT**, **THGROUP\_ATT\_BANKRIGHT**, **THGROUP\_ATT\_RIGHT**, **THGROUP\_ATT\_LEFT**, **THGROUP\_ATT\_UP**, **THGROUP\_ATT\_DOWN**, **THGROUP\_ATT\_FORWARD**, **THGROUP\_ATT\_BACK**, **THGROUP\_USER** = **0x40** }
- Thruster group types.*
- enum **ATTITUDEMODE** { **ATTMODE\_DISABLED**, **ATTMODE\_ROT**, **ATTMODE\_LIN** }
- enum **AIRFOIL\_ORIENTATION** { **LIFT\_VERTICAL**, **LIFT\_HORIZONTAL** }
- Lift vector orientation for airfoils.*
- enum **AIRCTRL\_TYPE** { **AIRCTRL\_ELEVATOR**, **AIRCTRL\_RUDDER**, **AIRCTRL\_AILERON**, **AIRCTRL\_FLAP**, **AIRCTRL\_ELEVATORTRIM**, **AIRCTRL\_RUDDERTRIM** }
- Control surfaces provide attitude and drag control during atmospheric flight.*
- enum **AltitudeMode** { **ALTMODE\_MEANRAD**, **ALTMODE\_GROUND** }
- Altitude mode used by altitude get functions.*
- enum **FontStyle** { **FONT\_NORMAL** = 0, **FONT\_BOLD** = 1, **FONT\_ITALIC** = 2, **FONT\_UNDERLINE** = 4 }

## Functions

- double **normangle** (double angle)
 

*Returns the input argument normalised to range -pi ... pi.*
- double **posangle** (double angle)
 

*Returns the input argument normalised to range 0 ... 2 pi.*
- OAPIFUNC void **FormatValue** (char \*cbuf, int n, double f, int precision=4)
 

*Write a floating point value to a string.*
- OAPIFUNC int **oapiGetOrbiterVersion** ()
 

*Returns the version number of the Orbiter core system.*
- int **oapiGetModuleVersion** ()
 

*Returns the API version number against which the module was linked.*
- OAPIFUNC HINSTANCE **oapiGetOrbiterInstance** ()
 

*Returns the instance handle for the running Orbiter application.*
- OAPIFUNC const char \* **oapiGetCmdLine** ()
 

*Returns a pointer to the command line with which Orbiter was invoked.*
- OAPIFUNC void **oapiGetViewportSize** (DWORD \*w, DWORD \*h, DWORD \*bpp=0)
 

*Returns the dimensions of the render viewport.*
- OAPIFUNC void **oapiRegisterModule** (oapi::Module \*module)
 

*Register a module interface class instance.*
- OAPIFUNC char \* **oapiDebugString** ()
 

*Returns a pointer to a string which will be displayed in the lower left corner of the viewport.*

- OAPIFUNC **OBJHANDLE** oapiGetObjectByName (char \*name)  
*Returns a handle for a named simulation object.*
- OAPIFUNC **OBJHANDLE** oapiGetObjectByIndex (int index)  
*Returns a handle for an indexed simulation object.*
- OAPIFUNC **DWORD** oapiGetObjectCount ()  
*Returns the number of objects currently present in the simulation.*
- OAPIFUNC **int** oapiGetObjectType (**OBJHANDLE** hObj)  
*Returns the type of an object identified by its handle.*
- OAPIFUNC **const void \*** oapiGetObjectParam (**OBJHANDLE** hObj, **DWORD** paramtype)  
*Returns an object-specific configuration parameter.*
- OAPIFUNC **OBJHANDLE** oapiGetVesselByName (char \*name)  
*Returns the handle of a vessel identified by its name.*
- OAPIFUNC **OBJHANDLE** oapiGetVesselByIndex (int index)  
*Returns the handle of a vessel identified by its reference index.*
- OAPIFUNC **DWORD** oapiGetVesselCount ()  
*Returns the number of vessels currently present in the simulation.*
- OAPIFUNC **bool** oapilsVessel (**OBJHANDLE** hVessel)  
*Checks if the specified handle is a valid vessel handle.*
- OAPIFUNC **OBJHANDLE** oapiGetGbodyByName (char \*name)  
*Returns the handle of a celestial body (sun, planet or moon) identified by its name.*
- OAPIFUNC **OBJHANDLE** oapiGetGbodyByIndex (int index)  
*Returns the handle of a celestial body (sun, planet or moon) indentified by its list index.*
- OAPIFUNC **DWORD** oapiGetGbodyCount ()  
*Returns the number of celestial bodies (sun, planets and moons) currently present in the simulation.*
- OAPIFUNC **OBJHANDLE** oapiGetBaseByName (**OBJHANDLE** hPlanet, char \*name)  
*Returns the handle of a surface base on a given planet or moon.*
- OAPIFUNC **OBJHANDLE** oapiGetBaseByIndex (**OBJHANDLE** hPlanet, int index)  
*Returns the handle of a surface base on a planet or moon given by its list index.*
- OAPIFUNC **DWORD** oapiGetBaseCount (**OBJHANDLE** hPlanet)  
*Returns the number of surface bases defined for a given planet.*
- OAPIFUNC **void** oapiGetObjectName (**OBJHANDLE** hObj, char \*name, int n)  
*Returns the name of an object.*
- OAPIFUNC **OBJHANDLE** oapiGetFocusObject ()  
*Returns the handle for the current focus object.*
- OAPIFUNC **OBJHANDLE** oapiSetFocusObject (**OBJHANDLE** hVessel)  
*Switches the input focus to a different vessel object.*
- OAPIFUNC **VESSEL \*** oapiGetVesselInterface (**OBJHANDLE** hVessel)  
*Returns a **VESSEL** class instance for a vessel.*
- OAPIFUNC **VESSEL \*** oapiGetFocusInterface ()  
*Returns the **VESSEL** class instance for the current focus object.*
- OAPIFUNC **CELBODY \*** oapiGetCelbodyInterface (**OBJHANDLE** hBody)  
*Returns a **CELBODY** interface instance for a celestial body, if available.*
- OAPIFUNC **OBJHANDLE** oapiCreateVessel (**const char** \*name, **const char** \*classname, **const VESSELSTATUS** &status)  
*Creates a new vessel.*
- OAPIFUNC **OBJHANDLE** oapiCreateVesselEx (**const char** \*name, **const char** \*classname, **const void** \*status)  
*Creates a new vessel via a **VESSELSTATUSx** ( $x \geq 2$ ) interface.*
- OAPIFUNC **bool** oapiDeleteVessel (**OBJHANDLE** hVessel, **OBJHANDLE** hAlternativeCameraTarget=0)  
*Deletes an existing vessel.*
- OAPIFUNC **void** oapiGetBarycentre (**OBJHANDLE** hObj, **VECTOR3** \*bary)

- OAPIFUNC double `oapiGetSize (OBJHANDLE hObj)`

Returns the global position of the barycentre of a complete planetary system or a single planet-moons system.
- OAPIFUNC double `oapiGetMass (OBJHANDLE hObj)`

Returns the size (mean radius) of an object.
- OAPIFUNC void `oapiGetGlobalPos (OBJHANDLE hObj, VECTOR3 *pos)`

Returns the mass of an object. For vessels, this is the total mass, including current fuel mass.
- OAPIFUNC void `oapiGetGlobalVel (OBJHANDLE hObj, VECTOR3 *vel)`

Returns the position of an object in the global reference frame.
- OAPIFUNC void `oapiGetRelativePos (OBJHANDLE hObj, OBJHANDLE hRef, VECTOR3 *pos)`

Returns the velocity of an object in the global reference frame.
- OAPIFUNC void `oapiGetRelativeVel (OBJHANDLE hObj, OBJHANDLE hRef, VECTOR3 *vel)`

Returns the distance vector from hRef to hObj in the ecliptic reference frame.
- OAPIFUNC double `oapiGetEmptyMass (OBJHANDLE hVessel)`

Returns the velocity difference vector of hObj relative to hRef in the ecliptic reference frame.
- OAPIFUNC void `oapiSetEmptyMass (OBJHANDLE hVessel, double mass)`

Returns empty mass of a vessel, excluding fuel.
- OAPIFUNC double `oapiGetFuelMass (OBJHANDLE hVessel)`

