

# DE4xxSolarSystemEphemerides

5.1

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# Chapter 1

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## Chapter 2

# Namespace Index

### 2.1 Namespace List

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## Chapter 4

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<a href="#">jeod::De4xxFileIO</a>	
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<a href="#">jeod::EphemerisInterface</a>	Interface class that specifies minimal functionality of an ephemeris model . . . . .	128
<a href="#">jeod::EphemerisItem</a>	Base class for representing an item that is modeled in an ephemeris model . . . . .	132
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<a href="#">jeod::EphemerisPoint</a>	An <a href="#">EphemerisPoint</a> object updates the translational state of an ephemeris reference frame . . . . .	152
<a href="#">jeod::EphemerisRefFrame</a>	An <a href="#">EphemerisRefFrame</a> is a <a href="#">RefFrame</a> whose state is set by an ephemeris model . . . . .	157
<a href="#">jeod::EphemerisZXZOrientation</a>	The <a href="#">EphemerisZXZOrientation</a> is an <a href="#">EphemerisOrientation</a> subclass that updates orientation based on an Z-X-Z Euler sequence and the time derivatives of this sequence . . . . .	161
<a href="#">jeod::PropagatedEphemerisOrientation</a>	A <a href="#">PropagatedEphemerisOrientation</a> is an <a href="#">EphemerisOrientation</a> whose state is coupled with the rotational state of a <a href="#">DynBody</a> reference frame . . . . .	167
<a href="#">jeod::PropagatedEphemerisPlanet</a>	A <a href="#">PropagatedEphemerisPlanet</a> is an <a href="#">EphemerisPoint</a> whose state is coupled with the translational state of a <a href="#">DynBody</a> reference frame . . . . .	171
<a href="#">jeod::PropagatedPlanet</a>	The <a href="#">PropagatedPlanet</a> ephemeris model provides planetary state via a <a href="#">DynBody</a> object whose state is propagated using the JEOD state integration techniques . . . . .	175
<a href="#">jeod::SinglePlanetEphemeris</a>	A space with one gravitation body has one ephemeris point . . . . .	187
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## Chapter 6

# Module Documentation

### 6.1 Models

#### Modules

- [Environment](#)

#### 6.1.1 Detailed Description

## 6.2 Environment

### Modules

- [Ephemerides](#)

### 6.2.1 Detailed Description

## 6.3 Ephemerides

### Modules

- [De4xxEphem](#)
- [EphemInterface](#)
- [EphemItem](#)
- [EphemManager](#)
- [PropagatedPlanet](#)

### 6.3.1 Detailed Description

## 6.4 De4xxEphem

### Files

- file [de4xx\\_ephem/include/class\\_declarations.hh](#)  
*Forward declarations of classes defined in the DE4xx model.*
- file [de4xx\\_base.hh](#)  
*Define data types for JPL ephemeris model.*
- file [de4xx\\_ephem.hh](#)  
*Define class for the De4xx ephemeris model.*
- file [de4xx\\_file.hh](#)  
*Define the class responsible for reading the DE4xx ephemeris file.*
- file [de4xx\\_ephem.cc](#)  
*Define the methods of the classes defined in [de4xx\\_ephem.hh](#).*
- file [de4xx\\_ephem\\_dynmanager.cc](#)  
*Wall off dependencies on the dynamics manager.*
- file [de4xx\\_file.cc](#)  
*This file defines several utility functions used to read a binary JPL DE405 ephemeris file.*
- file [de4xx\\_file\\_init.cc](#)  
*Define De4xx initialization methods.*
- file [de4xx\\_file\\_update.cc](#)  
*Define De4xxFile::update.*

### Namespaces

- [jeod](#)  
*Namespace jeod.*

### Macros

- [#define \\_\\_STDC\\_LIMIT\\_MACROS](#)

#### 6.4.1 Detailed Description

#### 6.4.2 Macro Definition Documentation

##### 6.4.2.1 \_\_STDC\_LIMIT\_MACROS

```
#define __STDC_LIMIT_MACROS
```

Definition at line 49 of file [de4xx\\_file.cc](#).



## 6.5 EphemInterface

### Files

- file [ephem\\_interface/include/class\\_declarations.hh](#)  
*Forward declarations of classes defined in models/environment/ephemerides/ephem\_interface files.*
- file [ephem\\_interface.hh](#)  
*Define base class for all ephemeris interface models.*
- file [ephem\\_messages.hh](#)  
*Define the class EphemeridesMessages, the class that specifies the message IDs used in the JEOD ephemerides model.*
- file [ephem\\_ref\\_frame.hh](#)  
*Define the class EphemerisRefFrame.*
- file [simple\\_ephemerides.hh](#)  
*Define classes that define simple ephemeris models.*
- file [ephem\\_messages.cc](#)  
*Implement the class EphemeridesMessages.*
- file [ephem\\_ref\\_frame.cc](#)  
*Define non-inlined member functions for the EphemRefFrame class.*
- file [simple\\_ephemerides.cc](#)  
*Define member functions for the SinglePointEphemeris class and subclasses.*

### Namespaces

- [jeod](#)  
*Namespace jeod.*

#### 6.5.1 Detailed Description

## 6.6 EphemItem

### Files

- file [ephem\\_item/include/class\\_declarations.hh](#)  
*Forward declarations of classes defined in models/environment/ephemerides/ephem\_item files.*
- file [ephem\\_item.hh](#)  
*Define classes for items represented in some ephemeris model.*
- file [ephem\\_item\\_inline.hh](#)  
*Define inline methods for the EphemerisItem class.*
- file [ephem\\_orient.hh](#)  
*Define class EphemerisOrientation.*
- file [ephem\\_orient\\_zxz.hh](#)  
*Define classes for items represented in some ephemeris model.*
- file [ephem\\_point.hh](#)  
*Define class EphemerisPoint.*
- file [ephem\\_item.cc](#)  
*Define member functions for the EphemItem class and subclasses.*
- file [ephem\\_orient.cc](#)  
*Define member functions for the EphemItem class and subclasses.*
- file [ephem\\_orient\\_zxz.cc](#)  
*Define member functions for the EphemItem class and subclasses.*
- file [ephem\\_point.cc](#)  
*Define member functions for the EphemPoint class.*

### Namespaces

- [jeod](#)  
*Namespace jeod.*

### Macros

- `#define EPSILON_TIME 1e-12`
- `#define TAYLOR_CUTOFF 0.00786`

#### 6.6.1 Detailed Description

#### 6.6.2 Macro Definition Documentation

##### 6.6.2.1 EPSILON\_TIME

```
#define EPSILON_TIME 1e-12
```

Definition at line 59 of file `ephem_orient_zxz.cc`.

Referenced by `jeod::EphemerisZXZOrientation::propagate()`.

##### 6.6.2.2 TAYLOR\_CUTOFF

```
#define TAYLOR_CUTOFF 0.00786
```

Definition at line 69 of file `ephem_orient_zxz.cc`.

Referenced by `jeod::EphemerisZXZOrientation::propagate()`.

## 6.7 EphemManager

### Files

- file [base\\_ephem\\_manager.hh](#)  
*Define the BaseEphemManager class, which defines the interfaces to the class EphemManager.*
- file [ephem\\_manager.hh](#)  
*Define the EphemManager class, which manages the ephemeris models in a JEOD-based simulation.*
- file [ephem\\_manager.cc](#)  
*Define EphemeridesManager methods.*
- file [find\\_planet.cc](#)  
*Define EphemeridesManager::find\_planet.*

### Namespaces

- [jeod](#)  
*Namespace jeod.*

#### 6.7.1 Detailed Description

## 6.8 PropagatedPlanet

### Files

- file [propagated\\_planet.hh](#)  
*Define the classes needed to propagate a planet.*
- file [propagated\\_planet.cc](#)  
*Define the methods of the classes defined in [propagated\\_planet.hh](#).*

### Namespaces

- [jeod](#)  
*Namespace jeod.*

### 6.8.1 Detailed Description

## Chapter 7

# Namespace Documentation

### 7.1 jeod Namespace Reference

Namespace jeod.

#### Namespaces

- [De4xxBase](#)  
*Defines enumerations used in the DE4xx ephemeris model.*

#### Data Structures

- class [BaseEphemeridesManager](#)  
*The EphemManager class augments the RefFrameManager with ephemeris-related items.*
- class [De4xxEphemeris](#)  
*The S\_define-level class that provides planetary ephemerides.*
- class [De4xxEphemItem](#)  
*Describes a point modeled in a DE4xx ephemeris file.*
- class [De4xxFile](#)  
*Provides the ability to read and interpret a DE4xx ephemeris file.*
- class [De4xxFileCoef](#)  
*Contains Chebychev polynomial coefficients and terms.*
- class [De4xxFileHeader](#)  
*Contains data extracted from the ephemeris file header.*
- class [De4xxFileIO](#)  
*Contains data used directly for reading the ephemeris file.*
- class [De4xxFileItem](#)  
*Contains data regarding one of the items in a DE ephemeris file.*
- class [De4xxFileRefTime](#)  
*Contains timing reference data.*
- class [De4xxFileRestart](#)  
*The FILE pointer in a [De4xxFileIO](#) cannot be restored by Trick.*
- class [De4xxFileSpec](#)  
*Specifies which file to use (user input initialization-time data).*

- class [EmptySpaceEphemeris](#)  
*Empty space has one ephemeris point.*
- class [EphemeridesManager](#)  
*The [EphemeridesManager](#) class manages the ephemeris models in a simulation.*
- class [EphemeridesMessages](#)  
*Specifies the message IDs used in the Ephemerides model.*
- struct [EphemerisDataItemMeta](#)  
*Structure containing the header metadata for sizing/locating the data entries with the data segments.*
- struct [EphemerisDataSegmentMeta](#)  
*Metadata implied from each data segment.*
- struct [EphemerisDataSetMeta](#)  
*Container for the metadata from the DE model header.*
- class [EphemerisInterface](#)  
*Interface class that specifies minimal functionality of an ephemeris model.*
- class [EphemerisItem](#)  
*The [EphemerisItem](#) class is the base class for representing an item that is modeled in an ephemeris model.*
- class [EphemerisOrientation](#)  
*An [EphemerisOrientation](#) object updates the rotational state of an ephemeris reference frame.*
- class [EphemerisPoint](#)  
*An [EphemerisPoint](#) object updates the translational state of an ephemeris reference frame.*
- class [EphemerisRefFrame](#)  
*An [EphemerisRefFrame](#) is a [RefFrame](#) whose state is set by an ephemeris model.*
- class [EphemerisZXZOrientation](#)  
*The [EphemerisZXZOrientation](#) is an [EphemerisOrientation](#) subclass that updates orientation based on an Z-X-Z Euler sequence and the time derivatives of this sequence.*
- class [PropagatedEphemerisOrientation](#)  
*A [PropagatedEphemerisOrientation](#) is an [EphemerisOrientation](#) whose state is coupled with the rotational state of a [DynBody](#) reference frame.*
- class [PropagatedEphemerisPlanet](#)  
*A [PropagatedEphemerisPlanet](#) is an [EphemerisPoint](#) whose state is coupled with the translational state of a [DynBody](#) reference frame.*
- class [PropagatedPlanet](#)  
*The [PropagatedPlanet](#) ephemeris model provides planetary state via a [DynBody](#) object whose state is propagated using the JEOD state integration techniques.*
- class [SinglePlanetEphemeris](#)  
*A space with one gravitation body has one ephemeris point.*
- class [SinglePointEphemeris](#)  
*A [SinglePointEphemeris](#) has one ephemeris point.*

## Functions

- void [process\\_mem\\_usage](#) (double &vm\_usage, double &resident\_set)
- static double [l1\\_point](#) (double b1b2\_mass\_ratio)  
*Calculate the location of the L1 point as a ratio.*

### 7.1.1 Detailed Description

Namespace jeod.

## 7.1.2 Function Documentation

### 7.1.2.1 l1\_point()

```
static double jeod::l1_point (
    double b1b2_mass_ratio ) [static]
```

Calculate the location of the L1 point as a ratio.

#### Returns

Ratio of body1 to L1-point distance to body1 to body2 distance

#### Parameters

in	<i>b1b2_mass_ratio</i>	Body1 to body2 mass ratio
----	------------------------	---------------------------

Definition at line 258 of file `de4xx_file_init.cc`.

Referenced by `jeod::De4xxFile::initialize()`.

### 7.1.2.2 process\_mem\_usage()

```
void jeod::process_mem_usage (
    double & vm_usage,
    double & resident_set )
```

Definition at line 395 of file `de4xx_file.cc`.

Referenced by `jeod::De4xxFile::capture_mem_stats()`.

## 7.2 jeod::De4xxBase Namespace Reference

Defines enumerations used in the DE4xx ephemeris model.

## Enumerations

- enum [De4xxFileEntries](#) {  
[De4xx\\_File\\_Mercury](#) = 0, [De4xx\\_File\\_Venus](#) = 1, [De4xx\\_File\\_EMbary](#) = 2, [De4xx\\_File\\_Mars](#) = 3,  
[De4xx\\_File\\_Jupiter](#) = 4, [De4xx\\_File\\_Saturn](#) = 5, [De4xx\\_File\\_Uranus](#) = 6, [De4xx\\_File\\_Neptune](#) = 7,  
[De4xx\\_File\\_Pluto](#) = 8, [De4xx\\_File\\_Moon](#) = 9, [De4xx\\_File\\_Sun](#) = 10, [De4xx\\_File\\_ENutation](#) = 11,  
[De4xx\\_File\\_LLibration](#) = 12, [De4xx\\_File\\_LAngVel](#) = 13, [De4xx\\_File\\_tt\\_tdb](#) = 14, [De4xx\\_File\\_MaxEntries](#) }  
*Defines names for planetary body descriptors in the ephemeris file.*
- enum [De4xxEphemConsts](#) {  
[De4xx\\_Const\\_DENUM](#) = 0, [De4xx\\_Const\\_LENUM](#), [De4xx\\_Const\\_AU](#), [De4xx\\_Const\\_EMSTAT](#),  
[De4xx\\_Const\\_CLIGHT](#), [De4xx\\_Const\\_GM1](#), [De4xx\\_Const\\_GM2](#), [De4xx\\_Const\\_GMB](#),  
[De4xx\\_Const\\_GM4](#), [De4xx\\_Const\\_GM5](#), [De4xx\\_Const\\_GM6](#), [De4xx\\_Const\\_GM7](#),  
[De4xx\\_Const\\_GM8](#), [De4xx\\_Const\\_GM9](#), [De4xx\\_Const\\_GMS](#), [De4xx\\_Const\\_MaxConsts](#) }  
*Index aliases for the constants listed in the DE header that are used by JEOD.*
- enum [De4xxEphemBodies](#) {  
[De4xx\\_Ephem\\_Sun](#) = 0, [De4xx\\_Ephem\\_Mercury](#) = 1, [De4xx\\_Ephem\\_Venus](#) = 2, [De4xx\\_Ephem\\_Earth](#) = 3,  
[De4xx\\_Ephem\\_Mars](#) = 4, [De4xx\\_Ephem\\_Jupiter](#) = 5, [De4xx\\_Ephem\\_Saturn](#) = 6, [De4xx\\_Ephem\\_Uranus](#) =  
7,  
[De4xx\\_Ephem\\_Neptune](#) = 8, [De4xx\\_Ephem\\_Pluto](#) = 9, [De4xx\\_Ephem\\_Moon](#) = 10, [De4xx\\_Ephem\\_EMbary](#)  
= 11,  
[De4xx\\_Ephem\\_SSbary](#) = 12, [De4xx\\_Ephem\\_EML1](#) = 13, [De4xx\\_Ephem\\_ENutation](#) = 14, [De4xx\\_Ephem\\_LLibration](#)  
= 15,  
[De4xx\\_Ephem\\_MaxBodies](#) }  
*Defines names for ephemeris items as represented in the JEOD DE4xx model.*

## Functions

- static const char \*point\_names [32] [\\_\\_attribute\\_\\_\(\(unused\)\)](#)
- static uint32\_t [number\\_jeod\\_items](#) (int de\_version\_num [\\_\\_attribute\\_\\_\(\(unused\)\)](#))  
*Total number of items in the JEOD ephemeris.*
- static uint32\_t [number\\_trans\\_points](#) (int de\_version\_num [\\_\\_attribute\\_\\_\(\(unused\)\)](#))  
*Total number of translational states in the JEOD ephemeris.*
- static uint32\_t [number\\_grav\\_models](#) (int de\_version\_num [\\_\\_attribute\\_\\_\(\(unused\)\)](#))  
*Number of gravity models in the JEOD ephemeris (Mercury to Sun + implied Earth) Currently only one possibility, but written for extensibility.*
- static uint32\_t [number\\_physical\\_bodies](#) (int de\_version\_num [\\_\\_attribute\\_\\_\(\(unused\)\)](#))  
*Number of bodies in the JEOD ephemeris (Planets + Pluto + Moon + Sun) Currently only one possibility, but written for extensibility.*

### 7.2.1 Detailed Description

Defines enumerations used in the DE4xx ephemeris model.