Set the empty mass of a vessel (excluding fuel)
- OAPIFUNC double `oapiGetMaxFuelMass (OBJHANDLE hVessel)`

Returns current fuel mass of the first propellant resource of a vessel.
- OAPIFUNC PROPELLANT\_HANDLE `oapiGetPropellantHandle (OBJHANDLE hVessel, DWORD idx)`

Returns maximum fuel capacity of the first propellant resource of a vessel.
- OAPIFUNC double `oapiGetPropellantMass (PROPELLANT_HANDLE ph)`

Returns an identifier of a vessel's propellant resource.
- OAPIFUNC double `oapiGetPropellantMaxMass (PROPELLANT_HANDLE ph)`

Returns the current fuel mass [kg] of a propellant resource.
- OAPIFUNC DOCKHANDLE `oapiGetDockHandle (OBJHANDLE hVessel, UINT n)`

Returns the maximum capacity [kg] of a propellant resource.
- OAPIFUNC OBJHANDLE `oapiGetDockStatus (DOCKHANDLE dock)`

Returns a handle to a vessel docking port.
- OAPIFUNC void `oapiGetFocusGlobalPos (VECTOR3 *pos)`

Returns the handle of a vessel docked at a port.
- OAPIFUNC void `oapiGetFocusGlobalVel (VECTOR3 *vel)`

Returns the position of the current focus object in the global reference frame.
- OAPIFUNC void `oapiGetFocusRelativePos (OBJHANDLE hRef, VECTOR3 *pos)`

Returns the velocity of the current focus object in the global reference frame.
- OAPIFUNC void `oapiGetFocusRelativeVel (OBJHANDLE hRef, VECTOR3 *vel)`

Returns the distance vector from hRef to the current focus object.
- OAPIFUNC BOOL `oapiGetAltitude (OBJHANDLE hVessel, double *alt)`

Returns the distance vector from hRef to the current focus object relative to hRef.
- OAPIFUNC BOOL `oapiGetAltitude (OBJHANDLE hVessel, AltitudeMode mode, double *alt)`

Returns the altitude of a vessel over a planet mean radius.
- OAPIFUNC BOOL `oapiGetAltitude (OBJHANDLE hVessel, AltitudeMode mode, double *alt)`

Returns the altitude of a vessel over a planetary surface.
- OAPIFUNC BOOL `oapiGetPitch (OBJHANDLE hVessel, double *pitch)`

Returns a vessel's pitch angle w.r.t. the local horizon.
- OAPIFUNC BOOL `oapiGetBank (OBJHANDLE hVessel, double *bank)`

Returns a vessel's bank angle w.r.t. the local horizon.
- OAPIFUNC BOOL `oapiGetHeading (OBJHANDLE hVessel, double *heading)`

Returns a vessel's heading (against geometric north) calculated for the local horizon plane.
- OAPIFUNC BOOL `oapiGetFocusAltitude (double *alt)`

Returns the altitude of the current focus vessel over a planetary surface.

- OAPIFUNC BOOL `oapiGetFocusPitch` (double \*pitch)  
*Returns the pitch angle of the current focus vessel w.r.t. the local horizon.*
- OAPIFUNC BOOL `oapiGetFocusBank` (double \*bank)  
*Returns the bank angle of the current focus vessel w.r.t. the local horizon.*
- OAPIFUNC BOOL `oapiGetFocusHeading` (double \*heading)  
*Returns the heading (against geometric north) of the current focus vessel calculated for the local horizon plane.*
- OAPIFUNC BOOL `oapiGetGroundspeed` (OBJHANDLE hVessel, double \*groundspeed)  
*Returns a vessel's ground speed w.r.t. the closest planet or moon.*
- OAPIFUNC bool `oapiGetGroundspeedVector` (OBJHANDLE hVessel, REFFRAME frame, VECTOR3 \*vel)  
*Returns a vessel's groundspeed vector w.r.t. the closest planet or moon in the requested frame of reference.*
- OAPIFUNC BOOL `oapiGetAirspeed` (OBJHANDLE hVessel, double \*airspeed)  
*Returns a vessel's true airspeed w.r.t. the closest planet or moon.*
- OAPIFUNC bool `oapiGetAirspeedVector` (OBJHANDLE hVessel, REFFRAME frame, VECTOR3 \*v)  
*Returns a vessel's true airspeed vector w.r.t. the closest planet or moon in the requested frame of reference.*
- OAPIFUNC BOOL `oapiGetEquPos` (OBJHANDLE hVessel, double \*longitude, double \*latitude, double \*radius)  
*Returns a vessel's spherical equatorial coordinates (longitude, latitude and radius) with respect to the closest planet or moon.*
- OAPIFUNC BOOL `oapiGetFocusEquPos` (double \*longitude, double \*latitude, double \*radius)  
*Returns the current focus vessel's spherical equatorial coordinates (longitude, latitude and radius) with respect to the closest planet or moon.*
- OAPIFUNC void `oapiGetAtm` (OBJHANDLE hVessel, ATMPARAM \*prm, OBJHANDLE \*hAtmRef=0)  
*Returns the atmospheric parameters at the current vessel position.*
- OAPIFUNC void `oapiGetEngineStatus` (OBJHANDLE hVessel, ENGINESTATUS \*es)  
*Retrieve the status of main, retro and hover thrusters for a vessel.*
- OAPIFUNC void `oapiGetFocusEngineStatus` (ENGINESTATUS \*es)  
*Retrieve the engine status for the focus vessel.*
- OAPIFUNC void `oapiSetEngineLevel` (OBJHANDLE hVessel, ENGINETYPE engine, double level)  
*Engage the specified engines.*
- OAPIFUNC int `oapiGetAttitudeMode` (OBJHANDLE hVessel)  
*Returns a vessel's current attitude thruster mode.*
- OAPIFUNC int `oapiToggleAttitudeMode` (OBJHANDLE hVessel)  
*Flip a vessel's attitude thruster mode between rotational and linear.*
- OAPIFUNC bool `oapiSetAttitudeMode` (OBJHANDLE hVessel, int mode)  
*Set a vessel's attitude thruster mode.*
- OAPIFUNC int `oapiGetFocusAttitudeMode` ()  
*Returns the current focus vessel's attitude thruster mode (rotational or linear)*
- OAPIFUNC int `oapiToggleFocusAttitudeMode` ()  
*Flip the current focus vessel's attitude thruster mode between rotational and linear.*
- OAPIFUNC bool `oapiSetFocusAttitudeMode` (int mode)  
*Set the current focus vessel's attitude thruster mode.*
- OAPIFUNC void `oapiGetRotationMatrix` (OBJHANDLE hObj, MATRIX3 \*mat)  
*Returns the current rotation matrix of an object.*
- OAPIFUNC void `oapiGlobalToLocal` (OBJHANDLE hObj, const VECTOR3 \*glob, VECTOR3 \*loc)  
*Maps a point from the global frame to a local object frame.*
- OAPIFUNC void `oapiLocalToGlobal` (OBJHANDLE hObj, const VECTOR3 \*loc, VECTOR3 \*glob)  
*Maps a point from a local object frame to the global frame.*
- OAPIFUNC void `oapiEquToLocal` (OBJHANDLE hObj, double lng, double lat, double rad, VECTOR3 \*loc)  
*Returns the cartesian position in the local object frame of a point given in equatorial coordinates.*
- OAPIFUNC void `oapiLocalToEqu` (OBJHANDLE hObj, const VECTOR3 &loc, double \*lng, double \*lat, double \*rad)

- OAPIFUNC void `oapiEquToGlobal` (OBJHANDLE hObj, double lng, double lat, double rad, VECTOR3 \*glob)
 

Returns the equatorial coordinates of a point given in the local frame of an object.
- OAPIFUNC void `oapiGlobalToEqu` (OBJHANDLE hObj, const VECTOR3 &glob, double \*lng, double \*lat, double \*rad)
 

Returns the global cartesian position of a point given in equatorial coordinates of an object.
- OAPIFUNC double `oapiOrthodome` (double lng1, double lat1, double lng2, double lat2)
 

Returns the angular distance of two points on a sphere.
- OAPIFUNC SURFHANDLE `oapiRegisterExhaustTexture` (char \*name)
 

Request a custom texture for vessel exhaust rendering.
- OAPIFUNC SURFHANDLE `oapiRegisterReentryTexture` (char \*name)
 