### 7.2.2 Enumeration Type Documentation

#### 7.2.2.1 De4xxEphemBodies

```
enum jeod::De4xxBase::De4xxEphemBodies
```

Defines names for ephemeris items as represented in the JEOD DE4xx model.

NOTA BENE: The Earth-moon barycenter follows the massive bodies as the barycenter is not itself a massive body.



## Enumerator

De4xx_Ephem_Sun	Sun.
De4xx_Ephem_Mercury	Mercury.
De4xx_Ephem_Venus	Venus.
De4xx_Ephem_Earth	Earth.
De4xx_Ephem_Mars	Mars.
De4xx_Ephem_Jupiter	Jupiter.
De4xx_Ephem_Saturn	Saturn.
De4xx_Ephem_Uranus	Uranus.
De4xx_Ephem_Neptune	Neptune.
De4xx_Ephem_Pluto	Pluto.
De4xx_Ephem_Moon	Moon.
De4xx_Ephem_EMBary	Earth-moon barycenter.
De4xx_Ephem_SSbary	Solar system barycenter.
De4xx_Ephem_EML1	Earth-moon L1 point (disabled)
De4xx_Ephem_ENutation	Nutations (disabled)
De4xx_Ephem_LLibration	Librations.
De4xx_Ephem_MaxBodies	

Definition at line 149 of file de4xx\_base.hh.

## 7.2.2.2 De4xxEphemConsts

```
enum jeod::De4xxBase::De4xxEphemConsts
```

Index aliases for the constants listed in the DE header that are used by JEOD.

This is an incomplete subset of the constants provided by DE, but all of these constants must be present for JEOD ephemeris to perform.

## Enumerator

De4xx_Const_DENUM	
De4xx_Const_LENUM	
De4xx_Const_AU	
De4xx_Const_EMERAT	
De4xx_Const_CLIGHT	
De4xx_Const_GM1	
De4xx_Const_GM2	
De4xx_Const_GMB	
De4xx_Const_GM4	
De4xx_Const_GM5	
De4xx_Const_GM6	
De4xx_Const_GM7	
De4xx_Const_GM8	
De4xx_Const_GM9	
De4xx_Const_GMS	
De4xx_Const_MaxConsts	

Definition at line 123 of file de4xx\_base.hh.

### 7.2.2.3 De4xxFileEntries

```
enum jeod::De4xxBase::De4xxFileEntries
```

Defines names for planetary body descriptors in the ephemeris file.

This enum defines names for the bodies as they are represented in the ephemeris file.

#### Enumerator

De4xx_File_Mercury	Mercury XYZ [km].
De4xx_File_Venus	Venus XYZ.
De4xx_File_EMbary	Earth-moon barycenter XYZ.
De4xx_File_Mars	Mars XYZ.
De4xx_File_Jupiter	Jupiter XYZ.
De4xx_File_Saturn	Saturn XYZ.
De4xx_File_Uranus	Uranus XYZ.
De4xx_File_Neptune	Neptune XYZ.
De4xx_File_Pluto	Pluto XYZ.
De4xx_File_Moon	Moon, geocentric coords. XYZ.
De4xx_File_Sun	Sun XYZ.
De4xx_File_ENutation	Earth Nutations d(psi), d(eps) [rad].
De4xx_File_LLibration	Lun mantle Libratns phi,tht,psi [rad].
De4xx_File_LAngVel	Lun mantle ang vel omg_{xyz} [rad/day].
De4xx_File_tt_tdb	TDB to TT offset @ geocenter [s].
De4xx_File_MaxEntries	

Definition at line 95 of file de4xx\_base.hh.

## 7.2.3 Function Documentation

### 7.2.3.1 \_\_attribute\_\_()

```
static const char* point_names [32] jeod::De4xxBase::__attribute__ (
    (unused) ) [static]
```

### 7.2.3.2 number\_grav\_models()

```
static uint32_t jeod::De4xxBase::number_grav_models (
    int de_version_num __attribute__((unused)) ) [inline], [static]
```

Number of gravity models in the JEOD ephemeris (Mercury to Sun + implied Earth) Currently only one possibility, but written for extensibility.

Definition at line 217 of file de4xx\_base.hh.

Referenced by jeod::De4xxFileHeader::De4xxFileHeader(), and jeod::De4xxFile::initialize().

### 7.2.3.3 number\_jeod\_items()

```
static uint32_t jeod::De4xxBase::number_jeod_items (
    int de_version_num __attribute__((unused)) ) [inline], [static]
```

Total number of items in the JEOD ephemeris.

Refer to De4xxEphemBodies for identities of each item. Currently only one possibility, but written for extensibility

Definition at line 197 of file de4xx\_base.hh.

Referenced by jeod::De4xxEphemeris::activate\_nodes(), jeod::De4xxEphemeris::De4xxEphemeris(), jeod::De4xxEphemeris::ephem\_activate(), jeod::De4xxEphemeris::ephem\_initialize(), and jeod::De4xxEphemeris::initialize\_items().

### 7.2.3.4 number\_physical\_bodies()

```
static uint32_t jeod::De4xxBase::number_physical_bodies (
    int de_version_num __attribute__((unused)) ) [inline], [static]
```

Number of bodies in the JEOD ephemeris (Planets + Pluto + Moon + Sun) Currently only one possibility, but written for extensibility.

Definition at line 226 of file de4xx\_base.hh.

### 7.2.3.5 number\_trans\_points()

```
static uint32_t jeod::De4xxBase::number_trans_points (
    int de_version_num __attribute__((unused)) ) [inline], [static]
```

Total number of translational states in the JEOD ephemeris.

(Sun, Mercury to Pluto, EMBary, SSbary) Currently excludes EML1 Currently only one possibility, but written for extensibility

Definition at line 207 of file de4xx\_base.hh.

Referenced by jeod::De4xxEphemeris::activate\_nodes(), jeod::De4xxEphemeris::De4xxEphemeris(), jeod::De4xxEphemeris::determine\_root\_node(), jeod::De4xxEphemeris::ephem\_build\_tree(), and jeod::De4xxEphemeris::initialize\_items().



## Chapter 8

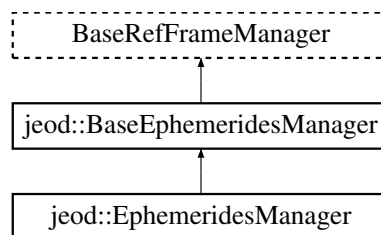
# Data Structure Documentation

### 8.1 jeod::BaseEphemeridesManager Class Reference

The EphemManager class augments the RefFrameManager with ephemeris-related items.

```
#include <base_ephem_manager.hh>
```

Inheritance diagram for jeod::BaseEphemeridesManager:



#### Public Member Functions

- [~BaseEphemeridesManager](#) () override=default  
*Destructor.*
- virtual void [ephem\\_note\\_tree\\_status\\_change](#) ()=0  
*Denote that the tree needs to be rebuilt.*
- virtual void [add\\_planet](#) (BasePlanet &planet)=0  
*Add a planet to the list of such.*
- virtual void [add\\_planet](#) (Planet &planet)=0  
*Add a planet to the list of such.*
- virtual BasePlanet \* [find\\_base\\_planet](#) (const std::string &name) const =0  
*Find a planet.*
- virtual Planet \* [find\\_planet](#) (const std::string &name) const =0  
*Find a planet.*
- virtual unsigned int [get\\_num\\_planets](#) () const =0  
*Return number of registered planets.*
- virtual void [add\\_ephemeris](#) (EphemerisInterface &ephem\_if)=0  
*Add an ephemeris model to the list of such.*

- virtual void `clear_added_ephemerides()`=0  
*Deactivate all registered ephemeris models.*
- virtual void `disable_add_ephemeris()`=0  
*Disable registration of new ephemeris models.*
- virtual void `add_ephem_item(EphemerisItem &ephem_item)`=0  
*Add an ephemeris item to the list of such.*
- virtual `EphemerisItem * find_ephem_item(const std::string &name)` const =0  
*Find an ephemeris item.*
- virtual `EphemerisOrientation * find_ephem_angle(const std::string &name)` const =0  
*Find an ephemeris orientation.*
- virtual `EphemerisPoint * find_ephem_point(const std::string &name)` const =0  
*Find an ephemeris point.*
- virtual void `add_integ_frame(EphemerisRefFrame &ref_frame)`=0  
*Add an integration frame to the list of such.*
- virtual `EphemerisRefFrame * find_integ_frame(const std::string &name)` const =0  
*Find an integration frame.*
- virtual bool `is_integ_frame(const RefFrame &ref_frame)` const =0  
*Check whether a reference frame is an integration frame.*
- virtual unsigned int `find_integ_frame_index(const EphemerisRefFrame &ref_frame)` const =0  
*Find a reference frame's index in the list of integration frames.*
- virtual const std::vector< `EphemerisRefFrame` \* > & `get_integ_frames()` const =0  
*Get the vector of integration frames.*

## Friends

- class `InputProcessor`
- void `init_attrjeod_BaseEphemeridesManager()`

### 8.1.1 Detailed Description

The EphemManager class augments the RefFrameManager with ephemeris-related items.

This class defines the external interfaces to that class.

Definition at line 88 of file `base_ephem_manager.hh`.

### 8.1.2 Constructor & Destructor Documentation

#### 8.1.2.1 ~BaseEphemeridesManager()

```
jeod::BaseEphemeridesManager::~BaseEphemeridesManager ( ) [override], [default]
```

Destructor.

### 8.1.3 Member Function Documentation

#### 8.1.3.1 add\_ephem\_item()

```
virtual void jeod::BaseEphemeridesManager::add_ephem_item (  
    EphemerisItem & ephem_item ) [pure virtual]
```

Add an ephemeris item to the list of such.

## Parameters

<i>ephem_item</i>	Item to be added.
-------------------	-------------------

Implemented in [jeod::EphemeridesManager](#).

## 8.1.3.2 add\_ephemeris()

```
virtual void jeod::BaseEphemeridesManager::add_ephemeris (
    EphemerisInterface & ephem_if ) [pure virtual]
```

Add an ephemeris model to the list of such.

## Parameters

<i>ephem↔ _if</i>	Ephemeris model to be added.
-----------------------	------------------------------

Implemented in [jeod::EphemeridesManager](#).

## 8.1.3.3 add\_integ\_frame()

```
virtual void jeod::BaseEphemeridesManager::add_integ_frame (
    EphemerisRefFrame & ref_frame ) [pure virtual]
```

Add an integration frame to the list of such.

## Parameters

<i>ref_frame</i>	Frame to be added.
------------------	--------------------

Implemented in [jeod::EphemeridesManager](#).

## 8.1.3.4 add\_planet() [1/2]

```
virtual void jeod::BaseEphemeridesManager::add_planet (
    BasePlanet & planet ) [pure virtual]
```

Add a planet to the list of such.

## Parameters

<i>planet</i>	Planet to be added.
---------------	---------------------



Implemented in [jeod::EphemeridesManager](#).

#### 8.1.3.5 add\_planet() [2/2]

```
virtual void jeod::BaseEphemeridesManager::add_planet (
    Planet & planet ) [pure virtual]
```

Add a planet to the list of such.

##### Parameters

<i>planet</i>	Planet to be added.
---------------	---------------------

Implemented in [jeod::EphemeridesManager](#).

#### 8.1.3.6 clear\_added\_ephemerides()

```
virtual void jeod::BaseEphemeridesManager::clear_added_ephemerides ( ) [pure virtual]
```

Deactivate all registered ephemeris models.

Implemented in [jeod::EphemeridesManager](#).

#### 8.1.3.7 disable\_add\_ephemeris()

```
virtual void jeod::BaseEphemeridesManager::disable_add_ephemeris ( ) [pure virtual]
```

Disable registration of new ephemeris models.

Implemented in [jeod::EphemeridesManager](#).

#### 8.1.3.8 ephem\_note\_tree\_status\_change()

```
virtual void jeod::BaseEphemeridesManager::ephem_note_tree_status_change ( ) [pure virtual]
```

Denote that the tree needs to be rebuilt.

Implemented in [jeod::EphemeridesManager](#).

Referenced by [jeod::EphemerisItem::disable\(\)](#), [jeod::EphemerisItem::enable\(\)](#), and [jeod::EphemerisRefFrame::set\\_active\\_status\(\)](#).

#### 8.1.3.9 find\_base\_planet()

```
virtual BasePlanet* jeod::BaseEphemeridesManager::find_base_planet (
    const std::string & name ) const [pure virtual]
```

Find a planet.

**Parameters**

<i>name</i>	Planet name.
-------------	--------------

**Returns**

Pointer to found planet.

Implemented in [jeod::EphemeridesManager](#).

**8.1.3.10 find\_ephem\_angle()**

```
virtual EphemerisOrientation* jeod::BaseEphemeridesManager::find_ephem_angle (
    const std::string & name ) const [pure virtual]
```

Find an ephemeris orientation.

**Parameters**

<i>name</i>	Item to be found.
-------------	-------------------

**Returns**

Found item.

Implemented in [jeod::EphemeridesManager](#).

**8.1.3.11 find\_ephem\_item()**

```
virtual EphemerisItem* jeod::BaseEphemeridesManager::find_ephem_item (
    const std::string & name ) const [pure virtual]
```

Find an ephemeris item.

**Parameters**

<i>name</i>	Item to be found.
-------------	-------------------

**Returns**

Found item.

Implemented in [jeod::EphemeridesManager](#).

### 8.1.3.12 find\_ephem\_point()

```
virtual EphemerisPoint* jeod::BaseEphemeridesManager::find_ephem_point (
    const std::string & name ) const [pure virtual]
```

Find an ephemeris point.

#### Parameters

<i>name</i>	Item to be found.
-------------	-------------------

#### Returns

Found item.

Implemented in [jeod::EphemeridesManager](#).

### 8.1.3.13 find\_integ\_frame()

```
virtual EphemerisRefFrame* jeod::BaseEphemeridesManager::find_integ_frame (
    const std::string & name ) const [pure virtual]
```

Find an integration frame.

#### Parameters

<i>name</i>	Frame to be found.
-------------	--------------------

#### Returns

Found frame.

Implemented in [jeod::EphemeridesManager](#).

### 8.1.3.14 find\_integ\_frame\_index()

```
virtual unsigned int jeod::BaseEphemeridesManager::find_integ_frame_index (
    const EphemerisRefFrame & ref_frame ) const [pure virtual]
```

Find a reference frame's index in the list of integration frames.

#### Parameters

<i>ref_frame</i>	Frame to be checked.
------------------	----------------------

**Returns**

Frame index.

Implemented in [jeod::EphemeridesManager](#).

**8.1.3.15 find\_planet()**

```
virtual Planet* jeod::BaseEphemeridesManager::find_planet (
    const std::string & name ) const [pure virtual]
```

Find a planet.

**Parameters**

<i>name</i>	Planet name.
-------------	--------------

**Returns**

Pointer to found planet.

Implemented in [jeod::EphemeridesManager](#).

**8.1.3.16 get\_integ\_frames()**

```
virtual const std::vector<EphemerisRefFrame *>& jeod::BaseEphemeridesManager::get_integ_frames
( ) const [pure virtual]
```

Get the vector of integration frames.

**Returns**

Vector of reference frame pointers.

Implemented in [jeod::EphemeridesManager](#).

**8.1.3.17 get\_num\_planets()**

```
virtual unsigned int jeod::BaseEphemeridesManager::get_num_planets ( ) const [pure virtual]
```

Return number of registered planets.

**Returns**

Number of planets.

Implemented in [jeod::EphemeridesManager](#).

## 8.1.3.18 is\_integ\_frame()

```
virtual bool jeod::BaseEphemeridesManager::is_integ_frame (
    const RefFrame & ref_frame ) const [pure virtual]
```

Check whether a reference frame is an integration frame.

## Parameters

<i>ref_frame</i>	Frame to be checked.
------------------	----------------------

## Returns

True if *ref\_frame* is an integration frame, false otherwise.

Implemented in [jeod::EphemeridesManager](#).

Referenced by [jeod::EphemerisItem::set\\_target\\_frame\(\)](#).