Request a custom texture for vessel reentry flame rendering.
- OAPIFUNC SURFHANDLE `oapiRegisterParticleTexture` (char \*name)
 

Aerodynamics helper function.
- OAPIFUNC void `oapiSetShowGrapplePoints` (bool show)
 

Aerodynamics helper function.
- OAPIFUNC bool `oapiGetShowGrapplePoints` ()
 

Aerodynamics helper function.
- OAPIFUNC double `oapiGetInducedDrag` (double cl, double A, double e)
 

Aerodynamics helper function.
- OAPIFUNC double `oapiGetWaveDrag` (double M, double M1, double M2, double M3, double cmax)
 

Aerodynamics helper function.
- OAPIFUNC bool `oapiCameraInternal` ()
 

Returns flag to indicate internal/external camera mode.
- OAPIFUNC int `oapiCameraMode` ()
 

Returns the current camera view mode.
- OAPIFUNC int `oapiCockpitMode` ()
 

Returns the current cockpit display mode.
- OAPIFUNC OBJHANDLE `oapiCameraTarget` ()
 

Returns a handle to the current camera target.
- OAPIFUNC int `oapiVCPPosition` ()
 

Returns the current virtual cockpit position.
- OAPIFUNC OBJHANDLE `oapiCameraProxyGbody` ()
 

Returns celestial body whose surface is closest to the camera.
- OAPIFUNC void `oapiCameraGlobalPos` (VECTOR3 \*gpos)
 

Returns current camera position in global coordinates.
- OAPIFUNC void `oapiCameraGlobalDir` (VECTOR3 \*gdir)
 

Returns current camera direction in global coordinates.
- OAPIFUNC void `oapiCameraRotationMatrix` (MATRIX3 \*rmat)
 

Returns the distance between the camera and its target [m].
- OAPIFUNC double `oapiCameraTargetDist` ()
 

Returns the current camera azimuth angle with respect to the target.
- OAPIFUNC double `oapiCameraPolar` ()
 

Returns the current camera polar angle with respect to the target.
- OAPIFUNC double `oapiCameraAperture` ()
 

Returns the current camera aperture (the field of view) in rad.
- OAPIFUNC void `oapiCameraSetAperture` (double aperture)
 

Change the camera aperture (field of view).
- OAPIFUNC void `oapiCameraScaleDist` (double dscale)
 

Moves the camera closer to the target or further away.
- OAPIFUNC void `oapiCameraRotAzimuth` (double dazimuth)
 

Rotate the camera around the target (azimuth angle).
- OAPIFUNC void `oapiCameraRotPolar` (double dpolar)
 

Rotates the camera around the target (polar angle).

- **OAPIFUNC void oapiCameraSetCockpitDir** (double polar, double azimuth, bool transition=false)
 

*Set the camera direction in cockpit mode.*
- **OAPIFUNC void oapiCameraAttach** (**OBJHANDLE** hObj, int mode)
 

*Attach the camera to a new target, or switch between internal and external camera mode.*
- **OAPIFUNC bool oapiSetCameraMode** (const CameraMode &mode)
 

*Set the camera to the mode specified by the CameraMode object.*
- **OAPIFUNC bool oapiMoveGroundCamera** (double forward, double right=0, double up=0)
 

*Move the ground observer camera.*
- **OAPIFUNC double oapiGetPlanetPeriod** (**OBJHANDLE** hPlanet)
 

*Returns the rotation period (the length of a siderial day) of a planet.*
- **OAPIFUNC double oapiGetPlanetObliquity** (**OBJHANDLE** hPlanet)
 

*Returns the obliquity of the planet's rotation axis (the angle between the rotation axis and the ecliptic zenith).*
- **OAPIFUNC double oapiGetPlanetTheta** (**OBJHANDLE** hPlanet)
 

*Returns the longitude of the ascending node.*
- **OAPIFUNC void oapiGetPlanetObliquityMatrix** (**OBJHANDLE** hPlanet, **MATRIX3** \*mat)
 

*Returns a rotation matrix which performs the transformation from the planet's tilted coordinates into global coordinates.*
- **OAPIFUNC double oapiGetPlanetCurrentRotation** (**OBJHANDLE** hPlanet)
 

*Returns the current rotation angle of the planet around its axis.*
- **OAPIFUNC bool oapiPlanetHasAtmosphere** (**OBJHANDLE** hPlanet)
 

*Test for existence of planetary atmosphere.*
- **OAPIFUNC void oapiGetPlanetAtmParams** (**OBJHANDLE** hPlanet, double rad, **ATMPARAM** \*prm)
 

*Returns atmospheric parameters as a function of distance from the planet centre.*
- **OAPIFUNC void oapiGetPlanetAtmParams** (**OBJHANDLE** hPlanet, double alt, double lng, double lat, **ATMPARAM** \*prm)
 

*Returns atmospheric parameters of a planet as a function of altitude and geographic position.*
- **OAPIFUNC const ATMCONST \* oapiGetPlanetAtmConstants** (**OBJHANDLE** hPlanet)
 

*Returns atmospheric constants for a planet.*
- **OAPIFUNC VECTOR3 oapiGetGroundVector** (**OBJHANDLE** hPlanet, double lng, double lat, int frame=2)
 

*Returns the velocity vector of a surface point.*
- **OAPIFUNC VECTOR3 oapiGetWindVector** (**OBJHANDLE** hPlanet, double lng, double lat, double alt, int frame=0, double \*windspeed=NULL)
 

*Returns the wind velocity at a given position in a planet's atmosphere.*
- **OAPIFUNC DWORD oapiGetPlanetJCoeffCount** (**OBJHANDLE** hPlanet)
 

*Returns the number of perturbation coefficients defined for a planet.*
- **OAPIFUNC double oapiGetPlanetJCoeff** (**OBJHANDLE** hPlanet, DWORD n)
 

*Returns a perturbation coefficient for the calculation of a planet's gravitational potential.*
- **OAPIFUNC ELEVHANDLE oapiElevationManager** (**OBJHANDLE** hPlanet)
 

*Returns a handle for elevation queries for a specified planet.*
- **OAPIFUNC double oapiSurfaceElevation** (**OBJHANDLE** hPlanet, double lng, double lat)
 

*Returns the elevation of a point on a planet surface.*
- **OAPIFUNC OBJHANDLE oapiGetBasePlanet** (**OBJHANDLE** hBase)
 

*Returns a handle for the planet/moon the given base is located on.*
- **OAPIFUNC void oapiGetBaseEquPos** (**OBJHANDLE** hBase, double \*lng, double \*lat, double \*rad=0)
 

*Returns the equatorial coordinates (longitude, latitude and radius) of the location of a surface base.*
- **OAPIFUNC DWORD oapiGetBasePadCount** (**OBJHANDLE** hBase)
 

*Returns the number of VTOL landing pads owned by the base.*
- **OAPIFUNC bool oapiGetBasePadEquPos** (**OBJHANDLE** hBase, DWORD pad, double \*lng, double \*lat, double \*rad=0)
 

*Returns the equatorial coordinates (longitude, latitude and radius) of the location of a VTOL landing pad.*

- OAPIFUNC bool `oapiGetBasePadStatus (OBJHANDLE hBase, DWORD pad, int *status)`  
*Returns the status of a VTOL landing pad (free, occupied or cleared).*
- OAPIFUNC NAVHANDLE `oapiGetBasePadNav (OBJHANDLE hBase, DWORD pad)`  
*Returns a handle to the ILS transmitter of a VTOL landing pad, if available.*
- OAPIFUNC double `oapiGetSimTime ()`  
*Retrieve simulation time (in seconds) since simulation start.*
- OAPIFUNC double `oapiGetSimStep ()`  
*Retrieve length of last simulation time step (from previous to current frame) in seconds.*
- OAPIFUNC double `oapiGetSysTime ()`  
*Retrieve system (real) time since simulation start.*
- OAPIFUNC double `oapiGetSysStep ()`  
*Retrieve length of last system time step in seconds.*
- OAPIFUNC double `oapiGetSimMJD ()`  
*Retrieve absolute time measure (Modified Julian Date) for current simulation state.*
- OAPIFUNC double `oapiGetSysMJD ()`  
*Retrieve the current computer system time in Modified Julian Date (MJD) format.*
- OAPIFUNC bool `oapiSetSimMJD (double mjd, int pmode=0)`  
*Set the current simulation time. The simulation session performs a jump to the new time.*
- OAPIFUNC double `oapiTime2MJD (double simt)`  
*Convert a simulation up time value into a Modified Julian Date.*
- OAPIFUNC double `oapiGetTimeAcceleration ()`  
*Returns simulation time acceleration factor.*
- OAPIFUNC void `oapiSetTimeAcceleration (double warp)`  
*Set the simulation time acceleration factor.*
- OAPIFUNC double `oapiGetFrameRate ()`  
*Returns current simulation frame rate (frames/sec).*
- OAPIFUNC bool `oapiGetPause ()`  
*Returns the current simulation pause state.*
- OAPIFUNC void `oapiSetPause (bool pause)`  
*Sets the simulation pause state.*
- OAPIFUNC void `oapiGetNavPos (NAVHANDLE hNav, VECTOR3 *gpos)`  
*Returns the current position of a NAV transmitter (in global coordinates, i.e. heliocentric ecliptic).*
- OAPIFUNC DWORD `oapiGetNavChannel (NAVHANDLE hNav)`  
*Returns the channel number of a NAV transmitter.*
- OAPIFUNC float `oapiGetNavFreq (NAVHANDLE hNav)`  
*Returns the frequency of a NAV transmitter.*
- OAPIFUNC double `oapiGetNavSignal (NAVHANDLE hNav, const VECTOR3 &gpos)`  
*Returns the signal strength of a transmitter at a given position.*
- OAPIFUNC float `oapiGetNavRange (NAVHANDLE hNav)`  
*Returns the range of a NAV transmitter.*
- OAPIFUNC DWORD `oapiGetNavType (NAVHANDLE hNav)`  
*Returns the type id of a NAV transmitter.*
- OAPIFUNC int `oapiGetNavData (NAVHANDLE hNav, NAVDATA *data)`  
*Returns information about a NAV transmitter.*
- OAPIFUNC int `oapiGetNavDescr (NAVHANDLE hNav, char *descr, int maxlen)`  
*Returns a descriptive string for a NAV transmitter.*
- OAPIFUNC bool `oapiNavInRange (NAVHANDLE hNav, const VECTOR3 &gpos)`  
*Determines whether a given global coordinate is within the range of a NAV transmitter.*
- OAPIFUNC INTERPRETERHANDLE `oapiCreateInterpreter ()`  
*Returns a handle to a new interpreter instance.*
- OAPIFUNC int `oapiDellInterpreter (INTERPRETERHANDLE hInterp)`

- OAPIFUNC bool `oapiExecScriptCmd (INTERPRETERHANDLE hInterp, const char *cmd)`

*Executes a script command in an interpreter instance.*
- OAPIFUNC bool `oapiAsyncScriptCmd (INTERPRETERHANDLE hInterp, const char *cmd)`

*Passes a command to an interpreter instance for execution.*
- OAPIFUNC `lua_State * oapiGetLua (INTERPRETERHANDLE hInterp)`
- OAPIFUNC `VISHANDLE * oapiObjectVisualPtr (OBJHANDLE hObject)`

*Returns a pointer storing the objects visual handle.*
- OAPIFUNC `MESHHANDLE oapiLoadMesh (const char *fname)`

*Loads a mesh from file and returns a handle to it.*
- OAPIFUNC const `MESHHANDLE oapiLoadMeshGlobal (const char *fname)`

*Retrieves a mesh handle from the global mesh manager.*
- OAPIFUNC const `MESHHANDLE oapiLoadMeshGlobal (const char *fname, LoadMeshCblkFunc fCblk)`

*Retrieves a mesh handle from the global mesh manager.*
- OAPIFUNC `MESHHANDLE oapiCreateMesh (DWORD ngrp, MESHGROUP *grp)`

*Creates a new mesh from a list of mesh group definitions.*
- OAPIFUNC void `oapiDeleteMesh (MESHHANDLE hMesh)`

*Removes a mesh from memory.*
- OAPIFUNC DWORD `oapiGetMeshFlags (MESHHANDLE hMesh)`

*Returns the bit flags for the mesh.*
- OAPIFUNC DWORD `oapiMeshGroupCount (MESHHANDLE hMesh)`

*Returns the number of mesh groups defined in a mesh.*
- OAPIFUNC `MESHGROUP * oapiMeshGroup (MESHHANDLE hMesh, DWORD idx)`

*Returns a pointer to the group specification of a mesh group.*
- OAPIFUNC `MESHGROUP * oapiMeshGroup (DEVMESHHANDLE hMesh, DWORD idx)`
- OAPIFUNC `MESHGROUPEX * oapiMeshGroupEx (MESHHANDLE hMesh, DWORD idx)`
- OAPIFUNC DWORD `oapiAddMeshGroup (MESHHANDLE hMesh, MESHGROUP *grp)`
- OAPIFUNC bool `oapiAddMeshGroupBlock (MESHHANDLE hMesh, DWORD grpidx, const NTVERTEX *vtx, DWORD nvtx, const WORD *idx, DWORD nidx)`
- OAPIFUNC int `oapiGetMeshGroup (DEVMESHHANDLE hMesh, DWORD grpidx, GROUPREQUESTSPEC *grs)`

*Retrieve mesh group data.*
- OAPIFUNC int `oapiEditMeshGroup (MESHHANDLE hMesh, DWORD grpidx, GROUPEDITSPEC *ges)`

*Modify mesh group data.*
- OAPIFUNC int `oapiEditMeshGroup (DEVMESHHANDLE hMesh, DWORD grpidx, GROUPEDITSPEC *ges)`
- OAPIFUNC DWORD `oapiMeshTextureCount (MESHHANDLE hMesh)`

*Returns the number of textures associated with a mesh.*
- OAPIFUNC `SURFHANDLE oapiGetTextureHandle (MESHHANDLE hMesh, DWORD texidx)`

*Retrieve a surface handle for a mesh texture.*
- OAPIFUNC `SURFHANDLE oapiLoadTexture (const char *fname, bool dynamic=false)`

*Load a texture from a file.*
- OAPIFUNC void `oapiReleaseTexture (SURFHANDLE hTex)`

*Release a texture.*
- OAPIFUNC bool `oapiSetTexture (MESHHANDLE hMesh, DWORD texidx, SURFHANDLE tex)`

*Replace a mesh texture.*
- OAPIFUNC bool `oapiSetTexture (DEVMESHHANDLE hMesh, DWORD texidx, SURFHANDLE tex)`
- OAPIFUNC DWORD `oapiMeshMaterialCount (MESHHANDLE hMesh)`

*Returns the number of materials defined in the mesh.*
- OAPIFUNC `MATERIAL * oapiMeshMaterial (MESHHANDLE hMesh, DWORD idx)`

*Returns a pointer to a material specification in the material list of the mesh.*
- OAPIFUNC int `oapiMeshMaterial (DEVMESHHANDLE hMesh, DWORD idx, MATERIAL *mat)`