## 8.1.4 Friends And Related Function Documentation

## 8.1.4.1 init\_attrjeod\_\_BaseEphemeridesManager

```
void init_attrjeod__BaseEphemeridesManager ( ) [friend]
```

## 8.1.4.2 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 90 of file [base\\_ephem\\_manager.hh](#).

The documentation for this class was generated from the following file:

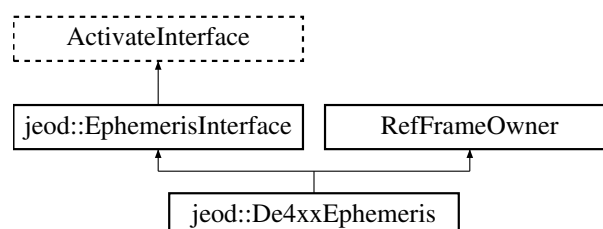
- [base\\_ephem\\_manager.hh](#)

## 8.2 jeod::De4xxEphemeris Class Reference

The S\_define-level class that provides planetary ephemerides.

```
#include <de4xx_ephem.hh>
```

Inheritance diagram for [jeod::De4xxEphemeris](#):



## Public Member Functions

- [De4xxEphemeris](#) ()  
*De4xxEphemeris* default constructor.
- [~De4xxEphemeris](#) () override  
*De4xxEphemeris* destructor.
- [De4xxEphemeris](#) (const [De4xxEphemeris](#) &)=delete
- [De4xxEphemeris](#) & [operator=](#) (const [De4xxEphemeris](#) &)=delete
- void [initialize\\_model](#) (const TimeManager &time\_manager, DynManager &dyn\_manager, const std::string &time\_type="TT")  
*Initialize the De4xxEphemeris model.*
- void [initialize\\_model](#) (const TimeManager &time\_manager, [EphemeridesManager](#) &ephem\_manager, const std::string &time\_type="TT")  
*Initialize the De4xxEphemeris model.*
- void [propagate\\_lunar\\_rnp](#) ()  
*Propagate the lunar orientation to the current time.*
- void [shutdown](#) ()  
*Free resources allocated by the De4xxEphemeris model.*
- void [activate](#) () override  
*Nominally, activate the object.*
- void [deactivate](#) () override  
*Deactivate the De4xxEphemeris object.*
- double [timestamp](#) () const override  
*Return time of last update.*
- std::string [get\\_name](#) () const override  
*Return model name.*
- void [ephem\\_initialize](#) ([EphemeridesManager](#) &ephem\_manager) override  
*Complete the initialization process.*
- void [ephem\\_activate](#) ([EphemeridesManager](#) &ephem\_manager) override  
*Mark appropriate items in the model as active.*
- void [ephem\\_build\\_tree](#) ([EphemeridesManager](#) &ephem\_manager) override  
*Construct the ephemeris model portions of the reference frame tree.*
- void [ephem\\_update](#) () override  
*Update ephemerides for subscribed items.*
- bool [time\\_is\\_in\\_range](#) () const  
*Check whether the specified time is represented in the JPL ephemeris file.*
- void [set\\_model\\_number](#) (int denum\_in)  
*Set ephemeris model number.*
- uint32\_t [get\\_model\\_number](#) ()  
*Get Ephemeris model number.*
- void [set\\_model\\_directory](#) (const std::string &dirIn)  
*Set ephemeris data model directory.*
- std::string [get\\_model\\_directory](#) ()  
*Get Ephemeris data model directory.*
- const [De4xxFileHeader](#) & [get\\_header\\_data](#) ()

## Data Fields

- bool [active](#) {true}  
*Is the model active? This is set to true by the constructor.*
- bool \* [selected\\_items](#)  
*Used at initialization time only to selectively enable/disable portions of the model.*

## Protected Attributes

- [De4xxFile](#) `file`  
*The ephemeris file model.*
- `bool` [force\\_update](#) `{}`  
*Is an update needed even if the time hasn't changed?*
- `unsigned int` [nactive\\_items](#) `{}`  
*Number of items that are currently active.*
- [De4xxEphemItem](#) \* [item\\_data](#)  
*Data pertaining to the points for which translational states are calculated.*
- `std::string` [ident](#)  
*Identifier for this model, computed from the supplied file.*
- `double` [update\\_time](#) `{-99e99}`  
*Time of last update, dynamic time seconds.*
- [EphemerisPoint](#) \* [points](#)  
*The planets and barycenter points, in De4xxEphemBodies FileBodies order.*
- [EphemerisZXZOrientation](#) [lunar\\_orientation](#)  
*Lunar orientation.*
- [EphemerisRefFrame](#) [earth\\_moon\\_barycenter\\_frame](#)  
*Earth-Moon barycenter reference frame.*
- [EphemerisRefFrame](#) [solar\\_system\\_barycenter\\_frame](#)  
*Solar system barycenter reference frame.*
- [De4xxEphemItem](#) \* [root\\_item](#) `{}`  
*The root point in the reference frame tree.*
- `const TimeStandard` \* [time\\_tt](#) `{}`  
*The source of ephemeris time information.*
- `const TimeDyn` \* [time\\_dyn](#) `{}`  
*The source of dynamic time information.*
- `int` \* [body\\_to\\_file\\_idx](#)  
*Mapping from De4xxEphemBodies numbers to De4xxFileBodies numbers.*

## Private Member Functions

- `void` [initialize\\_time](#) (`const TimeManager &time_manager`, `const std::string &time_type`)  
*Initialize [De4xxEphemeris](#) timing.*
- `void` [initialize\\_file](#) ()  
*Initialize the [De4xxEphemeris](#) file.*
- `void` [initialize\\_items](#) ([EphemeridesManager](#) &`ephem_manager`)  
*Initialize the [De4xxEphemeris](#) item data.*
- `unsigned int` [activate\\_nodes](#) ()  
*Mark appropriate items in the model as active.*
- `unsigned int` [activate\\_em\\_nodes](#) (`unsigned int tot_active`)  
*Adjust Earth, Moon, and Earth-Moon barycenter activity.*
- `void` [determine\\_root\\_node](#) ()  
*Determine which item should be the root of the ref frame tree.*

## Friends

- `class` [InputProcessor](#)
- `void` [init\\_attrjeod\\_De4xxEphemeris](#) ()

## 8.2.1 Detailed Description

The `S_define`-level class that provides planetary ephemerides.

The [De4xxEphemeris](#) class constructs the ephemeris reference frame tree and updates the states of the planets based on data from a DE4xx ephemeris model.

Definition at line 175 of file `de4xx_ephem.hh`.

## 8.2.2 Constructor & Destructor Documentation

### 8.2.2.1 De4xxEphemeris() [1/2]

```
jeod::De4xxEphemeris::De4xxEphemeris ( )
```

[De4xxEphemeris](#) default constructor.

Definition at line 89 of file `de4xx_ephem.cc`.

References `body_to_file_idx`, `jeod::De4xxBase::De4xx_Ephem_Earth`, `jeod::De4xxBase::De4xx_Ephem_E_Mbary`, `jeod::De4xxBase::De4xx_Ephem_EML1`, `jeod::De4xxBase::De4xx_Ephem_ENutation`, `jeod::De4xxBase::De4xx_Ephem_Jupiter`, `jeod::De4xxBase::De4xx_Ephem_LLibration`, `jeod::De4xxBase::De4xx_Ephem_Mars`, `jeod::De4xxBase::De4xx_Ephem_Mercury`, `jeod::De4xxBase::De4xx_Ephem_Moon`, `jeod::De4xxBase::De4xx_Ephem_Neptune`, `jeod::De4xxBase::De4xx_Ephem_Pluto`, `jeod::De4xxBase::De4xx_Ephem_Saturn`, `jeod::De4xxBase::De4xx_Ephem_Ssbary`, `jeod::De4xxBase::De4xx_Ephem_Sun`, `jeod::De4xxBase::De4xx_Ephem_Uranus`, `jeod::De4xxBase::De4xx_Ephem_Venus`, `jeod::De4xxBase::De4xx_File_EMbary`, `jeod::De4xxBase::De4xx_File_ENutation`, `jeod::De4xxBase::De4xx_File_Jupiter`, `jeod::De4xxBase::De4xx_File_LLibration`, `jeod::De4xxBase::De4xx_File_Mars`, `jeod::De4xxBase::De4xx_File_MaxEntries`, `jeod::De4xxBase::De4xx_File_Mercury`, `jeod::De4xxBase::De4xx_File_Moon`, `jeod::De4xxBase::De4xx_File_Neptune`, `jeod::De4xxBase::De4xx_File_Pluto`, `jeod::De4xxBase::De4xx_File_Saturn`, `jeod::De4xxBase::De4xx_File_Sun`, `jeod::De4xxBase::De4xx_File_Uranus`, `jeod::De4xxBase::De4xx_File_Venus`, `earth_moon_barycenter_frame`, `jeod::Ephemeris::enable()`, `jeod::EphemerisItem::enable()`, `jeod::EphemerisItem::get_name()`, `jeod::De4xxEphemItem::index`, `jeod::De4xxEphemItem::item`, `item_data`, `lunar_orientation`, `jeod::De4xxEphemItem::name`, `jeod::De4xxBase::number_jeod_items()`, `jeod::De4xxBase::number_trans_points()`, `points`, `selected_items`, `jeod::EphemerisItem::set_name()`, `jeod::EphemerisItem::set_owner()`, and `solar_system_barycenter_frame`.

### 8.2.2.2 ~De4xxEphemeris()

```
jeod::De4xxEphemeris::~De4xxEphemeris ( ) [override]
```

[De4xxEphemeris](#) destructor.

Definition at line 159 of file `de4xx_ephem.cc`.

References `body_to_file_idx`, `item_data`, `points`, `selected_items`, and `shutdown()`.



### 8.2.2.3 De4xxEphemeris() [2/2]

```
jeod::De4xxEphemeris::De4xxEphemeris (
    const De4xxEphemeris & ) [delete]
```

## 8.2.3 Member Function Documentation

### 8.2.3.1 activate()

```
void jeod::De4xxEphemeris::activate ( ) [override]
```

Nominally, activate the object.

In the case of a [De4xxEphemeris](#) object, an inactive object cannot be activated.

Definition at line 181 of file `de4xx_ephem.cc`.

References `active`, and `jeod::EphemeridesMessages::internal_error`.

### 8.2.3.2 activate\_em\_nodes()

```
unsigned int jeod::De4xxEphemeris::activate_em_nodes (
    unsigned int tot_active ) [private]
```

Adjust Earth, Moon, and Earth-Moon barycenter activity.

#### Returns

Void

#### Parameters

in	<i>tot_active</i>	Number active translation nodes
----	-------------------	---------------------------------

Definition at line 483 of file `de4xx_ephem.cc`.

References `jeod::EphemerisItem::activate()`, `jeod::De4xxEphemItem::Active`, `jeod::De4xxBase::De4xx_Ephem_Earth`, `jeod::De4xxBase::De4xx_Ephem_EMbary`, `jeod::De4xxBase::De4xx_Ephem_Moon`, `jeod::De4xxEphemItem::Deselected`, `jeod::EphemerisItem::enable()`, `jeod::De4xxEphemItem::enabled_item`, `jeod::De4xxEphemItem::Inactive`, `jeod::EphemeridesMessages::inconsistent_setup`, `jeod::De4xxEphemItem::InTree`, `jeod::De4xxEphemItem::item`, `item_data`, `nactive_items`, `jeod::De4xxEphemItem::name`, and `jeod::De4xxEphemItem::status`.

Referenced by `ephem_activate()`.

### 8.2.3.3 activate\_nodes()

```
unsigned int jeod::De4xxEphemeris::activate_nodes ( ) [private]
```

Mark appropriate items in the model as active.

#### Returns

Void

Definition at line 436 of file de4xx\_ephem.cc.

References `jeod::De4xxEphemItem::Active`, `jeod::De4xxEphemItem::Deselected`, `jeod::De4xxEphemItem::enabled_item`, `file`, `jeod::De4xxFile::file_spec`, `jeod::EphemerisItem::get_enabled_item()`, `jeod::De4xxFileSpec::get_model_number()`, `jeod::De4xxEphemItem::Inactive`, `jeod::De4xxEphemItem::InTree`, `jeod::EphemerisItem::is_active()`, `jeod::De4xxEphemItem::item`, `item_data`, `nactive_items`, `jeod::De4xxBase::number_jeod_items()`, `jeod::De4xxBase::number_trans_points()`, and `jeod::De4xxEphemItem::status`.

Referenced by `ephem_activate()`.

### 8.2.3.4 deactivate()

```
void jeod::De4xxEphemeris::deactivate ( ) [override]
```

Deactivate the [De4xxEphemeris](#) object.

Definition at line 195 of file de4xx\_ephem.cc.

References `active`.

### 8.2.3.5 determine\_root\_node()

```
void jeod::De4xxEphemeris::determine_root_node ( ) [private]
```

Determine which item should be the root of the ref frame tree.

Definition at line 552 of file de4xx\_ephem.cc.

References `jeod::De4xxBase::De4xx_Ephem_Earth`, `jeod::De4xxBase::De4xx_Ephem_EMbary`, `jeod::De4xxBase::De4xx_Ephem_Moon`, `jeod::De4xxBase::De4xx_Ephem_SSbary`, `jeod::De4xxEphemItem::enabled_item`, `file`, `jeod::De4xxFile::file_spec`, `jeod::De4xxFileSpec::get_model_number()`, `jeod::De4xxEphemItem::Inactive`, `jeod::De4xxEphemItem::IsRoot`, `jeod::De4xxEphemItem::item`, `item_data`, `nactive_items`, `jeod::De4xxBase::number_trans_points()`, `root_item`, and `jeod::De4xxEphemItem::status`.

Referenced by `ephem_activate()`.

### 8.2.3.6 ephem\_activate()

```
void jeod::De4xxEphemeris::ephem_activate (
    EphemeridesManager & ephem_manager ) [override], [virtual]
```

Mark appropriate items in the model as active.

## Parameters

<i>in, out</i>	<i>ephem_manager</i>	Ephemerides manager
----------------	----------------------	---------------------

Implements [jeod::EphemerisInterface](#).

Definition at line 618 of file `de4xx_ephem.cc`.

References `activate_em_nodes()`, `activate_nodes()`, `jeod::De4xxEphemItem::Active`, `active`, `jeod::De4xxFileItem::active`, `body_to_file_idx`, `jeod::De4xxBase::De4xx_Ephem_EMbary`, `jeod::De4xxBase::De4xx_Ephem_LLibration`, `jeod::De4xxBase::De4xx_Ephem_Sun`, `jeod::De4xxBase::De4xx_File_ENutation`, `jeod::De4xxBase::De4xx_File_LLibration`, `determine_root_node()`, `file`, `jeod::De4xxFile::file_spec`, `force_update`, `jeod::De4xxFileSpec::get_model_number()`, `jeod::De4xxFile::item`, `item_data`, `nactive_items`, `jeod::De4xxBase::number_jeod_items()`, and `jeod::De4xxEphemItem::status`.

8.2.3.7 `ephem_build_tree()`

```
void jeod::De4xxEphemeris::ephem_build_tree (
    EphemeridesManager & ephem_manager ) [override], [virtual]
```

Construct the ephemeris model portions of the reference frame tree.

## Parameters

<i>in, out</i>	<i>ephem_manager</i>	Ephemerides manager
----------------	----------------------	---------------------

Implements [jeod::EphemerisInterface](#).

Definition at line 671 of file `de4xx_ephem.cc`.

References `jeod::De4xxEphemItem::Active`, `active`, `jeod::De4xxBase::De4xx_Ephem_Earth`, `jeod::De4xxBase::De4xx_Ephem_EMbary`, `jeod::De4xxBase::De4xx_Ephem_Moon`, `jeod::De4xxBase::De4xx_Ephem_Sbary`, `jeod::De4xxEphemItem::Deselected`, `jeod::De4xxEphemItem::enabled_item`, `file`, `jeod::De4xxFile::file_spec`, `jeod::De4xxEphemItem::frame`, `jeod::De4xxFileSpec::get_model_number()`, `jeod::EphemeridesMessages::inconsistent_setup`, `jeod::De4xxEphemItem::item`, `item_data`, `jeod::De4xxEphemItem::name`, `jeod::De4xxBase::number_trans_points()`, `root_item`, and `jeod::De4xxEphemItem::status`.

8.2.3.8 `ephem_initialize()`

```
void jeod::De4xxEphemeris::ephem_initialize (
    EphemeridesManager & ephem_manager ) [override], [virtual]
```

Complete the initialization process.

This method should be called after all other ephemeris models have completed their basic initialization and after all planets have registered themselves with the ephemeris manager.

## Parameters

<code>in, out</code>	<code>ephem_manager</code>	Ephemerides manager
----------------------	----------------------------	---------------------

Implements [jeod::EphemerisInterface](#).

Definition at line 397 of file `de4xx_ephem.cc`.

References `active`, `jeod::De4xxEphemItem::Deselected`, `file`, `jeod::De4xxFile::file_spec`, `jeod::De4xxEphemItem::frame`, `jeod::De4xxFileSpec::get_model_number()`, `jeod::EphemerisItem::get_target_frame()`, `jeod::De4xxEphemItem::item`, `item_data`, `jeod::De4xxBase::number_jeod_items()`, and `jeod::De4xxEphemItem::status`.

### 8.2.3.9 `ephem_update()`

```
void jeod::De4xxEphemeris::ephem_update ( ) [override], [virtual]
```

Update ephemerides for subscribed items.

Implements [jeod::EphemerisInterface](#).

Definition at line 728 of file `de4xx_ephem.cc`.