- Retrieve properties of a device mesh material.*
- OAPIFUNC DWORD `oapiAddMaterial` (MESHHANDLE hMesh, MATERIAL \*mat)  
*Add a material definition to a mesh.*
  - OAPIFUNC bool `oapiDeleteMaterial` (MESHHANDLE hMesh, DWORD idx)  
*Delete a material definition from the mesh.*
  - OAPIFUNC int `oapiSetMaterial` (DEVMESHHANDLE hMesh, DWORD matidx, const MATERIAL \*mat)  
*Reset the properties of a mesh material.*
  - OAPIFUNC bool `oapiSetMeshProperty` (MESHHANDLE hMesh, DWORD property, DWORD value)  
*Set custom properties for a mesh.*
  - OAPIFUNC bool `oapiSetMeshProperty` (DEVMESHHANDLE hMesh, DWORD property, DWORD value)  
*Set custom properties for a device-specific mesh.*
  - OAPIFUNC void `oapiParticleSetLevelRef` (PSTREAM\_HANDLE ph, double \*lvl)  
*Reset the reference pointer used by the particle stream to calculate the intensity (opacity) of the generated particles.*
  - OAPIFUNC bool `oapiSetHUDMode` (int mode)  
*Set HUD (head up display) mode.*
  - OAPIFUNC bool `oapiSetHUDMode` (int mode, const HUDPARAM \*prm)  
*Set HUD (head up display) mode with mode-specific parameters.*
  - OAPIFUNC int `oapiGetHUDMode` ()  
*Query current HUD (head up display) mode.*
  - OAPIFUNC int `oapiGetHUDMode` (HUDPARAM \*prm)  
*Query current HUD mode and mode parameters.*
  - OAPIFUNC void `oapiToggleHUColour` ()  
*Switch the HUD display to a different colour.*
  - OAPIFUNC double `oapiGetHUDIntensity` ()  
*Return the current HUD brightness setting.*
  - OAPIFUNC void `oapiSetHUDIntensity` (double val)  
*Set the HUD brightness.*
  - OAPIFUNC void `oapiIncHUDIntensity` ()  
*Increase the brightness of the HUD display.*
  - OAPIFUNC void `oapiDecHUDIntensity` ()  
*Decrease the brightness of the HUD display.*
  - OAPIFUNC void `oapiRenderHUD` (MESHHANDLE hMesh, SURFHANDLE \*hTex)  
*Render custom HUD elements.*
  - OAPIFUNC void `oapiOpenMFD` (int mode, int mfd)  
*Set an MFD (multifunctional display) to a specific mode.*
  - OAPIFUNC void `oapiToggleMFD_on` (int mfd)  
*Switches an MFD on or off.*
  - OAPIFUNC int `oapiGetMFDMode` (int mfd)  
*Get the current mode of the specified MFD.*
  - OAPIFUNC double `oapiSetMFDRefreshIntervalMultiplier` (int mfd, double multiplier=1.0)  
*Modify the refresh interval of the specified MFD instrument.*
  - OAPIFUNC int `oapiBroadcastMFDMessage` (int mode, int msg, void \*data)
  - OAPIFUNC int `oapiSendMFDKey` (int mfd, DWORD key)  
*Sends a keystroke to an MFD.*
  - OAPIFUNC void `oapiRefreshMFDButtons` (int mfd, OBJHANDLE hVessel=0)  
*Sends a clbkMFDMode call to the current focus vessel to allow it to dynamically update its button labels.*
  - OAPIFUNC bool `oapiProcessMFDButton` (int mfd, int bt, int event)  
*Requests a default action as a result of a MFD button event.*
  - OAPIFUNC const char \* `oapiMFDButtonLabel` (int mfd, int bt)  
*Retrieves a default label for an MFD button.*
  - OAPIFUNC void `oapiRegisterMFD` (int mfd, const MFDSPEC &spec)

- OAPIFUNC void **oapiRegisterMFD** (int mfd, const EXTMFDSPEC \*spec)
 

Registers an *MFD* position for a custom panel.
- OAPIFUNC void **oapiRegisterExternMFD** (ExternMFD \*emfd, const MFDSPEC &spec)
 

Registers an *MFD* position for a custom panel or virtual cockpit. This version has an extended parameter list.
- OAPIFUNC bool **oapiUnregisterExternMFD** (ExternMFD \*emfd)
 

Unregisters an *MFD* position for a custom panel or virtual cockpit.
- OAPIFUNC void **oapiRegisterPanelBackground** (HBITMAP hBmp, DWORD flag=PANEL\_ATTACH\_BOTTOM|PANEL\_MOVEOUT\_BOTTOM, DWORD ck=(DWORD)-1)
 

Register the background bitmap for a custom panel.
- OAPIFUNC void **oapiRegisterPanelArea** (int id, const RECT &pos, int draw\_event=PANEL\_REDRAW\_NEVER, int mouse\_event=PANEL\_MOUSE\_IGNORE, int bkmode=PANEL\_MAP\_NONE)
 

Defines a rectangular area within a panel to receive mouse or redraw notifications.
- OAPIFUNC void **oapiSetPanelNeighbours** (int left, int right, int top, int bottom)
 

Defines the neighbour panels of the current panels. These are the panels the user can switch to via Ctrl-Arrow keys.
- OAPIFUNC bool **oapiBltPanelAreaBackground** (int area\_id, SURFHANDLE surf)
 

Copies the stored background of a panel area into the provided surface.
- OAPIFUNC void **oapiSetDefNavDisplay** (int mode)
 

Defines how the navigation mode buttons will be displayed in a default cockpit view.
- OAPIFUNC void **oapiSetDefRCSDisplay** (int mode)
 

Enable or disable the display of the reaction control system indicators/controls in default cockpit view.
- OAPIFUNC int **oapiSwitchPanel** (int direction)
 

Switch to a neighbour instrument panel in 2-D panel cockpit mode.
- OAPIFUNC int **oapiSetPanel** (int panel\_id)
 

Switch to a different instrument panel in 2-D panel cockpit mode.
- OAPIFUNC double **oapiGetPanelScale** ()
 

Returns the scaling factor for 2-D instrument panels.
- OAPIFUNC double **oapiGetPanel2DScale** ()
 

Returns the current scaling factor for the active 2D instrument panel.
- OAPIFUNC void **oapiSetPanelBlink** (VECTOR3 v[4])
 

Obtain a drawing context for a surface.
- OAPIFUNC oapi::Sketchpad \* **oapiGetSketchpad** (SURFHANDLE surf)
 

Release a drawing device context instance.
- OAPIFUNC oapi::Font \* **oapiCreateFont** (int height, bool prop, char \*face, FontStyle style=FONT\_NORMAL)
 

Creates a font resource for drawing text into surfaces.
- OAPIFUNC oapi::Font \* **oapiCreateFont** (int height, bool prop, const char \*face, FontStyle style, int orientation)
 

Creates a font resource for drawing text into surfaces.
- OAPIFUNC void **oapiReleaseFont** (oapi::Font \*font)
 

Release a font resource.
- OAPIFUNC oapi::Pen \* **oapiCreatePen** (int style, int width, DWORD col)
 

Creates a pen resource for drawing lines and shape outlines.
- OAPIFUNC void **oapiReleasePen** (oapi::Pen \*pen)
 

Release a pen resource.
- OAPIFUNC oapi::Brush \* **oapiCreateBrush** (DWORD col)
 

Creates a brush resource for filling shapes.
- OAPIFUNC void **oapiReleaseBrush** (oapi::Brush \*brush)
 

Release a brush resource.
- OAPIFUNC HDC **oapiGetDC** (SURFHANDLE surf)
 

Obtain a Windows device context handle (HDC) for a surface.
- OAPIFUNC void **oapiReleaseDC** (SURFHANDLE surf, HDC hDC)
 

Release a GDI drawing device context handle.