References `jeod::De4xxEphemItem::Active`, `active`, `jeod::De4xxFileHeader::be_em_dist_ratio`, `jeod::De4xxFileHeader::bm_em_dist_ratio`, `body_to_file_idx`, `jeod::De4xxBase::De4xx_Ephem_Earth`, `jeod::De4xxBase::De4xx_Ephem_EMbary`, `jeod::De4xxBase::De4xx_Ephem_LLibration`, `jeod::De4xxBase::De4xx_Ephem_Moon`, `jeod::De4xxBase::De4xx_Ephem_Sun`, `jeod::De4xxBase::De4xx_File_LLibration`, `jeod::De4xxEphemItem::enabled`, `item`, `file`, `force_update`, `jeod::De4xxFile::header`, `jeod::De4xxEphemItem::item`, `jeod::De4xxFile::item`, `item_data`, `lunar_orientation`, `nactive_items`, `points`, `root_item`, `jeod::De4xxFileItem::state`, `time_dyn`, `time_tt`, `jeod::EphemerisPoint::update()`, `jeod::EphemerisZXZOrientation::update()`, `jeod::De4xxFile::update()`, `jeod::EphemerisPoint::update_scaled()`, and `update_time`.

### 8.2.3.10 `get_header_data()`

```
const De4xxFileHeader& jeod::De4xxEphemeris::get_header_data ( ) [inline]
```

Definition at line 272 of file `de4xx_ephem.hh`.

References `file`, `jeod::De4xxFile::file_spec`, and `jeod::De4xxFileSpec::get_model_directory()`.

### 8.2.3.11 `get_model_directory()`

```
std::string jeod::De4xxEphemeris::get_model_directory ( ) [inline]
```

Get Ephemeris data model directory.

This number is used to specify the de file to use the pathname is of the form `<ephem_file_dir>/libde<denumIn>.so`  
Defaults to `PWD/build/de4xx_lib/libde<denumIn>.so`

Definition at line 267 of file `de4xx_ephem.hh`.

### 8.2.3.12 get\_model\_number()

```
uint32_t jeod::De4xxEphemeris::get_model_number ( ) [inline]
```

Get Ephemeris model number.

This number is used to specify the de file to use the pathname is of the form PWD/build/de4xx\_lib/libde<denum↵  
In>.so

Definition at line 245 of file de4xx\_ephem.hh.

### 8.2.3.13 get\_name()

```
std::string jeod::De4xxEphemeris::get_name ( ) const [override], [virtual]
```

Return model name.

#### Returns

Name

Implements [jeod::EphemerisInterface](#).

Definition at line 213 of file de4xx\_ephem.cc.

References [ident](#).

### 8.2.3.14 initialize\_file()

```
void jeod::De4xxEphemeris::initialize_file ( ) [private]
```

Initialize the [De4xxEphemeris](#) file.

Definition at line 293 of file de4xx\_ephem.cc.

References [jeod::De4xxBase::De4xx\\_Const\\_DENUM](#), [jeod::De4xxBase::De4xx\\_Const\\_LENUM](#), [jeod::↵  
EphemerisDataSetMeta::de\\_constants](#), [file](#), [ident](#), [jeod::De4xxFile::initialize\(\)](#), [jeod::De4xxFile::io](#), [jeod::De4xx↵  
FileIO::metaData](#), and [time\\_tt](#).

Referenced by [initialize\\_model\(\)](#).

### 8.2.3.15 initialize\_items()

```
void jeod::De4xxEphemeris::initialize_items (
    EphemeridesManager & ephem_manager ) [private]
```

Initialize the [De4xxEphemeris](#) item data.

## Parameters

in, out	<i>ephem_manager</i>	Ephemerides manager
---------	----------------------	---------------------

Definition at line 324 of file `de4xx_ephem.cc`.

References `jeod::EphemeridesManager::add_ephem_item()`, `jeod::EphemeridesManager::add_integ_frame()`, `jeod::De4xxBase::De4xx_Ephem_Earth`, `jeod::De4xxBase::De4xx_Ephem_EMbary`, `jeod::De4xxBase::De4xx_Ephem_LLibration`, `jeod::De4xxBase::De4xx_Ephem_Moon`, `jeod::De4xxBase::De4xx_Ephem_Ssbary`, `jeod::De4xxEphemItem::Deselected`, `jeod::EphemerisItem::disable()`, `earth_moon_barycenter_frame`, `file`, `jeod::De4xxFile::file_spec`, `jeod::De4xxFileSpec::get_model_number()`, `jeod::De4xxEphemItem::Inactive`, `jeod::EphemeridesMessages::inconsistent_setup`, `jeod::De4xxEphemItem::item`, `item_data`, `lunar_orientation`, `jeod::De4xxBase::number_jeod_items()`, `jeod::De4xxBase::number_trans_points()`, `points`, `selected_items`, `solar_system_barycenter_frame`, and `jeod::De4xxEphemItem::status`.

Referenced by `initialize_model()`.

### 8.2.3.16 `initialize_model()` [1/2]

```
void jeod::De4xxEphemeris::initialize_model (
    const TimeManager & time_manager,
    DynManager & dyn_manager,
    const std::string & time_type = "TT" )
```

Initialize the [De4xxEphemeris](#) model.

## Parameters

in	<i>time_manager</i>	Time manager
in, out	<i>dyn_manager</i>	Dynamics manager
in	<i>time_type</i>	time type

Definition at line 48 of file `de4xx_ephem_dynmanager.cc`.

### 8.2.3.17 `initialize_model()` [2/2]

```
void jeod::De4xxEphemeris::initialize_model (
    const TimeManager & time_manager,
    EphemeridesManager & ephem_manager,
    const std::string & time_type = "TT" )
```

Initialize the [De4xxEphemeris](#) model.

This method is called before the planets have been registered with the reference frame manager, so we don't know whether the ephemeris items should be enabled or disabled.

## Parameters

in	<i>time_manager</i>	Time manager
in, out	<i>ephem_manager</i>	Ephemerides manager
in	<i>time_type</i>	optional "tt" "tdb" "tt" default manager

Definition at line 227 of file de4xx\_ephem.cc.

References `jeod::EphemeridesManager::add_ephemeris()`, `initialize_file()`, `initialize_items()`, and `initialize_time()`.

## 8.2.3.18 initialize\_time()

```
void jeod::De4xxEphemeris::initialize_time (
    const TimeManager & time_manager,
    const std::string & time_type ) [private]
```

Initialize [De4xxEphemeris](#) timing.

## Parameters

in	<i>time_manager</i>	Time manager
in	<i>time_type</i>	time type

Definition at line 255 of file de4xx\_ephem.cc.

References `jeod::EphemeridesMessages::inconsistent_setup`, `time_dyn`, and `time_tt`.

Referenced by `initialize_model()`.

## 8.2.3.19 operator=()

```
De4xxEphemeris& jeod::De4xxEphemeris::operator= (
    const De4xxEphemeris & ) [delete]
```

## 8.2.3.20 propagate\_lunar\_rnp()

```
void jeod::De4xxEphemeris::propagate_lunar_rnp ( )
```

Propagate the lunar orientation to the current time.

Definition at line 817 of file de4xx\_ephem.cc.

References `jeod::De4xxEphemItem::Active`, `active`, `jeod::De4xxBase::De4xx_Ephem_LLibration`, `item_data`, `lunar_orientation`, `jeod::EphemerisZXZOrientation::propagate()`, and `time_dyn`.

**8.2.3.21 set\_model\_directory()**

```
void jeod::De4xxEphemeris::set_model_directory (
    const std::string & dirIn ) [inline]
```

Set ephemeris data model directory.

This number is used to specify the de file to use the pathname is of the form <ephem\_file\_dir>/libde<denumIn>.so  
Defaults to PWD/build/de4xx\_lib/libde<denumIn>.so

Definition at line 256 of file de4xx\_ephem.hh.

**8.2.3.22 set\_model\_number()**

```
void jeod::De4xxEphemeris::set_model_number (
    int denum_in ) [inline]
```

Set ephemeris model number.

This number is used to specify the de file to use the pathname is of the form <ephem\_file\_dir>/libde<denumIn>.so  
Defaults to PWD/build/de4xx\_lib/libde<denumIn>.so

Definition at line 235 of file de4xx\_ephem.hh.

**8.2.3.23 shutdown()**

```
void jeod::De4xxEphemeris::shutdown ( )
```

Free resources allocated by the [De4xxEphemeris](#) model.

Definition at line 171 of file de4xx\_ephem.cc.

References file, and jeod::De4xxFile::shutdown().

Referenced by ~De4xxEphemeris().

**8.2.3.24 time\_is\_in\_range()**

```
bool jeod::De4xxEphemeris::time_is_in_range ( ) const
```

Check whether the specified time is represented in the JPL ephemeris file.

**Assumptions and Limitations**

- Ephemeris file is open for input
- Ephemeris file is blocked per value set in the ephem\_file structure

**Returns**

True if time is in file

Definition at line 809 of file de4xx\_ephem.cc.

References file, jeod::De4xxFile::time\_is\_in\_range(), and time\_tt.



### 8.2.3.25 timestamp()

```
double jeod::De4xxEphemeris::timestamp ( ) const [override], [virtual]
```

Return time of last update.

#### Returns

Timestamp  
Units: day

Implements [jeod::EphemerisInterface](#).

Definition at line 204 of file de4xx\_ephem.cc.

References [update\\_time](#).

## 8.2.4 Friends And Related Function Documentation

### 8.2.4.1 init\_attrjeod\_\_De4xxEphemeris

```
void init_attrjeod__De4xxEphemeris ( ) [friend]
```

### 8.2.4.2 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 178 of file de4xx\_ephem.hh.

## 8.2.5 Field Documentation

### 8.2.5.1 active

```
bool jeod::De4xxEphemeris::active {true}
```

Is the model active? This is set to true by the constructor.

Setting this flag to false prior to initialization time will result in the model never doing anything. Setting this flag to false after the model has been active for some time is not supported.[trick\\_units\(-\)](#)

Definition at line 286 of file de4xx\_ephem.hh.

Referenced by [activate\(\)](#), [deactivate\(\)](#), [ephem\\_activate\(\)](#), [ephem\\_build\\_tree\(\)](#), [ephem\\_initialize\(\)](#), [ephem\\_update\(\)](#), [initialize\\_model\(\)](#), and [propagate\\_lunar\\_rnp\(\)](#).

### 8.2.5.2 body\_to\_file\_idx

```
int* jeod::De4xxEphemeris::body_to_file_idx [protected]
```

Mapping from De4xxEphemBodies numbers to De4xxFileBodies numbers.

trick\_units(-)

Definition at line 378 of file de4xx\_ephem.hh.

Referenced by De4xxEphemeris(), ephemer\_activate(), ephemer\_update(), and ~De4xxEphemeris().

### 8.2.5.3 earth\_moon\_barycenter\_frame

```
EphemerisRefFrame jeod::De4xxEphemeris::earth_moon_barycenter_frame [protected]
```

Earth-Moon barycenter reference frame.

trick\_units(-)

Definition at line 353 of file de4xx\_ephem.hh.

Referenced by De4xxEphemeris(), and initialize\_items().

### 8.2.5.4 file

```
De4xxFile jeod::De4xxEphemeris::file [protected]
```

The ephemeris file model.

The items of interest to the typical user are the data members file.file\_spec.ephem\_file\_name and file.file\_spec.denum. The former specifies the name of the file while the latter serves as a sanity check that the right file is being read.trick\_units(-)

Definition at line 312 of file de4xx\_ephem.hh.

Referenced by activate\_nodes(), determine\_root\_node(), ephemer\_activate(), ephemer\_build\_tree(), ephemer\_initialize(), ephemer\_update(), get\_header\_data(), initialize\_file(), initialize\_items(), shutdown(), and time\_is\_in\_range().

### 8.2.5.5 force\_update

```
bool jeod::De4xxEphemeris::force_update {} [protected]
```

Is an update needed even if the time hasn't changed?

trick\_units(-)

Definition at line 317 of file de4xx\_ephem.hh.

Referenced by ephemer\_activate(), and ephemer\_update().

## 8.2.5.6 ident

```
std::string jeod::De4xxEphemeris::ident [protected]
```

Identifier for this model, computed from the supplied file.

trick\_units(-)

Definition at line 333 of file de4xx\_ephem.hh.

Referenced by get\_name(), and initialize\_file().

## 8.2.5.7 item\_data

```
De4xxEphemItem* jeod::De4xxEphemeris::item_data [protected]
```

Data pertaining to the points for which translational states are calculated.

trick\_units(-)

Definition at line 328 of file de4xx\_ephem.hh.

Referenced by activate\_em\_nodes(), activate\_nodes(), De4xxEphemeris(), determine\_root\_node(), ephem\_↔ activate(), ephem\_build\_tree(), ephem\_initialize(), ephem\_update(), initialize\_items(), propagate\_lunar\_rnp(), and ~De4xxEphemeris().

## 8.2.5.8 lunar\_orientation

```
EphemerisZXZOrientation jeod::De4xxEphemeris::lunar_orientation [protected]
```

Lunar orientation.

trick\_units(-)

Definition at line 348 of file de4xx\_ephem.hh.

Referenced by De4xxEphemeris(), ephem\_update(), initialize\_items(), and propagate\_lunar\_rnp().

## 8.2.5.9 nactive\_items

```
unsigned int jeod::De4xxEphemeris::nactive_items {} [protected]
```

Number of items that are currently active.

trick\_units(-)

Definition at line 322 of file de4xx\_ephem.hh.

Referenced by activate\_em\_nodes(), activate\_nodes(), determine\_root\_node(), ephem\_activate(), and ephem\_↔ update().

#### 8.2.5.10 points

`EphemerisPoint*` `jeod::De4xxEphemeris::points` [protected]

The planets and barycenter points, in De4xxEphemBodies FileBodies order.

`trick_units(-)`

Definition at line 343 of file `de4xx_ephem.hh`.

Referenced by `De4xxEphemeris()`, `ephem_update()`, `initialize_items()`, and `~De4xxEphemeris()`.

#### 8.2.5.11 root\_item

`De4xxEphemItem*` `jeod::De4xxEphemeris::root_item` {} [protected]

The root point in the reference frame tree.

`trick_units(-)`

Definition at line 363 of file `de4xx_ephem.hh`.

Referenced by `determine_root_node()`, `ephem_build_tree()`, and `ephem_update()`.

#### 8.2.5.12 selected\_items

`bool*` `jeod::De4xxEphemeris::selected_items`

Used at initialization time only to selectively enable/disable portions of the model.

The constructor initializes all elements of this array to true. Users can set selected elements to false to disable the corresponding ephemeris items. The intent is to enable the use of multiple ephemeris models. Typical users of the model can leave this member as-is. NOTE: while the container is of length 16, Nutations and lunar librations are not currently supported by JEODtrick\_units(-)

Definition at line 298 of file `de4xx_ephem.hh`.

Referenced by `De4xxEphemeris()`, `initialize_items()`, and `~De4xxEphemeris()`.

#### 8.2.5.13 solar\_system\_barycenter\_frame

`EphemerisRefFrame` `jeod::De4xxEphemeris::solar_system_barycenter_frame` [protected]

Solar system barycenter reference frame.

`trick_units(-)`

Definition at line 358 of file `de4xx_ephem.hh`.

Referenced by `De4xxEphemeris()`, and `initialize_items()`.

#### 8.2.5.14 time\_dyn

```
const TimeDyn* jeod::De4xxEphemeris::time_dyn {} [protected]
```

The source of dynamic time information.

trick\_units(-)

Definition at line 373 of file de4xx\_ephem.hh.

Referenced by ephem\_update(), initialize\_time(), and propagate\_lunar\_rnp().

#### 8.2.5.15 time\_tt

```
const TimeStandard* jeod::De4xxEphemeris::time_tt {} [protected]
```

The source of ephemeris time information.

trick\_units(-)

Definition at line 368 of file de4xx\_ephem.hh.

Referenced by ephem\_update(), initialize\_file(), initialize\_time(), and time\_is\_in\_range().

#### 8.2.5.16 update\_time

```
double jeod::De4xxEphemeris::update_time {-99e99} [protected]
```

Time of last update, dynamic time seconds.

trick\_units(s)

Definition at line 338 of file de4xx\_ephem.hh.

Referenced by ephem\_update(), and timestamp().

The documentation for this class was generated from the following files:

- [de4xx\\_ephem.hh](#)
- [de4xx\\_ephem.cc](#)
- [de4xx\\_ephem\\_dynmanager.cc](#)

## 8.3 jeod::De4xxEphemItem Class Reference

Describes a point modeled in a DE4xx ephemeris file.

```
#include <de4xx_ephem.hh>
```

## Public Types

- enum [Status](#) {  
[Deselected](#) = 0, [Inactive](#) = 1, [IsRoot](#) = 2, [InTree](#) = 3,  
[Active](#) = 4 }

*Enumerates the status values of a [De4xEphemItem](#).*

## Public Member Functions

- [De4xEphemItem](#) ()=default
- [~De4xEphemItem](#) ()=default
- [De4xEphemItem](#) (const [De4xEphemItem](#) &)=delete
- [De4xEphemItem](#) & [operator=](#) (const [De4xEphemItem](#) &)=delete

## Protected Attributes

- [EphemerisItem](#) \* [item](#) {}  
*The ephemeris item for this item from this model.*
- [EphemerisItem](#) \* [enabled\\_item](#) {}  
*The enabled ephemeris item for this item, not necessarily from this model.*
- [EphemerisRefFrame](#) \* [frame](#) {}  
*The reference frame whose state is set by this item.*
- std::string [name](#)  
*Item name; used for reporting errors.*
- [Status](#) [status](#) {[Deselected](#)}  
*The status for this item.*
- unsigned int [index](#) {UINT\_MAX}  
*The node index number, per the [De4xxEphemBodies](#) numbering scheme.*

## Friends

- class [InputProcessor](#)
- class [De4xxEphemeris](#)
- void [init\\_attrjeod\\_\\_De4xEphemItem](#) ()

### 8.3.1 Detailed Description

Describes a point modeled in a DE4xx ephemeris file.