- OAPIFUNC **SURFHANDLE** **oapiCreateSurface** (int width, int height)  
*Create a surface of the specified dimensions.*
- OAPIFUNC **SURFHANDLE** **oapiCreateSurfaceEx** (int width, int height, DWORD attrib)  
*Create a surface of the specified dimensions and usage/access attributes.*
- OAPIFUNC **SURFHANDLE** **oapiCreateSurface** (HBITMAP hBmp, bool release\_bmp=true)  
*Create a surface from a bitmap. Bitmap surfaces are typically used for blitting operations during instrument panel redraws.*
- OAPIFUNC **SURFHANDLE** **oapiCreateTextureSurface** (int width, int height)  
*Create a surface that can be used as a texture for a 3-D object.*
- OAPIFUNC void **oapiDestroySurface** (**SURFHANDLE** surf)  
*Destroy a surface previously created with **oapiCreateSurface**.*
- OAPIFUNC void **oapiClearSurface** (**SURFHANDLE** surf, DWORD col=0)
- OAPIFUNC void **oapiSetSurfaceColourKey** (**SURFHANDLE** surf, DWORD ck)  
*Define a colour key for a surface to allow transparent blitting.*
- OAPIFUNC void **oapiClearSurfaceColourKey** (**SURFHANDLE** surf)  
*Clear a previously defined colour key.*
- OAPIFUNC void **oapiBlit** (**SURFHANDLE** tgt, **SURFHANDLE** src, int tgtx, int tgty, int srcx, int srcy, int w, int h, DWORD ck=SURF\_NO\_CK)  
*Copy a rectangular area from one surface to another.*
- OAPIFUNC void **oapiBlit** (**SURFHANDLE** tgt, **SURFHANDLE** src, RECT \*tgt, RECT \*src, DWORD ck=SURF\_NO\_CK, DWORD rotate=SURF\_NO\_ROTATION)  
*Copy a scaled rectangular area from one surface to another.*
- OAPIFUNC int **oapiBeginBltGroup** (**SURFHANDLE** tgt)  
*Begin a block of blitting operations to the same target surface.*
- OAPIFUNC int **oapiEndBltGroup** ()  
*End a block of blitting operations to the same target surface.*
- OAPIFUNC void **oapiColourFill** (**SURFHANDLE** tgt, DWORD fillcolor, int tgtx=0, int tgty=0, int w=0, int h=0)  
*Fill an area of the target surface with a uniform colour.*
- OAPIFUNC int **oapiRegisterMFDMode** (MFDMODESPECEX &spec)  
*Register a custom **MFD** mode.*
- OAPIFUNC bool **oapiUnregisterMFDMode** (int mode)  
*Unregister a previously registered custom **MFD** mode.*
- OAPIFUNC void **oapiDisableMFDMode** (int mode)  
*Disable an **MFD** mode.*
- OAPIFUNC int **oapiGetMFDModeSpecEx** (char \*name, MFDMODESPECEX \*\*spec=0)  
*Returns the mode identifier and spec for an **MFD** mode defined by its name.*
- OAPIFUNC void **oapiVCRegisterMFD** (int mfd, const VCMFDSPEC \*spec)  
*Define a render target for rendering an **MFD** display in a virtual cockpit.*
- OAPIFUNC void **oapiVCRegisterArea** (int id, const RECT &tgtrect, int draw\_event, int mouse\_event, int bkmode, **SURFHANDLE** tgt)  
*Define an active area in a virtual cockpit. Active areas can be repainted. This function is similar to **oapiRegisterPanelArea**.*
- OAPIFUNC void **oapiVCRegisterArea** (int id, int draw\_event, int mouse\_event)  
*Define an active area in a virtual cockpit. This version is used when no dynamic texture update is required during redraw events.*
- OAPIFUNC void **oapiVCSetAreaClickmode\_Spherical** (int id, const **VECTOR3** &cnt, double rad)  
*Associate a spherical region in the virtual cockpit with a registered area to receive mouse events.*
- OAPIFUNC void **oapiVCSetAreaClickmode\_Quadrilateral** (int id, const **VECTOR3** &p1, const **VECTOR3** &p2, const **VECTOR3** &p3, const **VECTOR3** &p4)  
*Associate a quadrilateral region in the virtual cockpit with a registered area to receive mouse events.*
- OAPIFUNC void **oapiVCSetNeighbours** (int left, int right, int top, int bottom)

- Defines the neighbouring virtual cockpit camera positions in relation to the current position. The user can switch to neighbour positions with Ctrl-Arrow keys.*
- OAPIFUNC void [oapiVCTriggerRedrawArea](#) (int vc\_id, int area\_id)  
*Triggers a redraw notification for a virtual cockpit area.*
  - OAPIFUNC void [oapiVCRegisterHUD](#) (const VCHUDSPEC \*spec)  
*Define a render target for the head-up display (HUD) in a virtual cockpit.*
  - OAPIFUNC [LAUNCHPADITEM\\_HANDLE](#) [oapiRegisterLaunchpadItem](#) (LaunchpadItem \*item, [LAUNCHPADITEM\\_HANDLE](#) parent=0)  
*Register a new item in the parameter list of the "Extra" tab of the Orbiter Launchpad dialog.*
  - OAPIFUNC bool [oapiUnregisterLaunchpadItem](#) (LaunchpadItem \*item)  
*Unregister a previously registered entry in the "Extra" tab of the Orbiter Launchpad dialog.*
  - OAPIFUNC [LAUNCHPADITEM\\_HANDLE](#) [oapiFindLaunchpadItem](#) (const char \*name=0, [LAUNCHPADITEM\\_HANDLE](#) parent=0)  
*Returns a handle for an existing entry in the Extra parameter list.*
  - OAPIFUNC DWORD [oapiRegisterCustomCmd](#) (char \*label, char \*desc, CustomFunc func, void \*context)  
*Register a custom function. Custom functions can be accessed in Orbiter by pressing Ctrl-F4. A common use for custom functions is opening plugin dialog boxes.*
  - OAPIFUNC bool [oapiUnregisterCustomCmd](#) (int cmdId)  
*Unregister a previously defined custom function.*
  - OAPIFUNC HWND [oapiOpenDialog](#) (HINSTANCE hDLLInst, int resourceId, DLGPROC msgProc, void \*context=0)  
*Open a dialog box defined as a Windows resource.*
  - OAPIFUNC HWND [oapiOpenDialogEx](#) (HINSTANCE hDLLInst, int resourceId, DLGPROC msgProc, DWORD flag=0, void \*context=0)  
*Open a dialog box defined as a Windows resource. This version provides additional functionality compared to [oapiOpenDialog\(\)](#).*
  - OAPIFUNC HWND [oapiFindDialog](#) (HINSTANCE hDLLInst, int resourceId)  
*Returns the window handle of an open dialog box, or NULL if the specified dialog box is not open.*
  - OAPIFUNC void [oapiCloseDialog](#) (HWND hDlg)  
*Close a dialog box.*
  - OAPIFUNC void \* [oapiGetDialogContext](#) (HWND hDlg)  
*Retrieves the context pointer of a dialog box which has been defined during the call to [oapiOpenDialog\(\)](#).*
  - OAPIFUNC bool [oapiRegisterWindow](#) (HINSTANCE hDLLInst, HWND hWnd, DWORD flag=0)  
• OAPIFUNC bool [oapiAddTitleButton](#) (DWORD msgid, HBITMAP hBmp, DWORD flag)  
*Adds a custom button in the title bar of a dialog box.*
  - OAPIFUNC DWORD [oapiGetTitleButtonState](#) (HWND hDlg, DWORD msgid)  
• OAPIFUNC bool [oapiSetTitleButtonState](#) (HWND hDlg, DWORD msgid, DWORD state)  
• OAPIFUNC BOOL [oapiDefDialogProc](#) (HWND hDlg, UINT uMsg, WPARAM wParam, LPARAM lParam)  
*Default Orbiter dialog message handler.*
  - OAPIFUNC bool [oapiOpenHelp](#) (HELPCONTEXT \*hcontext)  
*Opens the ingame help window on the specified help page.*
  - OAPIFUNC bool [oapiOpenLaunchpadHelp](#) (HELPCONTEXT \*hcontext)  
*Opens a help window outside a simulation session, i.e. when the Launchpad dialog is displayed.*
  - OAPIFUNC DWORD [oapiGetMainMenuVisibilityMode](#) ()  
*Returns the display mode of the main menu bar.*
  - OAPIFUNC void [oapiSetMainMenuVisibilityMode](#) (DWORD mode)  
*Set the display mode for the main menu bar.*
  - OAPIFUNC DWORD [oapiGetMainInfoVisibilityMode](#) ()  
*Returns the display mode of the two info blocks at the top left and right screen corners.*
  - OAPIFUNC void [oapiSetMainInfoVisibilityMode](#) (DWORD mode)  
*Set the display mode for the two info blocks at the top left and right screen corners.*
  - OAPIFUNC [FILEHANDLE](#) [oapiOpenFile](#) (const char \*fname, FileAccessMode mode, PathRoot root=ROOT)

- **OAPIFUNC void oapiCloseFile (FILEHANDLE file, FileAccessMode mode)**

*Close a file after reading or writing.*
- **OAPIFUNC bool oapiSaveScenario (const char \*fname, const char \*desc)**

*Writes the current simulation state to a scenario file.*
- **OAPIFUNC void oapiWriteLine (FILEHANDLE file, char \*line)**

*Writes a line to a file.*
- **OAPIFUNC void oapiWriteLog (char \*line)**

*Writes a line to the Orbiter log file (orbiter.log) in the main orbiter directory.*
- **OAPIFUNC void oapiWriteLogV (const char \*format,...)**

*Writes a formatted string with variable number of arguments to orbiter.log.*
- **OAPIFUNC void oapiWriteScenario\_string (FILEHANDLE scn, char \*item, char \*string)**

*Writes a string-valued item to a scenario file.*
- **OAPIFUNC void oapiWriteScenario\_int (FILEHANDLE scn, char \*item, int i)**

*Writes an integer-valued item to a scenario file.*
- **OAPIFUNC void oapiWriteScenario\_float (FILEHANDLE scn, char \*item, double d)**