This class is only used inside the [De4xxEphemeris](#) class as the type of the protected `item_data` data member.

Definition at line 97 of file `de4xx_ephem.hh`.

### 8.3.2 Member Enumeration Documentation

#### 8.3.2.1 Status

```
enum jeod::De4xxEphemItem::Status
```

Enumerates the status values of a [De4xEphemItem](#).

## Enumerator

Deselected	The item is marked as deselected or the corresponding reference frame is not present in the simulation. The corresponding ephemeris item is permanently disabled under such circumstances.
Inactive	The item has not been deselected and the corresponding reference frame is present but is inactive.
IsRoot	The item has not been deselected and the corresponding reference frame is present and active. However, the item in question is the root of the reference frame tree and hence its state is the trivial state.
InTree	The item has not been deselected and the corresponding reference frame is present and active. However, the ephemeris item that updates this frame is not a part of this model.
Active	The item has not been deselected, the corresponding reference frame is present and active, and the ephemeris item that updates this frame belongs to this model.

Definition at line 107 of file de4xx\_ephem.hh.

### 8.3.3 Constructor & Destructor Documentation

#### 8.3.3.1 De4xxEphemItem() [1/2]

```
jeod::De4xxEphemItem::De4xxEphemItem ( ) [default]
```

#### 8.3.3.2 ~De4xxEphemItem()

```
jeod::De4xxEphemItem::~~De4xxEphemItem ( ) [default]
```

#### 8.3.3.3 De4xxEphemItem() [2/2]

```
jeod::De4xxEphemItem::De4xxEphemItem (
    const De4xxEphemItem & ) [delete]
```

### 8.3.4 Member Function Documentation

#### 8.3.4.1 operator=()

```
De4xxEphemItem& jeod::De4xxEphemItem::operator= (
    const De4xxEphemItem & ) [delete]
```

### 8.3.5 Friends And Related Function Documentation

#### 8.3.5.1 De4xxEphemeris

```
friend class De4xxEphemeris [friend]
```

Definition at line 99 of file de4xx\_ephem.hh.

#### 8.3.5.2 init\_attrjeod\_\_De4xxEphemItem

```
void init_attrjeod__De4xxEphemItem ( ) [friend]
```

#### 8.3.5.3 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 99 of file de4xx\_ephem.hh.

### 8.3.6 Field Documentation

#### 8.3.6.1 enabled\_item

```
EphemerisItem* jeod::De4xxEphemItem::enabled_item {} [protected]
```

The enabled ephemeris item for this item, not necessarily from this model.

trick\_units(-)

Definition at line 147 of file de4xx\_ephem.hh.

Referenced by jeod::De4xxEphemeris::activate\_em\_nodes(), jeod::De4xxEphemeris::activate\_nodes(), jeod::De4xxEphemeris::determine\_root\_node(), jeod::De4xxEphemeris::ephem\_build\_tree(), and jeod::De4xxEphemeris::ephem\_update().



### 8.3.6.2 frame

`EphemerisRefFrame*` jeod::De4xxEphemItem::frame {} [protected]

The reference frame whose state is set by this item.

trick\_units(—)

Definition at line 152 of file de4xx\_ephem.hh.

Referenced by jeod::De4xxEphemeris::ephem\_build\_tree(), and jeod::De4xxEphemeris::ephem\_initialize().

### 8.3.6.3 index

`unsigned int` jeod::De4xxEphemItem::index {UINT\_MAX} [protected]

The node index number, per the De4xxEphemBodies numbering scheme.

trick\_units(—)

Definition at line 167 of file de4xx\_ephem.hh.

Referenced by jeod::De4xxEphemeris::De4xxEphemeris().

### 8.3.6.4 item

`EphemerisItem*` jeod::De4xxEphemItem::item {} [protected]

The ephemeris item for this item from this model.

trick\_units(—)

Definition at line 141 of file de4xx\_ephem.hh.

Referenced by jeod::De4xxEphemeris::activate\_em\_nodes(), jeod::De4xxEphemeris::activate\_nodes(), jeod::De4xxEphemeris::De4xxEphemeris(), jeod::De4xxEphemeris::determine\_root\_node(), jeod::De4xxEphemeris::ephem\_build\_tree(), jeod::De4xxEphemeris::ephem\_initialize(), jeod::De4xxEphemeris::ephem\_update(), and jeod::De4xxEphemeris::initialize\_items().

### 8.3.6.5 name

`std::string` jeod::De4xxEphemItem::name [protected]

Item name; used for reporting errors.

trick\_units(—)

Definition at line 157 of file de4xx\_ephem.hh.

Referenced by jeod::De4xxEphemeris::activate\_em\_nodes(), jeod::De4xxEphemeris::De4xxEphemeris(), and jeod::De4xxEphemeris::ephem\_build\_tree().

### 8.3.6.6 status

```
Status jeod::De4xxEphemItem::status {Deselected} [protected]
```

The status for this item.

trick\_units(–)

Definition at line 162 of file de4xx\_ephem.hh.

Referenced by jeod::De4xxEphemeris::activate\_em\_nodes(), jeod::De4xxEphemeris::activate\_nodes(), jeod::De4xxEphemeris::determine\_root\_node(), jeod::De4xxEphemeris::ephem\_activate(), jeod::De4xxEphemeris::ephem\_build\_tree(), jeod::De4xxEphemeris::ephem\_initialize(), and jeod::De4xxEphemeris::initialize\_items().

The documentation for this class was generated from the following file:

- [de4xx\\_ephem.hh](#)

## 8.4 jeod::De4xxFile Class Reference

Provides the ability to read and interpret a DE4xx ephemeris file.

```
#include <de4xx_file.hh>
```

### Public Member Functions

- [De4xxFile](#) ()  
*Construct the JPL ephemeris file.*
- [~De4xxFile](#) ()  
*Destroy the JPL ephemeris file.*
- [De4xxFile](#) (const [De4xxFile](#) &)=delete
- [De4xxFile](#) & operator= (const [De4xxFile](#) &)=delete
- void [pre\\_initialize](#) ()  
*Pre-initialize a DE4xxFile instance.*
- void [initialize](#) (double epoch\_time, double del\_day, double time\_offset, double init\_time)  
*Initialize a DE4xxFile instance.*
- bool [time\\_is\\_in\\_range](#) (double time) const  
*Check whether the specified time is represented in the JPL ephemeris file.*
- void [update](#) (double time)  
*Calculate the position and velocity states of selected planetary bodies at some point in time.*
- void [shutdown](#) ()  
*Shutdown the JPL ephemeris file.*

## Data Fields

- [De4xxFileSpec file\\_spec](#)  
*File specification.*
- [De4xxFileHeader header](#)  
*File header.*
- [De4xxFileItem \\* item](#)  
*Item data.*
- [De4xxFileIO io](#)  
*File descriptor.*
- [De4xxFileRefTime ref\\_time](#)  
*Reference time.*
- [De4xxFileCoef coef](#)  
*Chebyshev coefs.*
- [De4xxFileRestart restart](#)  
*Restart handler.*
- double [update\\_time](#) {-99e99}  
*Time of last update.*
- double [vm\\_usage](#) {}  
*trick\_units(-)*
- double [resident\\_set](#) {}  
*trick\_units(-)*
- bool [logMemoryStats](#) {true}  
*trick\_units(-)*

## Private Member Functions

- void [open](#) ()  
*Open the JPL ephemeris file.*
- void [reopen](#) ()  
*Open the JPL ephemeris file on restart.*
- void [close](#) ()  
*Close the JPL ephemeris file.*
- void [interpolate](#) (double time, double fblk)  
*Calculate the position and velocity states of selected planetary bodies at some point in time.*
- void [capture\\_mem\\_stats](#) ()

## Friends

- class [InputProcessor](#)
- class [De4xxFileRestart](#)
- void [init\\_attrjeod\\_\\_De4xxFile](#) ()

### 8.4.1 Detailed Description

Provides the ability to read and interpret a DE4xx ephemeris file.

Definition at line 546 of file de4xx\_file.hh.

## 8.4.2 Constructor & Destructor Documentation

### 8.4.2.1 De4xxFile() [1/2]

```
jeod::De4xxFile::De4xxFile ( )
```

Construct the JPL ephemeris file.

Definition at line 157 of file de4xx\_file.cc.

References `jeod::De4xxBase::De4xx_File_ENutation`, `jeod::De4xxBase::De4xx_File_LLibration`, `jeod::De4xxBase::De4xx_File_MaxEntries`, `jeod::De4xxBase::De4xx_File_tt_tdb`, `item`, `jeod::De4xxFileItem::nitems`, `jeod::De4xxFileItem::pscale`, and `restart`.

### 8.4.2.2 ~De4xxFile()

```
jeod::De4xxFile::~~De4xxFile ( )
```

Destroy the JPL ephemeris file.

Definition at line 192 of file de4xx\_file.cc.

References `close()`, `item`, and `restart`.

### 8.4.2.3 De4xxFile() [2/2]

```
jeod::De4xxFile::De4xxFile (
    const De4xxFile & ) [delete]
```

## 8.4.3 Member Function Documentation

### 8.4.3.1 capture\_mem\_stats()

```
void jeod::De4xxFile::capture_mem_stats ( ) [private]
```

Definition at line 431 of file de4xx\_file.cc.

References `logMemoryStats`, `jeod::process_mem_usage()`, `resident_set`, and `vm_usage`.

### 8.4.3.2 close()

```
void jeod::De4xxFile::close ( ) [private]
```

Close the JPL ephemeris file.

#### Assumptions and Limitations

- Ephemeris file is open for input
- Errors are fatal

Definition at line 338 of file `de4xx_file.cc`.

References `jeod::De4xxFileCoef::chebyderiv`, `jeod::De4xxFileCoef::chebypoly`, `coef`, `jeod::De4xxFileIO::file`, `jeod::EphemeridesMessages::file_error`, `io`, and `jeod::De4xxFileIO::metaData`.

Referenced by `shutdown()`, and `~De4xxFile()`.

### 8.4.3.3 initialize()

```
void jeod::De4xxFile::initialize (
    double epoch_time,
    double del_day,
    double time_offset,
    double init_time )
```

Initialize a DE4xxFile instance.

#### Parameters

in	<i>epoch_time</i>	Julian date Units: day
in	<i>del_day</i>	Days from epoch Units: day
in	<i>time_offset</i>	Terrestrial Time offset Units: s
in	<i>init_time</i>	Seconds from epoch Units: s

Definition at line 177 of file `de4xx_file_init.cc`.

References `jeod::De4xxFileHeader::au`, `jeod::De4xxFileHeader::b1_em_dist_ratio`, `jeod::De4xxFileHeader::be_em_dist_ratio`, `jeod::De4xxFileRefTime::block_no`, `jeod::De4xxFileHeader::bm_em_dist_ratio`, `jeod::De4xxFileCoef::chebyderiv`, `jeod::De4xxFileCoef::chebypoly`, `coef`, `jeod::De4xxBase::De4xx_Const_AU`, `jeod::De4xxBase::De4xx_Const_CLIGHT`, `jeod::De4xxBase::De4xx_Const_EMERAT`, `jeod::De4xxBase::De4xx_Const_GM1`, `jeod::De4xxBase::De4xx_Const_GM2`, `jeod::De4xxBase::De4xx_Const_GM4`, `jeod::De4xxBase::De4xx_Const_GM5`, `jeod::De4xxBase::De4xx_Const_GM6`, `jeod::De4xxBase::De4xx_Const_GM7`, `jeod::De4xxBase::De4xx_Const_GM8`, `jeod::De4xxBase::De4xx_Const_GM9`, `jeod::De4xxBase::De4xx_Const_GMB`, `jeod::De4xxBase::De4xx_Const_GMS`, `jeod::De4xxBase::De4xx_Ephem_Earth`, `jeod::De4xxBase::De4xx_Ephem_EMBary`, `jeod::De4xxBase::De4xx_Ephem_Jupiter`, `jeod::De4xxBase::De4xx_Ephem_Mars`, `jeod::De4xxBase::De4xx_Ephem_Mercury`,

jeod::De4xxBase::De4xx\_Ephem\_Moon, jeod::De4xxBase::De4xx\_Ephem\_Neptune, jeod::De4xxBase::De4xx\_Ephem\_Pluto, jeod::De4xxBase::De4xx\_Ephem\_Saturn, jeod::De4xxBase::De4xx\_Ephem\_Sun, jeod::De4xxBase::De4xx\_Ephem\_Uranus, jeod::De4xxBase::De4xx\_Ephem\_Venus, jeod::EphemerisDataSetMeta::de\_constants, jeod::EphemerisDataSetMeta::delta\_epoch, jeod::De4xxFileSpec::denum, jeod::De4xxFileHeader::e1\_em\_dist\_ratio, jeod::De4xxFileHeader::em\_mass\_ratio, jeod::De4xxFileRefTime::epoch\_date, jeod::De4xxFileRefTime::fdate, file\_spec, jeod::De4xxFileHeader::gmbody, header, jeod::De4xxFileRefTime::init\_time, io, jeod::l1\_point(), jeod::De4xxFileIO::max\_terms, jeod::De4xxFileIO::metaData, jeod::De4xxBase::number\_grav\_models(), pre\_initialize(), ref\_time, jeod::De4xxFileIO::segmentData, jeod::EphemerisDataSegmentMeta::start\_epoch, jeod::EphemeridesMessages::time\_not\_in\_range, jeod::De4xxFileIO::total\_num\_recs, update\_time, and jeod::De4xxFileHeader::vlight.

Referenced by jeod::De4xxEphemeris::initialize\_file().

#### 8.4.3.4 interpolate()

```
void jeod::De4xxFile::interpolate (
    double time,
    double fblk ) [private]
```

Calculate the position and velocity states of selected planetary bodies at some point in time.

##### Parameters

in	<i>time</i>	Time since reference Units: s
in	<i>fblk</i>	Fractional block

Definition at line 263 of file de4xx\_file\_update.cc.

References jeod::De4xxFileItem::active, jeod::De4xxFileCoef::chebyderiv, jeod::De4xxFileCoef::chebypoly, jeod::De4xxFileCoef::chebyterms, jeod::De4xxFileCoef::chebyx, jeod::De4xxFileCoef::coef, coef, jeod::EphemerisDataSetMeta::delta\_epoch, io, item, jeod::De4xxFileItem::item\_idx, itemData, jeod::De4xxFileIO::itemData, jeod::De4xxFileIO::metaData, jeod::De4xxFileItem::nitems, jeod::EphemerisDataItemMeta::npoly, jeod::EphemerisDataItemMeta::nterms, jeod::EphemerisDataSetMeta::number\_file\_items, jeod::EphemerisDataItemMeta::offset, jeod::De4xxFileItem::pscale, jeod::De4xxFileItem::state, and jeod::De4xxFileItem::update\_time.

Referenced by update().

#### 8.4.3.5 open()

```
void jeod::De4xxFile::open ( ) [private]
```

Open the JPL ephemeris file.

##### Assumptions and Limitations

- Errors are fatal

**Returns**

Void

Definition at line 214 of file de4xx\_file.cc.

References jeod::De4xxBase::De4xx\_File\_MaxEntries, jeod::EphemeridesMessages::debug, jeod::De4xxFile↵  
Spec::ephem\_file\_dir, jeod::De4xxFileSpec::ephem\_file\_name, jeod::De4xxFileIO::file, jeod::Ephemerides↵  
Messages::file\_error, file\_spec, io, jeod::De4xxFileIO::itemData, jeod::De4xxFileIO::metaData, jeod::Ephemeris↵  
DataSetMeta::number\_file\_items, jeod::De4xxFileSpec::pathname, and jeod::De4xxFileIO::segmentData.

Referenced by pre\_initialize().

**8.4.3.6 operator=()**

```
De4xxFile& jeod::De4xxFile::operator= (
    const De4xxFile & ) [delete]
```

**8.4.3.7 pre\_initialize()**

```
void jeod::De4xxFile::pre_initialize ( )
```

Pre-initialize a DE4xxFile instance.

Definition at line 63 of file de4xx\_file\_init.cc.

References jeod::De4xxFileItem::avail, jeod::De4xxFileCoef::coef, coef, jeod::De4xxFileIO::coeffs\_segment↵  
\_starting\_addr, jeod::De4xxFileIO::current\_record\_starting\_addr, jeod::De4xxBase::De4xx\_Const\_DENUM, jeod::De4xxBase::De4xx\_File\_MaxEntries, jeod::EphemerisDataSetMeta::de\_constants, jeod::De4xxFileSpec↵  
::denum, jeod::De4xxFileIO::file, jeod::EphemeridesMessages::file\_error, file\_spec, jeod::EphemeridesMessages↵  
::garbage\_file, jeod::EphemeridesMessages::internal\_error, io, item, jeod::De4xxFileItem::item\_idx, itemData, jeod::De4xxFileIO::itemData, jeod::De4xxFileIO::max\_terms, jeod::De4xxFileIO::metaData, jeod::Ephemeris↵  
DataItemMeta::nterms, jeod::EphemerisDataSegmentMeta::num\_recs, jeod::EphemerisDataSetMeta::number↵  
\_file\_items, jeod::EphemerisDataSetMeta::number\_segments, jeod::EphemerisDataItemMeta::offset, open(), jeod::De4xxFileSpec::pathname, jeod::De4xxFileIO::recno, jeod::De4xxFileIO::segment\_index, jeod::De4xxFile↵  
IO::segment\_recno, jeod::De4xxFileIO::segmentData, jeod::EphemerisDataSegmentMeta::start\_epoch, jeod::↵  
EphemerisDataSegmentMeta::stop\_epoch, and jeod::De4xxFileIO::total\_num\_recs.

Referenced by initialize(), and reopen().

#### 8.4.3.8 reopen()

```
void jeod::De4xxFile::reopen ( ) [private]
```

Open the JPL ephemeris file on restart.

##### Assumptions and Limitations

- File spec has been reloaded.
- Data has been allocated
- Errors are fatal

Definition at line 318 of file de4xx\_file.cc.

References jeod::De4xxFileIO::file, io, and pre\_initialize().

Referenced by jeod::De4xxFileRestart::simple\_restore().

#### 8.4.3.9 shutdown()

```
void jeod::De4xxFile::shutdown ( )
```

Shutdown the JPL ephemeris file.

Definition at line 202 of file de4xx\_file.cc.

References close().

Referenced by jeod::De4xxEphemeris::shutdown().

#### 8.4.3.10 time\_is\_in\_range()

```
bool jeod::De4xxFile::time_is_in_range (
    double time ) const
```

Check whether the specified time is represented in the JPL ephemeris file.

##### Assumptions and Limitations

- Ephemeris file is open for input
- Ephemeris file is blocked per value set in the ephem\_file structure

##### Returns

True if time is in file



## Parameters

in	<i>time</i>	Time since reference Units: s
----	-------------	----------------------------------

Definition at line 381 of file de4xx\_file.cc.

References jeod::De4xxFileRefTime::block\_no, jeod::EphemerisDataSetMeta::delta\_epoch, jeod::De4xxFileRefTime::init\_time, io, jeod::De4xxFileIO::metaData, ref\_time, and jeod::De4xxFileIO::total\_num\_recs.

Referenced by jeod::De4xxEphemeris::time\_is\_in\_range().

## 8.4.3.11 update()

```
void jeod::De4xxFile::update (
    double time )
```

Calculate the position and velocity states of selected planetary bodies at some point in time.

The EphemeridesState structure embedded in the Ephemerides structure contains an update indicator and state for each body. The state for a body is updated if the body's indicator indicates that a state update is needed.

Body selection – The 'active\_bodies' array in the EphemeridesState structure indicates which planets' states are to be updated. The function updates the position and velocity for the selected bodies.

Time specification – Four input variables are available for specifying the time.

- `tt_offset` is the offset between the remaining input times and Terrestrial Time (aka Terrestrial Dynamic Time, or TDT). Set this to zero if the other input times are already expressed in Terrestrial Time.
- For highest precision, set `epoch_time` to the Julian date at midnight of the time point of interest and set either `del_day` or `del_time` to the difference between the time point of interest and the epoch\_time.
- An alternative that retains full precession is to pass the time at the start of the simulation in `epoch_time` and `del_day` and the time into the simulation in `del_time`. In this approach, `epoch_time` represents the Julian date at the midnight preceding the start of the simulation and `del_day` represents the time between the epoch time and simulation start.
- For ease of use, set `epoch_time` to the Julian date representing the the time point of interest and set both `del_day` and `del_time` to 0.0. Note that this approach has a machine granularity of about 0.2 msec.
- An intermediate alternative is to set the `epoch_time` to the start time of the simulation, `del_day` to zero and `del_time` to the simulation time in seconds. This approach will result in a small temporal bias due to the precision loss in the epoch time.

Outputs – Positions and velocities are expressed in the ICRF coordinate system. The states of the Sun and planets, including Earth-Moon barycenter, are expressed with respect to the solar system barycenter. Lunar states are expressed with respect to the center of the Earth.

NOTA BENE – The states of unselected bodies may or may not be changed.

## Assumptions and Limitations

- Assumption 1. Ephemeris file is open.

- Assumption 2. Offset times in `del_day` and `del_time` are small. See description above.
- Assumption 3. The caller will not reference the states of bodies not requested in the `active_bodies` array. The unselected body states are fair game and may or may not be modified by this function.
- Limitation 1. No light speed time-of-travel corrections. Such corrections must be made by the caller if needed.
- Limitation 2. No relativistic time corrections for the difference between Terrestrial and Barycenter Dynamic Time.
- Limitation 3. The states of the sun and the major planets are expressed in ICRF coordinates relative to the Solar System barycenter. The state of the Moon is expressed in ICRF coordinates relative to the center of the Earth.

#### Parameters

in	<i>time</i>	Time since reference Units: s
----	-------------	----------------------------------

Definition at line 113 of file `de4xx_file_update.cc`.

References `jeod::De4xxFileItem::active`, `jeod::De4xxFileItem::avail`, `jeod::De4xxFileRefTime::block_no`, `jeod::De4xxFileCoef::coef`, `coef`, `jeod::De4xxFileIO::coeffs_segment_starting_addr`, `jeod::De4xxFileIO::current_record_starting_addr`, `jeod::EphemerisDataSetMeta::delta_epoch`, `jeod::De4xxFileIO::file`, `jeod::EphemeridesMessages::file_error`, `file_spec`, `jeod::De4xxFileRefTime::init_time`, `jeod::EphemeridesMessages::internal_error`, `interpolate()`, `io`, `item`, `jeod::EphemeridesMessages::item_not_in_file`, `jeod::De4xxFileIO::metaData`, `jeod::EphemerisDataSetMeta::ncoeff`, `jeod::EphemerisDataSegmentMeta::num_recs`, `jeod::EphemerisDataSetMeta::number_file_items`, `jeod::EphemerisDataSetMeta::number_segments`, `jeod::De4xxFileSpec::pathname`, `jeod::De4xxFileIO::recno`, `ref_time`, `jeod::De4xxFileIO::segment_index`, `jeod::De4xxFileIO::segment_recno`, `jeod::De4xxFileIO::segmentData`, `jeod::De4xxFileIO::total_num_recs`, and `update_time`.

Referenced by `jeod::De4xxEphemeris::ephem_update()`.

## 8.4.4 Friends And Related Function Documentation

### 8.4.4.1 De4xxFileRestart

```
friend class De4xxFileRestart [friend]
```

Definition at line 548 of file `de4xx_file.hh`.

### 8.4.4.2 init\_attrjeod\_\_De4xxFile

```
void init_attrjeod__De4xxFile ( ) [friend]
```

#### 8.4.4.3 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 548 of file de4xx\_file.hh.

### 8.4.5 Field Documentation

#### 8.4.5.1 coef

```
De4xxFileCoef jeod::De4xxFile::coef
```

Chebyshev coefs.

trick\_units(—)

Definition at line 602 of file de4xx\_file.hh.

Referenced by close(), initialize(), interpolate(), pre\_initialize(), and update().

#### 8.4.5.2 file\_spec

```
De4xxFileSpec jeod::De4xxFile::file_spec
```

File specification.

trick\_units(—)

Definition at line 577 of file de4xx\_file.hh.

Referenced by jeod::De4xxEphemeris::activate\_nodes(), jeod::De4xxEphemeris::determine\_root\_node(), jeod::De4xxEphemeris::ephem\_activate(), jeod::De4xxEphemeris::ephem\_build\_tree(), jeod::De4xxEphemeris::ephem\_initialize(), jeod::De4xxEphemeris::get\_header\_data(), initialize(), jeod::De4xxEphemeris::initialize\_items(), open(), pre\_initialize(), and update().

#### 8.4.5.3 header

```
De4xxFileHeader jeod::De4xxFile::header
```

File header.

trick\_units(—)

Definition at line 582 of file de4xx\_file.hh.

Referenced by jeod::De4xxEphemeris::ephem\_update(), and initialize().

#### 8.4.5.4 io

`De4xxFileIO` jeod::De4xxFile::io

File descriptor.

trick\_units(—)

Definition at line 592 of file de4xx\_file.hh.

Referenced by close(), initialize(), jeod::De4xxEphemeris::initialize\_file(), interpolate(), open(), pre\_initialize(), reopen(), time\_is\_in\_range(), and update().

#### 8.4.5.5 item

`De4xxFileItem*` jeod::De4xxFile::item

Item data.

Sized to fit number of entries in most recent DE4xx releasetrick\_units(—)

Definition at line 587 of file de4xx\_file.hh.

Referenced by De4xxFile(), jeod::De4xxEphemeris::ephem\_activate(), jeod::De4xxEphemeris::ephem\_update(), interpolate(), pre\_initialize(), update(), and ~De4xxFile().

#### 8.4.5.6 logMemoryStats

`bool` jeod::De4xxFile::logMemoryStats {true}

trick\_units(—)

Definition at line 627 of file de4xx\_file.hh.

Referenced by capture\_mem\_stats().

#### 8.4.5.7 ref\_time

`De4xxFileRefTime` jeod::De4xxFile::ref\_time

Reference time.

trick\_units(—)

Definition at line 597 of file de4xx\_file.hh.

Referenced by initialize(), time\_is\_in\_range(), and update().

#### 8.4.5.8 resident\_set

```
double jeod::De4xxFile::resident_set {}
```

trick\_units(—)

Definition at line 622 of file de4xx\_file.hh.

Referenced by capture\_mem\_stats().

#### 8.4.5.9 restart

```
De4xxFileRestart jeod::De4xxFile::restart
```

Restart handler.

trick\_io(\*\*)

Definition at line 607 of file de4xx\_file.hh.

Referenced by De4xxFile(), and ~De4xxFile().

#### 8.4.5.10 update\_time

```
double jeod::De4xxFile::update_time {-99e99}
```

Time of last update.

trick\_units(s)

Definition at line 612 of file de4xx\_file.hh.

Referenced by initialize(), and update().

#### 8.4.5.11 vm\_usage

```
double jeod::De4xxFile::vm_usage {}
```

trick\_units(—)

Definition at line 617 of file de4xx\_file.hh.

Referenced by capture\_mem\_stats().

The documentation for this class was generated from the following files:

- [de4xx\\_file.hh](#)
- [de4xx\\_file.cc](#)
- [de4xx\\_file\\_init.cc](#)
- [de4xx\\_file\\_update.cc](#)

## 8.5 jeod::De4xxFileCoef Class Reference

Contains Chebychev polynomial coefficients and terms.

```
#include <de4xx_file.hh>
```

### Public Member Functions

- [De4xxFileCoef](#) ()=default
- [De4xxFileCoef](#) (const [De4xxFileCoef](#) &)=delete
- [De4xxFileCoef](#) & [operator=](#) (const [De4xxFileCoef](#) &)=delete

### Protected Attributes

- size\_t [chebyterms](#) {}  
*No.*
- double [chebyx](#) {-99e99}  
*Chebychev x value.*
- double \* [chebypoly](#) {}  
*Chebychev polynomial coeffs.*
- double \* [chebyderiv](#) {}  
*Derivative of chebypoly.*
- double \* [coef](#) {}  
*Current block contents.*

### Friends

- class [InputProcessor](#)
- class [De4xxFile](#)
- void [init\\_attrjeod\\_\\_De4xxFileCoef](#) ()

#### 8.5.1 Detailed Description

Contains Chebychev polynomial coefficients and terms.

Definition at line 483 of file de4xx\_file.hh.

#### 8.5.2 Constructor & Destructor Documentation

##### 8.5.2.1 De4xxFileCoef() [1/2]

```
jeod::De4xxFileCoef::De4xxFileCoef ( ) [default]
```

### 8.5.2.2 De4xxFileCoef() [2/2]

```
jeod::De4xxFileCoef::De4xxFileCoef (
    const De4xxFileCoef & ) [delete]
```

## 8.5.3 Member Function Documentation

### 8.5.3.1 operator=()

```
De4xxFileCoef& jeod::De4xxFileCoef::operator= (
    const De4xxFileCoef & ) [delete]
```

## 8.5.4 Friends And Related Function Documentation

### 8.5.4.1 De4xxFile

```
friend class De4xxFile [friend]
```

Definition at line 485 of file de4xx\_file.hh.

### 8.5.4.2 init\_attrjeod\_\_De4xxFileCoef

```
void init_attrjeod__De4xxFileCoef ( ) [friend]
```

### 8.5.4.3 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 485 of file de4xx\_file.hh.

## 8.5.5 Field Documentation

#### 8.5.5.1 chebyderiv

```
double* jeod::De4xxFileCoef::chebyderiv {} [protected]
```

Derivative of chebypoly.

trick\_units(-)

Definition at line 508 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::close(), jeod::De4xxFile::initialize(), and jeod::De4xxFile::interpolate().

#### 8.5.5.2 chebypoly

```
double* jeod::De4xxFileCoef::chebypoly {} [protected]
```

Chebyshev polynomial coeffs.

trick\_units(-)

Definition at line 503 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::close(), jeod::De4xxFile::initialize(), and jeod::De4xxFile::interpolate().

#### 8.5.5.3 chebyterms

```
size_t jeod::De4xxFileCoef::chebyterms {} [protected]
```

No.

Chebyshev polynomials termstrick\_units(-)

Definition at line 493 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::interpolate().

#### 8.5.5.4 chebyx

```
double jeod::De4xxFileCoef::chebyx {-99e99} [protected]
```

Chebyshev x value.

trick\_units(-)

Definition at line 498 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::interpolate().



## 8.5.5.5 coef

```
double* jeod::De4xxFileCoef::coef {} [protected]
```

Current block contents.

trick\_units(-) trick\_io(\*\*)

Definition at line 513 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::interpolate(), jeod::De4xxFile::pre\_initialize(), and jeod::De4xxFile::update().

The documentation for this class was generated from the following file:

- [de4xx\\_file.hh](#)

## 8.6 jeod::De4xxFileHeader Class Reference

Contains data extracted from the ephemeris file header.

```
#include <de4xx_file.hh>
```

### Public Member Functions

- [De4xxFileHeader](#) ()  
*Construct a [De4xxFileHeader](#) object.*
- [~De4xxFileHeader](#) ()  
*Destruct a [De4xxFileHeader](#) object.*
- [De4xxFileHeader](#) (const [De4xxFileHeader](#) &)=delete
- [De4xxFileHeader](#) & operator= (const [De4xxFileHeader](#) &)=delete

### Data Fields

- double [au](#) {}  
*Astronomical unit in meters.*
- double [vlight](#) {}  
*Speed of light.*
- double [em\\_mass\\_ratio](#) {}  
*Earth:Moon mass ratio.*
- double [be\\_em\\_dist\\_ratio](#) {}  
*Ratio of Earth-to-barycenter and Earth-to-Moon distances Note: Also equal to the ratio of Moon and Earth+Moon masses.*
- double [bm\\_em\\_dist\\_ratio](#) {}  
*Ratio of Barycenter-to-Moon and Earth-to-Moon distances Note: Also equal to the ratio of Earth and Earth+Moon masses.*
- double [e1\\_em\\_dist\\_ratio](#) {}  
*Ratio of Earth to Earth-moon L1 point and Earth-to-Moon distances.*
- double [b1\\_em\\_dist\\_ratio](#) {}  
*Ratio of Earth-Moon barycenter to L1 point and Earth-to-Moon distances.*
- double \* [gmbody](#)  
*Body gravitational constants.*

## Friends

- class [InputProcessor](#)
- class [De4xxFile](#)
- void [init\\_attrjeod\\_\\_De4xxFileHeader](#) ()

### 8.6.1 Detailed Description

Contains data extracted from the ephemeris file header.

Definition at line 336 of file `de4xx_file.hh`.

### 8.6.2 Constructor & Destructor Documentation

#### 8.6.2.1 `De4xxFileHeader()` [1/2]

```
jeod::De4xxFileHeader::De4xxFileHeader ( )
```

Construct a [De4xxFileHeader](#) object.

Definition at line 103 of file `de4xx_file.cc`.

References `gmbody`, and `jeod::De4xxBase::number_grav_models()`.

#### 8.6.2.2 `~De4xxFileHeader()`

```
jeod::De4xxFileHeader::~~De4xxFileHeader ( )
```

Destruct a [De4xxFileHeader](#) object.

Definition at line 116 of file `de4xx_file.cc`.

References `gmbody`.