*Writes a floating point-valued item to a scenario file.*
- **OAPIFUNC void oapiWriteScenario\_vec (FILEHANDLE scn, char \*item, const VECTOR3 &vec)**

*Writes a vector-valued item to a scenario file.*
- **OAPIFUNC bool oapiReadScenario\_nextline (FILEHANDLE scn, char \*&line)**

*Reads an item from a scenario file.*
- **OAPIFUNC bool oapiReadItem\_string (FILEHANDLE f, char \*item, char \*string)**

*Read the value of a tag from a configuration file.*
- **OAPIFUNC bool oapiReadItem\_float (FILEHANDLE f, char \*item, double &d)**

*Read the value of a tag from a configuration file.*
- **OAPIFUNC bool oapiReadItem\_int (FILEHANDLE f, char \*item, int &i)**

*Read the value of a tag from a configuration file.*
- **OAPIFUNC bool oapiReadItem\_bool (FILEHANDLE f, char \*item, bool &b)**

*Read the value of a tag from a configuration file.*
- **OAPIFUNC bool oapiReadItem\_vec (FILEHANDLE f, char \*item, VECTOR3 &vec)**

*Read the value of a tag from a configuration file.*
- **OAPIFUNC void oapiWriteItem\_string (FILEHANDLE f, char \*item, char \*string)**

*Write a tag and its value to a configuration file.*
- **OAPIFUNC void oapiWriteItem\_float (FILEHANDLE f, char \*item, double d)**

*Write a tag and its value to a configuration file.*
- **OAPIFUNC void oapiWriteItem\_int (FILEHANDLE f, char \*item, int i)**

*Write a tag and its value to a configuration file.*
- **OAPIFUNC void oapiWriteItem\_bool (FILEHANDLE f, char \*item, bool b)**

*Write a tag and its value to a configuration file.*
- **OAPIFUNC void oapiWriteItem\_vec (FILEHANDLE f, char \*item, const VECTOR3 &vec)**

*Write a tag and its value to a configuration file.*
- **OAPIFUNC double oapiRand ()**

*Returns uniformly distributed pseudo-random number in the range [0..1].*
- **OAPIFUNC DWORD oapiDeflate (const BYTE \*ebuf, DWORD nebuf, BYTE \*zbuf, DWORD nzbuf)**

*Compress a data block.*
- **OAPIFUNC DWORD oapiInflate (const BYTE \*zbuf, DWORD nzbuf, BYTE \*ebuf, DWORD nebuf)**

*Uncompress a data block previously compressed with oapiDeflate.*
- **OAPIFUNC DWORD oapiGetColour (DWORD red, DWORD green, DWORD blue)**

*Returns a colour value adapted to the current screen colour depth for given red, green and blue components.*
- **OAPIFUNC void oapiOpenInputBox (char \*title, bool(\*Cblk)(void \*, char \*, void \*), char \*buf=0, int vislen=20, void \*usrdata=0)**

- **Opens a modal input box requesting a string from the user.**
- **OAPIFUNC void oapiOpenInputBoxEx** (const char \*title, bool(\*Cbk\_enter)(void \*, char \*, void \*), bool(\*Cbk\_cancel)(void \*, char \*, void \*), char \*buf=0, int vislen=20, void \*usrdata=0, DWORD flags=0)
- **OAPIFUNC NOTEHANDLE oapiCreateAnnotation** (bool exclusive, double size, const **VECTOR3** &col)
  - Creates an annotation handle for displaying onscreen text during a simulation.*
- **OAPIFUNC bool oapiDelAnnotation** (NOTEHANDLE hNote)
  - Deletes an annotation handle.*
- **OAPIFUNC void oapiAnnotationSetPos** (NOTEHANDLE hNote, double x1, double y1, double x2, double y2)
  - Resets the bounding box of the annotation display area.*
- **OAPIFUNC void oapiAnnotationSetSize** (NOTEHANDLE hNote, double size)
  - Resets the font size of the annotation text.*
- **OAPIFUNC void oapiAnnotationSetColour** (NOTEHANDLE hNote, const **VECTOR3** &col)
  - Resets the font colour of the annotation text.*
- **OAPIFUNC void oapiAnnotationSetText** (NOTEHANDLE hNote, char \*note)
  - Writes a new annotation to screen, or overwrites the previous text.*
- **OAPIFUNC OBJHANDLE oapiGetStationByName** (char \*name)
- **OAPIFUNC OBJHANDLE oapiGetStationByIndex** (int index)
- **OAPIFUNC DWORD oapiGetStationCount** ()
- **OAPIFUNC BOOL oapiGetAirspeedVector** (OBJHANDLE hVessel, **VECTOR3** \*speedvec)
  - Returns a vessel's airspeed vector w.r.t. the closest planet or moon in the local horizon's frame of reference.*
- **OAPIFUNC BOOL oapiGetShipAirspeedVector** (OBJHANDLE hVessel, **VECTOR3** \*speedvec)
  - Returns a vessel's airspeed vector w.r.t. the closest planet or moon in the vessel's local frame of reference.*
- **OAPIFUNC BOOL oapiGetFocusAirspeed** (double \*airspeed)
  - Returns the current focus vessel's airspeed w.r.t. the closest planet or moon.*
- **OAPIFUNC BOOL oapiGetFocusAirspeedVector** (**VECTOR3** \*speedvec)
  - Returns the current focus vessel's airspeed vector w.r.t. the closest planet or moon in the local horizon's frame of reference.*
- **OAPIFUNC BOOL oapiGetFocusShipAirspeedVector** (**VECTOR3** \*speedvec)
  - Returns the current focus vessel's airspeed vector w.r.t. closest planet or moon in the vessel's local frame of reference.*
- **OAPIFUNC void oapiGetAtmPressureDensity** (OBJHANDLE hVessel, double \*pressure, double \*density)
  - Returns the atmospheric pressure and density caused by a planetary atmosphere at the current vessel position.*
- **OAPIFUNC void oapiGetFocusAtmPressureDensity** (double \*pressure, double \*density)
  - Returns the atmospheric pressure and density caused by a planetary atmosphere at the current focus vessel's position.*
- **OAPIFUNC bool oapiAcceptDelayedKey** (char key, double interval)
- **OAPIFUNC int oapiRegisterMFDMode** (MFDMODESPEC &spec)
  - Register a custom **MFD** mode.*
- **OAPIFUNC int oapiGetMFDModeSpec** (char \*name, MFDMODESPEC \*\*spec=0)
  - Returns the mode identifier and spec for an **MFD** mode defined by its name.*
- **OAPIFUNC void oapiTriggerPanelRedrawArea** (int panel\_id, int area\_id)
- **OAPIFUNC void oapiTriggerRedrawArea** (int panel\_id, int vc\_id, int area\_id)
- **VECTOR3\_V** (double x, double y, double z)
  - Vector composition.*
- **void veccpy** (**VECTOR3** &a, const **VECTOR3** &b)
  - Vector copy.*
- **VECTOR3 operator+** (const **VECTOR3** &a, const **VECTOR3** &b)
  - Vector addition.*
- **VECTOR3 operator-** (const **VECTOR3** &a, const **VECTOR3** &b)
  - Vector subtraction.*
- **VECTOR3 operator\*** (const **VECTOR3** &a, const double f)
  - Multiplication of vector with scalar.*
- **VECTOR3 operator/** (const **VECTOR3** &a, const double f)

- **VECTOR3 & operator+= (VECTOR3 &a, const VECTOR3 &b)**

*Vector addition-assignment  $a += b$ .*
- **VECTOR3 & operator-= (VECTOR3 &a, const VECTOR3 &b)**

*Vector subtraction-assignment  $a -= b$ .*
- **VECTOR3 & operator\*= (VECTOR3 &a, const double f)**

*Vector-scalar multiplication-assignment  $a *= f$ .*
- **VECTOR3 & operator/= (VECTOR3 &a, const double f)**

*Vector-scalar division-assignment  $a /= f$ .*
- **VECTOR3 operator- (const VECTOR3 &a)**

*Vector unary minus  $-a$ .*
- **double dotp (const VECTOR3 &a, const VECTOR3 &b)**

*Scalar (inner, dot) product of two vectors.*
- **VECTOR3 crossp (const VECTOR3 &a, const VECTOR3 &b)**