#### 8.6.2.3 `De4xxFileHeader()` [2/2]

```
jeod::De4xxFileHeader::De4xxFileHeader (
    const De4xxFileHeader & ) [delete]
```

### 8.6.3 Member Function Documentation

### 8.6.3.1 operator=()

```
De4xxFileHeader& jeod::De4xxFileHeader::operator= (
    const De4xxFileHeader & ) [delete]
```

## 8.6.4 Friends And Related Function Documentation

### 8.6.4.1 De4xxFile

```
friend class De4xxFile [friend]
```

Definition at line 338 of file de4xx\_file.hh.

### 8.6.4.2 init\_attrjeod\_\_De4xxFileHeader

```
void init_attrjeod__De4xxFileHeader ( ) [friend]
```

### 8.6.4.3 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 338 of file de4xx\_file.hh.

## 8.6.5 Field Documentation

### 8.6.5.1 au

```
double jeod::De4xxFileHeader::au {}
```

Astronomical unit in meters.

trick\_units(m)

Definition at line 345 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::initialize().

#### 8.6.5.2 b1\_em\_dist\_ratio

```
double jeod::De4xxFileHeader::b1_em_dist_ratio {}
```

Ratio of Earth-Moon barycenter to L1 point and Earth-to-Moon distances.

trick\_units(-)

Definition at line 377 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::initialize().

#### 8.6.5.3 be\_em\_dist\_ratio

```
double jeod::De4xxFileHeader::be_em_dist_ratio {}
```

Ratio of Earth-to-barycenter and Earth-to-Moon distances Note: Also equal to the ratio of Moon and Earth+Moon masses.

trick\_units(-)

Definition at line 361 of file de4xx\_file.hh.

Referenced by jeod::De4xxEphemeris::ephem\_update(), and jeod::De4xxFile::initialize().

#### 8.6.5.4 bm\_em\_dist\_ratio

```
double jeod::De4xxFileHeader::bm_em_dist_ratio {}
```

Ratio of Barycenter-to-Moon and Earth-to-Moon distances Note: Also equal to the ratio of Earth and Earth+Moon masses.

trick\_units(-)

Definition at line 367 of file de4xx\_file.hh.

Referenced by jeod::De4xxEphemeris::ephem\_update(), and jeod::De4xxFile::initialize().

#### 8.6.5.5 e1\_em\_dist\_ratio

```
double jeod::De4xxFileHeader::e1_em_dist_ratio {}
```

Ratio of Earth to Earth-moon L1 point and Earth-to-Moon distances.

trick\_units(-)

Definition at line 372 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::initialize().

#### 8.6.5.6 em\_mass\_ratio

```
double jeod::De4xxFileHeader::em_mass_ratio {}
```

Earth:Moon mass ratio.

trick\_units(—)

Definition at line 355 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::initialize().

#### 8.6.5.7 gmbody

```
double* jeod::De4xxFileHeader::gmbody
```

Body gravitational constants.

trick\_units(m3/s2)

Definition at line 382 of file de4xx\_file.hh.

Referenced by De4xxFileHeader(), jeod::De4xxFile::initialize(), and ~De4xxFileHeader().

#### 8.6.5.8 vlight

```
double jeod::De4xxFileHeader::vlight {}
```

Speed of light.

trick\_units(m/s)

Definition at line 350 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::initialize().

The documentation for this class was generated from the following files:

- [de4xx\\_file.hh](#)
- [de4xx\\_file.cc](#)

## 8.7 jeod::De4xxFileIO Class Reference

Contains data used directly for reading the ephemeris file.

```
#include <de4xx_file.hh>
```

## Public Member Functions

- [De4xxFileIO](#) ()=default
- [De4xxFileIO](#) (const [De4xxFileIO](#) &)=delete
- [De4xxFileIO](#) & [operator=](#) (const [De4xxFileIO](#) &)=delete

## Data Fields

- [EphemerisDataSetMeta](#) \* [metaData](#) {}  
*Metadata (e.g., sizing) regarding the selected DE ephemeris data set.*
- [EphemerisDataItemMeta](#) \* [itemData](#) {}  
*Metadata (e.g., number of terms) regarding each ephemeris item (e.g., Mercury) contained in the JPL data.*
- [EphemerisDataSegmentMeta](#) \* [segmentData](#) {}  
*Metadata (e.g., number of records) regarding each polynomial segment of the JPL data.*
- double \* [coeffs\\_segment\\_starting\\_addr](#) {}  
*Pointer to first value in the segment.*
- double \* [current\\_record\\_starting\\_addr](#) {}  
*Pointer to first value in the record.*
- uint32\_t [recno](#) {std::numeric\_limits<int>::max()}  
*The current record number.*
- uint32\_t [segment\\_index](#) {}  
*The current segment number.*
- uint32\_t [segment\\_recno](#) {}  
*The current segment record number.*
- uint32\_t [total\\_num\\_recs](#) {}  
*The number of records in the dataset.*
- uint32\_t [max\\_terms](#) {}  
*The maximum number of Chebychev terms in the file.*

## Protected Attributes

- void \* [file](#) {}  
*The dl handle for the ephemeris shared object.*

## Friends

- class [InputProcessor](#)
- class [De4xxFile](#)
- void [init\\_attrjeod\\_\\_De4xxFileIO](#) ()

### 8.7.1 Detailed Description

Contains data used directly for reading the ephemeris file.

Definition at line 262 of file [de4xx\\_file.hh](#).

## 8.7.2 Constructor & Destructor Documentation

### 8.7.2.1 De4xxFileIO() [1/2]

```
jeod::De4xxFileIO::De4xxFileIO ( ) [default]
```

### 8.7.2.2 De4xxFileIO() [2/2]

```
jeod::De4xxFileIO::De4xxFileIO (
    const De4xxFileIO & ) [delete]
```

## 8.7.3 Member Function Documentation

### 8.7.3.1 operator=()

```
De4xxFileIO& jeod::De4xxFileIO::operator= (
    const De4xxFileIO & ) [delete]
```

## 8.7.4 Friends And Related Function Documentation

### 8.7.4.1 De4xxFile

```
friend class De4xxFile [friend]
```

Definition at line 264 of file de4xx\_file.hh.

### 8.7.4.2 init\_attrjeod\_\_De4xxFileIO

```
void init_attrjeod__De4xxFileIO ( ) [friend]
```

### 8.7.4.3 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 264 of file de4xx\_file.hh.

## 8.7.5 Field Documentation

### 8.7.5.1 coeffs\_segment\_starting\_addr

```
double* jeod::De4xxFileIO::coeffs_segment_starting_addr {}
```

Pointer to first value in the segment.

```
trick_units(-) trick_io(**)
```

Definition at line 288 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::pre\_initialize(), and jeod::De4xxFile::update().

### 8.7.5.2 current\_record\_starting\_addr

```
double* jeod::De4xxFileIO::current_record_starting_addr {}
```

Pointer to first value in the record.

```
trick_units(-) trick_io(**)
```

Definition at line 293 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::pre\_initialize(), and jeod::De4xxFile::update().

### 8.7.5.3 file

```
void* jeod::De4xxFileIO::file {} [protected]
```

The dl handle for the ephemeris shared object.

```
trick_units(-) trick_io(**)
```

Definition at line 324 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::close(), jeod::De4xxFile::open(), jeod::De4xxFile::pre\_initialize(), jeod::De4xxFile::reopen(), and jeod::De4xxFile::update().



#### 8.7.5.4 itemData

```
EphemerisDataItemMeta* jeod::De4xxFileIO::itemData {}
```

Metadata (e.g., number of terms) regarding each ephemeris item (e.g., Mercury) contained in the JPL data.

trick\_units(-) trick\_io(\*\*)

Definition at line 277 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::interpolate(), jeod::De4xxFile::open(), and jeod::De4xxFile::pre\_initialize().

#### 8.7.5.5 max\_terms

```
uint32_t jeod::De4xxFileIO::max_terms {}
```

The maximum number of Chebychev terms in the file.

trick\_units(-)

Definition at line 318 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::initialize(), and jeod::De4xxFile::pre\_initialize().

#### 8.7.5.6 metaData

```
EphemerisDataSetMeta* jeod::De4xxFileIO::metaData {}
```

Metadata (e.g., sizing) regarding the selected DE ephemeris data set.

trick\_units(-) trick\_io(\*\*)

Definition at line 271 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::close(), jeod::De4xxFile::initialize(), jeod::De4xxEphemeris::initialize\_file(), jeod::De4xxFile::interpolate(), jeod::De4xxFile::open(), jeod::De4xxFile::pre\_initialize(), jeod::De4xxFile::time\_is\_in\_range(), and jeod::De4xxFile::update().

#### 8.7.5.7 recno

```
uint32_t jeod::De4xxFileIO::recno {std::numeric_limits<int>::max() }
```

The current record number.

trick\_units(-)

Definition at line 298 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::pre\_initialize(), and jeod::De4xxFile::update().

**8.7.5.8 segment\_index**

```
uint32_t jeod::De4xxFileIO::segment_index {}
```

The current segment number.

trick\_units(-)

Definition at line 303 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::pre\_initialize(), and jeod::De4xxFile::update().

**8.7.5.9 segment\_recno**

```
uint32_t jeod::De4xxFileIO::segment_recno {}
```

The current segment record number.

trick\_units(-)

Definition at line 308 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::pre\_initialize(), and jeod::De4xxFile::update().

**8.7.5.10 segmentData**

```
EphemerisDataSegmentMeta* jeod::De4xxFileIO::segmentData {}
```

Metadata (e.g., number of records) regarding each polynomial segment of the JPL data.

trick\_units(-) trick\_io(\*\*)

Definition at line 283 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::initialize(), jeod::De4xxFile::open(), jeod::De4xxFile::pre\_initialize(), and jeod::De4xxFile::update().

**8.7.5.11 total\_num\_recs**

```
uint32_t jeod::De4xxFileIO::total_num_recs {}
```

The number of records in the dataset.

trick\_units(-)

Definition at line 313 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::initialize(), jeod::De4xxFile::pre\_initialize(), jeod::De4xxFile::time\_is\_in\_range(), and jeod::De4xxFile::update().

The documentation for this class was generated from the following file:

- [de4xx\\_file.hh](#)

## 8.8 jeod::De4xxFileItem Class Reference

Contains data regarding one of the items in a DE ephemeris file.

```
#include <de4xx_file.hh>
```

### Public Member Functions

- [De4xxFileItem](#) ()  
*Construct a [De4xxFileItem](#) object.*
- [De4xxFileItem](#) (const [De4xxFileItem](#) &)=delete
- [De4xxFileItem](#) & operator= (const [De4xxFileItem](#) &)=delete

### Data Fields

- bool [active](#) {}  
*Is this item's state to be computed? (external input)*
- bool [avail](#) {}  
*Is this item represented in the ephemeris file?*
- uint32\_t [item\\_idx](#) {}  
*trick\_units(-)*
- int32\_t [nitems](#) {3}  
*Vector size.*
- double [pscale](#) {1000.0}  
*Zeroth derivative scale factor.*
- double [update\\_time](#) {-99e99}  
*Update time (simulation time)*
- double [state](#) [2][3] {}  
*State data (zeroth, first derivative)*

### Friends

- class [InputProcessor](#)
- class [De4xxFile](#)
- void [init\\_attrjeod\\_\\_De4xxFileItem](#) ()

#### 8.8.1 Detailed Description

Contains data regarding one of the items in a DE ephemeris file.

Definition at line 395 of file `de4xx_file.hh`.

#### 8.8.2 Constructor & Destructor Documentation

**8.8.2.1 De4xxFileItem()** [1/2]

```
jeod::De4xxFileItem::De4xxFileItem ( )
```

Construct a [De4xxFileItem](#) object.

As most ephemeris file items are position vectors in kilometers, this constructor sets the scale to 1000 and the number of items to three.

Definition at line 127 of file `de4xx_file.cc`.

References state.

**8.8.2.2 De4xxFileItem()** [2/2]

```
jeod::De4xxFileItem::De4xxFileItem (
    const De4xxFileItem & ) [delete]
```

**8.8.3 Member Function Documentation****8.8.3.1 operator=()**

```
De4xxFileItem& jeod::De4xxFileItem::operator= (
    const De4xxFileItem & ) [delete]
```

**8.8.4 Friends And Related Function Documentation****8.8.4.1 De4xxFile**

```
friend class De4xxFile [friend]
```

Definition at line 397 of file `de4xx_file.hh`.

**8.8.4.2 init\_attrjeod\_\_De4xxFileItem**

```
void init_attrjeod__De4xxFileItem ( ) [friend]
```

#### 8.8.4.3 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 397 of file de4xx\_file.hh.

### 8.8.5 Field Documentation

#### 8.8.5.1 active

```
bool jeod::De4xxFileItem::active {}
```

Is this item's state to be computed? (external input)

trick\_units(-)

Definition at line 404 of file de4xx\_file.hh.

Referenced by jeod::De4xxEphemeris::ephem\_activate(), jeod::De4xxFile::interpolate(), and jeod::De4xxFile::update().

#### 8.8.5.2 avail

```
bool jeod::De4xxFileItem::avail {}
```

Is this item represented in the ephemeris file?

trick\_units(-)

Definition at line 409 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::pre\_initialize(), and jeod::De4xxFile::update().

#### 8.8.5.3 item\_idx

```
uint32_t jeod::De4xxFileItem::item_idx {}
```

trick\_units(-)

Definition at line 412 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::interpolate(), and jeod::De4xxFile::pre\_initialize().

#### 8.8.5.4 nitems

```
int32_t jeod::De4xxFileItem::nitems {3}
```

Vector size.

trick\_units(-)

Definition at line 417 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::De4xxFile(), and jeod::De4xxFile::interpolate().

#### 8.8.5.5 pscale

```
double jeod::De4xxFileItem::pscale {1000.0}
```

Zeroth derivative scale factor.

trick\_units(-)

Definition at line 422 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::De4xxFile(), and jeod::De4xxFile::interpolate().

#### 8.8.5.6 state

```
double jeod::De4xxFileItem::state[2][3] {}
```

State data (zeroth, first derivative)

trick\_units(-)

Definition at line 432 of file de4xx\_file.hh.

Referenced by De4xxFileItem(), jeod::De4xxEphemeris::ephem\_update(), and jeod::De4xxFile::interpolate().

#### 8.8.5.7 update\_time

```
double jeod::De4xxFileItem::update_time {-99e99}
```

Update time (simulation time)

trick\_units(s)

Definition at line 427 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::interpolate().

The documentation for this class was generated from the following files:

- [de4xx\\_file.hh](#)
- [de4xx\\_file.cc](#)

## 8.9 jeod::De4xxFileRefTime Class Reference

Contains timing reference data.

```
#include <de4xx_file.hh>
```

### Public Member Functions

- [De4xxFileRefTime](#) ()=default
- [De4xxFileRefTime](#) (const [De4xxFileRefTime](#) &)=delete
- [De4xxFileRefTime](#) & [operator=](#) (const [De4xxFileRefTime](#) &)=delete

### Data Fields

- double [epoch\\_date](#) {-99e99}  
*Julian date of midnight preceding reference time point.*
- double [fdate](#) {-99e99}  
*Fractional days past epoch date of reference time point.*
- double [time\\_offset](#) {-99e99}  
*Time offset, Typically, Terrestrial Time offset.*
- double [init\\_time](#) {-99e99}  
*Initialization time (seconds from reference, typically zero).*
- double [block\\_no](#) {-99e99}  
*File block number corresponding to reference time.*

### Friends

- class [InputProcessor](#)
- class [De4xxFile](#)
- void [init\\_attrjeod\\_\\_De4xxFileRefTime](#) ()

#### 8.9.1 Detailed Description

Contains timing reference data.

Definition at line 444 of file `de4xx_file.hh`.

#### 8.9.2 Constructor & Destructor Documentation

##### 8.9.2.1 De4xxFileRefTime() [1/2]

```
jeod::De4xxFileRefTime::De4xxFileRefTime ( ) [default]
```

### 8.9.2.2 De4xxFileRefTime() [2/2]

```
jeod::De4xxFileRefTime::De4xxFileRefTime (
    const De4xxFileRefTime & ) [delete]
```

## 8.9.3 Member Function Documentation

### 8.9.3.1 operator=()

```
De4xxFileRefTime& jeod::De4xxFileRefTime::operator= (
    const De4xxFileRefTime & ) [delete]
```

## 8.9.4 Friends And Related Function Documentation

### 8.9.4.1 De4xxFile

```
friend class De4xxFile [friend]
```

Definition at line 446 of file de4xx\_file.hh.

### 8.9.4.2 init\_attrjeod\_\_De4xxFileRefTime

```
void init_attrjeod__De4xxFileRefTime ( ) [friend]
```

### 8.9.4.3 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 446 of file de4xx\_file.hh.

## 8.9.5 Field Documentation



#### 8.9.5.1 block\_no

```
double jeod::De4xxFileRefTime::block_no {-99e99}
```

File block number corresponding to reference time.

trick\_units(-)

Definition at line 471 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::initialize(), jeod::De4xxFile::time\_is\_in\_range(), and jeod::De4xxFile::update().