*Vector (cross) product of two vectors.*
- **double length (const VECTOR3 &a)**

*Length (L2-norm) of a vector.*
- **double length2 (const VECTOR3 &a)**

*Length squared of a vector.*
- **double dist (const VECTOR3 &a, const VECTOR3 &b)**

*Distance between two points.*
- **void normalise (VECTOR3 &a)**

*Normalise a vector.*
- **VECTOR3 unit (const VECTOR3 &a)**

*Returns normalised vector.*
- **MATRIX3 \_M (double m11, double m12, double m13, double m21, double m22, double m23, double m31, double m32, double m33)**

*Matrix composition.*
- **MATRIX3 identity ()**

*Returns the identity matrix.*
- **MATRIX3 outerp (const VECTOR3 &a, const VECTOR3 &b)**

*Outer product of two vectors.*
- **MATRIX3 operator+ (const MATRIX3 &A, double s)**

*Sum of matrix and scalar.*
- **MATRIX3 operator- (const MATRIX3 &A, double s)**

*Difference of matrix and scalar.*
- **MATRIX3 operator\* (const MATRIX3 &A, double s)**

*Product of matrix and scalar.*
- **MATRIX3 operator/ (const MATRIX3 &A, double s)**

*Quotient of matrix and scalar.*
- **MATRIX3 & operator\*= (MATRIX3 &A, double s)**

*Matrix-scalar product-assignment  $A *= s$ .*
- **MATRIX3 & operator/= (MATRIX3 &A, double s)**

*Matrix-scalar division-assignment  $A /= s$ .*
- **VECTOR3 mul (const MATRIX3 &A, const VECTOR3 &b)**

*Matrix-vector multiplication.*
- **VECTOR3 tmul (const MATRIX3 &A, const VECTOR3 &b)**

*Matrix transpose-vector multiplication.*
- **MATRIX3 mul (const MATRIX3 &A, const MATRIX3 &B)**

*Matrix-matrix multiplication.*
- **MATRIX3 rotm (const VECTOR3 &axis, double angle)**

*Construct a rotation matrix from an axis and an angle.*

- **VECTOR4 \_V** (double x, double y, double z, double w)
- **VECTOR4 \_V** (const **VECTOR3** &v)
- **VECTOR4 mul** (const **MATRIX4** &A, const **VECTOR4** &b)
- **VECTOR4 mul** (const **VECTOR4** &b, const **MATRIX4** &A)
- **MATRIX4 \_M** (double m11, double m12, double m13, double m14, double m21, double m22, double m23, double m24, double m31, double m32, double m33, double m34, double m41, double m42, double m43, double m44)
- **MATRIX4 identity4 ()**

*Returns the identity matrix.*

- **MATRIX4 mul** (const **MATRIX4** &A, const **MATRIX4** &B)

*Matrix-matrix multiplication for 4-matrices.*

- **RECT \_R** (int left, int top, int right, int bottom)
- **VECTOR3 POINTERTOREF** (**VECTOR3** \*p)

## Variables

- const double **PI** = 3.14159265358979323846  
*pi*
- const double **PI05** = 1.57079632679489661923  
*pi/2*
- const double **PI2** = 6.28318530717958647693  
*pi\*2*
- const double **RAD** = **PI**/180.0  
*factor to map degrees to radians*
- const double **DEG** = 180.0/**PI**  
*factor to map radians to degrees*
- const double **C0** = 299792458.0  
*speed of light in vacuum [m/s]*
- const double **TAUA** = 499.004783806  
*light time for 1 AU [s]*
- const double **AU** = **C0**\***TAUA**  
*astronomical unit (mean geocentric distance of the sun) [m]*
- const double **GGRAV** = 6.67259e-11  
*gravitational constant [m^3 kg^-1 s^-2]*
- const double **G** = 9.81  
*gravitational acceleration [m/s^2] at Earth mean radius*
- const double **ATMP** = 101.4e3  
*atmospheric pressure [Pa] at Earth sea level*
- const double **ATMD** = 1.293  
*atmospheric density [kg/m^3] at Earth sea level*
- const DWORD **MAXTEX** = 1
- const UINT **ALLDOCKS** = (UINT)-1

### 18.4.1 Detailed Description

General API interface functions.

- Todo** Check functions in **VESSELSTATUS2::arot** and **oapiGetPlanetObliquityMatrix()**, minus sign has changed a place in a matrix. Is this correct??  
class CameraMode documentation

## 18.4.2 Function Documentation

### 18.4.2.1 OAPIFUNC void FormatValue ( `char * cbuf, int n, double f, int precision = 4` )

Write a floating point value to a string.

## Parameters

<i>cbuf</i>	character buffer
<i>n</i>	size of cbuf array
<i>f</i>	floating point value
<i>precision</i>	output precision

## Note

Formats the string in the standard Orbiter convention, with 'k', 'M', 'G' postfixes as required  
 cbuf must be allocated to sufficient size to hold the string

18.4.2.2 double normangle ( double *angle* ) [inline]

Returns the input argument normalised to range -pi ... pi.

## Parameters

<i>angle</i>	input angle [rad]
--------------	-------------------

## Returns

normalised angle [rad]

18.4.2.3 double posangle ( double *angle* ) [inline]

Returns the input argument normalised to range 0 ... 2 pi.

## Parameters

<i>angle</i>	input angle [rad]
--------------	-------------------

## Returns

normalised angle [rad]

## 18.5 Orbitersdk/include/VesselAPI.h File Reference

Contains the class interfaces for vessel objects ([VESSEL](#), [VESSEL2](#), [VESSEL3](#)).

## Classes

- struct [TOUCHDOWNVTX](#)  
*Collision vertex definition.*
- class [VESSEL](#)  
*Base class for objects of vessel type (spacecraft and similar)*
- class [VESSEL2](#)  
*Callback extensions to the [VESSEL](#) class.*
- class [VESSEL3](#)  
*Callback extensions to the [VESSEL](#) class.*
- class [VESSEL4](#)  
*Extensions to the [VESSEL](#) class.*

## Macros

- `#define FRAME_ECL 0`
- `#define FRAME_EQU 1`

### 18.5.1 Detailed Description

Contains the class interfaces for vessel objects ([VESSEL](#), [VESSEL2](#), [VESSEL3](#)).

## 19 Example Documentation

### 19.1 clbkLoadStateEx.cpp

Example of an overloaded [VESSEL2::clbkLoadStateEx](#) method.

```
class MyVessel: public VESSEL2 {
public:
    ...
    clbkLoadStateEx (FILEHANDLE scn, void *status);
    ...
};

void MyVessel::clbkLoadStateEx (FILEHANDLE scn, void *status)
{
    char *line;
    int my_value;

    while (apiReadScenario_nextline (scn, line)) {
        if (!strnicmp (line, "my_option", 9)) { // custom item
            sscanf (line+9, "%d", &my_value);
        } else if (...) { // more items
            ...
        } else { // anything not recognised is passed on to Orbiter
            ParseScenarioLineEx (line, vs);
        }
    }
}
```

### 19.2 clbkSetStateEx.cpp

Example of an overloaded [VESSEL2::clbkSetStateEx](#) method.

```
class MyVessel: public VESSEL2 {
public:
    ...
    clbkSetStateEx (const void *status);
    ...
};

void MyVessel::clbkSetStateEx (const void *status)
{
    // specialised vessel initialisations
    // ...

    // default initialisation:
    DefSetStateEx (status);
}
```

## 20 VESSEL2.cpp

Example for constructing and destroying an overloaded [VESSEL2](#) (p. 553) instance during the instance initialisation of a vessel module.

```
1 class MyVessel: public VESSEL2 {
2 public:
3     MyVessel (OBJHANDLE hvessel, int flightmodel = 1);
4     ...
5 };
6
7 MyVessel::MyVessel (OBJHANDLE hvessel, int flightmodel)
```

```
8 : VESSEL2 (hvessel, flightmodel)
9 {
10     ...
11 }
12
13 DLLCLBK VESSEL2 *ovcInit (OBJHANDLE hvessel, int flightmodel)
14 {
15     return new MyVessel (hvessel, flightmodel);
16 }
17
18 DLLCLBK void ovcExit (VESSEL2 *vessel)
19 {
20     delete (MyVessel*)vessel;
21 }
```



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