#### 8.9.5.2 epoch\_date

```
double jeod::De4xxFileRefTime::epoch_date {-99e99}
```

Julian date of midnight preceding reference time point.

trick\_units(day)

Definition at line 453 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::initialize().

#### 8.9.5.3 fdate

```
double jeod::De4xxFileRefTime::fdate {-99e99}
```

Fractional days past epoch date of reference time point.

trick\_units(day)

Definition at line 458 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::initialize().

#### 8.9.5.4 init\_time

```
double jeod::De4xxFileRefTime::init_time {-99e99}
```

Initialization time (seconds from reference, typically zero).

trick\_units(s)

Definition at line 466 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::initialize(), jeod::De4xxFile::time\_is\_in\_range(), and jeod::De4xxFile::update().

#### 8.9.5.5 time\_offset

```
double jeod::De4xxFileRefTime::time_offset {-99e99}
```

Time offset, Typically, Terrestrial Time offset.

trick\_units(s)

Definition at line 462 of file de4xx\_file.hh.

The documentation for this class was generated from the following file:

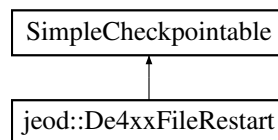
- [de4xx\\_file.hh](#)

## 8.10 jeod::De4xxFileRestart Class Reference

The FILE pointer in a [De4xxFileIO](#) cannot be restored by Trick.

```
#include <de4xx_file.hh>
```

Inheritance diagram for jeod::De4xxFileRestart:



### Public Member Functions

- [De4xxFileRestart](#) ([De4xxFile](#) &in)  
*Construct a [De4xxFileRestart](#) object.*
- [~De4xxFileRestart](#) () override=default
- [De4xxFileRestart](#) (const [De4xxFileRestart](#) &)=delete
- [De4xxFileRestart](#) & operator= (const [De4xxFileRestart](#) &)=delete
- void [simple\\_restore](#) () override  
*Reopen the De4xx file for a restart.*

### Protected Attributes

- [De4xxFile](#) & [de4xx\\_file](#)  
*The [De4xxFile](#) object to be restored.*

#### 8.10.1 Detailed Description

The FILE pointer in a [De4xxFileIO](#) cannot be restored by Trick.

This class provides that essential restart mechanism.

Definition at line 526 of file de4xx\_file.hh.

## 8.10.2 Constructor & Destructor Documentation

### 8.10.2.1 De4xxFileRestart() [1/2]

```
jeod::De4xxFileRestart::De4xxFileRestart (
    De4xxFile & in ) [explicit]
```

Construct a [De4xxFileRestart](#) object.

#### Parameters

<code>in, out</code>	<code>in</code>	The <a href="#">De4xxFile</a> object
----------------------	-----------------	--------------------------------------

Definition at line 141 of file `de4xx_file.cc`.

### 8.10.2.2 ~De4xxFileRestart()

```
jeod::De4xxFileRestart::~~De4xxFileRestart ( ) [override], [default]
```

### 8.10.2.3 De4xxFileRestart() [2/2]

```
jeod::De4xxFileRestart::De4xxFileRestart (
    const De4xxFileRestart & ) [delete]
```

## 8.10.3 Member Function Documentation

### 8.10.3.1 operator=()

```
De4xxFileRestart& jeod::De4xxFileRestart::operator= (
    const De4xxFileRestart & ) [delete]
```

### 8.10.3.2 simple\_restore()

```
void jeod::De4xxFileRestart::simple_restore ( ) [override]
```

Reopen the De4xx file for a restart.

Definition at line 149 of file `de4xx_file.cc`.

References `de4xx_file`, and `jeod::De4xxFile::reopen()`.

## 8.10.4 Field Documentation

### 8.10.4.1 de4xx\_file

`De4xxFile& jeod::De4xxFileRestart::de4xx_file` [protected]

The `De4xxFile` object to be restored.

`trick_io(**)`

Definition at line 540 of file `de4xx_file.hh`.

Referenced by `simple_restore()`.

The documentation for this class was generated from the following files:

- [de4xx\\_file.hh](#)
- [de4xx\\_file.cc](#)

## 8.11 jeod::De4xxFileSpec Class Reference

Specifies which file to use (user input initialization-time data).

```
#include <de4xx_file.hh>
```

### Public Member Functions

- [De4xxFileSpec](#) ()  
*Construct a [De4xxFileSpec](#) object.*
- [De4xxFileSpec](#) (const [De4xxFileSpec](#) &)=delete
- [De4xxFileSpec](#) & operator= (const [De4xxFileSpec](#) &)=delete
- void [set\\_model\\_number](#) (int denum\_in)  
*Set ephemeris model number.*
- uint32\_t [get\\_model\\_number](#) ()  
*Get Ephemeris model number.*
- void [set\\_model\\_directory](#) (const std::string &dirIn)  
*Set ephemeris data model directory.*
- std::string [get\\_model\\_directory](#) ()  
*Get Ephemeris data model directory.*

### Protected Attributes

- uint32\_t [denum](#) {405}  
*Ephemeris model number.*
- std::string [ephem\\_file\\_dir](#) {"build/de4xx\_lib"}  
*Ephemeris file directory.*
- std::string [ephem\\_file\\_name](#)  
*Ephemeris file name.*
- std::string [pathname](#)  
*Ephemeris file path name.*

## Friends

- class [InputProcessor](#)
- class [De4xxFile](#)
- void [init\\_attrjeod\\_\\_De4xxFileSpec](#) ()

### 8.11.1 Detailed Description

Specifies which file to use (user input initialization-time data).

Definition at line 185 of file `de4xx_file.hh`.

### 8.11.2 Constructor & Destructor Documentation

#### 8.11.2.1 `De4xxFileSpec()` [1/2]

```
jeod::De4xxFileSpec::De4xxFileSpec ( )
```

Construct a [De4xxFileSpec](#) object.

Definition at line 82 of file `de4xx_file.cc`.

References `set_model_number()`.

#### 8.11.2.2 `De4xxFileSpec()` [2/2]

```
jeod::De4xxFileSpec::De4xxFileSpec (
    const De4xxFileSpec & ) [delete]
```

### 8.11.3 Member Function Documentation

#### 8.11.3.1 `get_model_directory()`

```
std::string jeod::De4xxFileSpec::get_model_directory ( ) [inline]
```

Get Ephemeris data model directory.

This number is used to specify the de file to use the pathname is of the form `<ephem_file_dir>/libde<denumIn>.so`  
Defaults to `PWD/build/de4xx_lib/libde<denumIn>.so`

Definition at line 227 of file `de4xx_file.hh`.

Referenced by `jeod::De4xxEphemeris::get_header_data()`.

### 8.11.3.2 `get_model_number()`

```
uint32_t jeod::De4xxFileSpec::get_model_number ( ) [inline]
```

Get Ephemeris model number.

This number is used to specify the de file to use the pathname is of the form PWD/build/de4xx\_lib/libde<denumIn>.so

Definition at line 208 of file de4xx\_file.hh.

Referenced by `jeod::De4xxEphemeris::activate_nodes()`, `jeod::De4xxEphemeris::determine_root_node()`, `jeod::De4xxEphemeris::ephem_activate()`, `jeod::De4xxEphemeris::ephem_build_tree()`, `jeod::De4xxEphemeris::ephem_initialize()`, and `jeod::De4xxEphemeris::initialize_items()`.

### 8.11.3.3 `operator=()`

```
De4xxFileSpec& jeod::De4xxFileSpec::operator= (
    const De4xxFileSpec & ) [delete]
```

### 8.11.3.4 `set_model_directory()`

```
void jeod::De4xxFileSpec::set_model_directory (
    const std::string & dirIn )
```

Set ephemeris data model directory.

This number is used to specify the de file to use the pathname is of the form <ephem\_file\_dir>/libde<denumIn>.so Defaults to PWD/build/de4xx\_lib/libde<denumIn>.so

Definition at line 94 of file de4xx\_file.cc.

References `ephem_file_dir`, `ephem_file_name`, and `pathname`.

### 8.11.3.5 `set_model_number()`

```
void jeod::De4xxFileSpec::set_model_number (
    int denum_in )
```

Set ephemeris model number.

This number is used to specify the de file to use the pathname is of the form <ephem\_file\_dir>/libde<denumIn>.so Defaults to PWD/build/de4xx\_lib/libde<denumIn>.so

Definition at line 87 of file de4xx\_file.cc.

References `denum`, `ephem_file_dir`, `ephem_file_name`, and `pathname`.

Referenced by `De4xxFileSpec()`.

## 8.11.4 Friends And Related Function Documentation

### 8.11.4.1 De4xxFile

```
friend class De4xxFile [friend]
```

Definition at line 187 of file de4xx\_file.hh.

### 8.11.4.2 init\_attrjeod\_\_De4xxFileSpec

```
void init_attrjeod__De4xxFileSpec ( ) [friend]
```

### 8.11.4.3 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 187 of file de4xx\_file.hh.

## 8.11.5 Field Documentation

### 8.11.5.1 denum

```
uint32_t jeod::De4xxFileSpec::denum {405} [protected]
```

Ephemeris model number.

This must match the DE number in the data file; a sanity checktrick\_units(-)

Definition at line 240 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::initialize(), jeod::De4xxFile::pre\_initialize(), and set\_model\_number().

#### 8.11.5.2 ephemeris\_dir

```
std::string jeod::De4xxFileSpec::ephemeris_dir {"build/de4xx_lib"} [protected]
```

Ephemeris file directory.

trick\_units(-)

Definition at line 245 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::open(), set\_model\_directory(), and set\_model\_number().

#### 8.11.5.3 ephemeris\_name

```
std::string jeod::De4xxFileSpec::ephemeris_name [protected]
```

Ephemeris file name.

trick\_units(-)

Definition at line 250 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::open(), set\_model\_directory(), and set\_model\_number().

#### 8.11.5.4 pathname

```
std::string jeod::De4xxFileSpec::pathname [protected]
```

Ephemeris file path name.

trick\_io(\*o) trick\_units(-)

Definition at line 256 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::open(), jeod::De4xxFile::pre\_initialize(), set\_model\_directory(), set\_model\_number(), and jeod::De4xxFile::update().

The documentation for this class was generated from the following files:

- [de4xx\\_file.hh](#)
- [de4xx\\_file.cc](#)

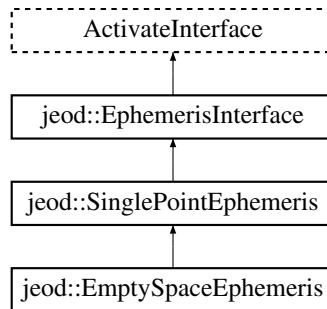


## 8.12 jeod::EmptySpaceEphemeris Class Reference

Empty space has one ephemeris point.

```
#include <simple_ephemerides.hh>
```

Inheritance diagram for jeod::EmptySpaceEphemeris:



### Public Member Functions

- [EmptySpaceEphemeris](#) ()  
Construct an *EmptySpaceEphemeris* object.
- [~EmptySpaceEphemeris](#) () override=default
- [EmptySpaceEphemeris](#) (const [EmptySpaceEphemeris](#) &)=delete
- [EmptySpaceEphemeris](#) & operator= (const [EmptySpaceEphemeris](#) &)=delete
- void [set\\_name](#) (const std::string &frame\_name) override  
Set the name of an *EmptySpaceEphemeris* object.
- void [initialize\\_model](#) ([EphemeridesManager](#) &ephem\_manager) override  
Initialize an *EmptySpaceEphemeris* object.
- void [ephem\\_initialize](#) ([EphemeridesManager](#) &ephem\_manager) override  
Initialize an *EmptySpaceEphemeris* object.
- void [ephem\\_activate](#) ([EphemeridesManager](#) &ephem\_manager) override  
Activate an *EmptySpaceEphemeris* object.
- void [ephem\\_build\\_tree](#) ([EphemeridesManager](#) &ephem\_manager) override  
Build the reference frame tree with the central frame as the root.

### Protected Attributes

- [EphemerisPoint](#) central\_point  
The *EphemerisPoint* that represents the center of an empty universe.
- [EphemerisRefFrame](#) central\_frame  
The sole ephemeris frame for this model.

### Friends

- class [InputProcessor](#)
- void [init\\_attrjeod\\_\\_EmptySpaceEphemeris](#) ()

### 8.12.1 Detailed Description

Empty space has one ephemeris point.

Definition at line 169 of file simple\_ephemerides.hh.

### 8.12.2 Constructor & Destructor Documentation

#### 8.12.2.1 EmptySpaceEphemeris() [1/2]

```
jeod::EmptySpaceEphemeris::EmptySpaceEphemeris ( )
```

Construct an [EmptySpaceEphemeris](#) object.

Definition at line 111 of file simple\_ephemerides.cc.

References [central\\_point](#), [jeod::EphemerisItem::enable\(\)](#), and [jeod::EphemerisItem::set\\_owner\(\)](#).

#### 8.12.2.2 ~EmptySpaceEphemeris()

```
jeod::EmptySpaceEphemeris::~~EmptySpaceEphemeris ( ) [override], [default]
```

#### 8.12.2.3 EmptySpaceEphemeris() [2/2]

```
jeod::EmptySpaceEphemeris::EmptySpaceEphemeris (
    const EmptySpaceEphemeris & ) [delete]
```

### 8.12.3 Member Function Documentation

#### 8.12.3.1 ephemer\_activate()

```
void jeod::EmptySpaceEphemeris::ephemer_activate (
    EphemeridesManager & ephemer_manager ) [override], [virtual]
```

Activate an [EmptySpaceEphemeris](#) object.

## Parameters

in, out	<i>ephem_manager</i>	Ephemerides manager
---------	----------------------	---------------------

Implements [jeod::SinglePointEphemeris](#).

Definition at line 187 of file simple\_ephemerides.cc.

8.12.3.2 `ephem_build_tree()`

```
void jeod::EmptySpaceEphemeris::ephem_build_tree (
    EphemeridesManager & ephem_manager ) [override], [virtual]
```

Build the reference frame tree with the central frame as the root.

## Parameters

in, out	<i>ephem_manager</i>	Ephemerides manager
---------	----------------------	---------------------

Implements [jeod::SinglePointEphemeris](#).

Definition at line 196 of file simple\_ephemerides.cc.

References [jeod::SinglePointEphemeris::active](#), and [central\\_frame](#).

8.12.3.3 `ephem_initialize()`

```
void jeod::EmptySpaceEphemeris::ephem_initialize (
    EphemeridesManager & ephem_manager ) [override], [virtual]
```

Initialize an [EmptySpaceEphemeris](#) object.

## Parameters

in, out	<i>ephem_manager</i>	Ephemerides manager
---------	----------------------	---------------------

Implements [jeod::SinglePointEphemeris](#).

Definition at line 165 of file simple\_ephemerides.cc.

References [central\\_point](#), [jeod::SinglePointEphemeris::deactivate\(\)](#), [jeod::EphemerisItem::disable\(\)](#), [jeod::EphemerisItem::get\\_target\\_frame\(\)](#), [jeod::SinglePointEphemeris::identifier](#), and [jeod::EphemeridesMessages::inconsistent\\_setup](#).

#### 8.12.3.4 initialize\_model()

```
void jeod::EmptySpaceEphemeris::initialize_model (
    EphemeridesManager & ephem_manager ) [override], [virtual]
```

Initialize an [EmptySpaceEphemeris](#) object.

##### Parameters

in, out	<i>ephem_manager</i>	Ephemerides manager
---------	----------------------	---------------------

Implements [jeod::SinglePointEphemeris](#).

Definition at line 148 of file simple\_ephemerides.cc.

References [jeod::SinglePointEphemeris::active](#), [jeod::EphemeridesManager::add\\_ephem\\_item\(\)](#), [jeod::EphemeridesManager::add\\_ephemeris\(\)](#), [jeod::EphemeridesManager::add\\_integ\\_frame\(\)](#), [central\\_frame](#), and [central\\_point](#).

#### 8.12.3.5 operator=()

```
EmptySpaceEphemeris& jeod::EmptySpaceEphemeris::operator= (
    const EmptySpaceEphemeris & ) [delete]
```

#### 8.12.3.6 set\_name()

```
void jeod::EmptySpaceEphemeris::set_name (
    const std::string & new_name ) [override], [virtual]
```

Set the name of an [EmptySpaceEphemeris](#) object.

##### Parameters

in, out	<i>new_name</i>	Ephemeris name
---------	-----------------	----------------

Reimplemented from [jeod::SinglePointEphemeris](#).

Definition at line 121 of file simple\_ephemerides.cc.

References [central\\_frame](#), [central\\_point](#), [jeod::SinglePointEphemeris::set\\_name\(\)](#), and [jeod::EphemerisItem::set\\_name\(\)](#).

## 8.12.4 Friends And Related Function Documentation

#### 8.12.4.1 init\_attrjeod\_\_EmptySpaceEphemeris

```
void init_attrjeod__EmptySpaceEphemeris ( ) [friend]
```

#### 8.12.4.2 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 171 of file simple\_ephemerides.hh.

### 8.12.5 Field Documentation

#### 8.12.5.1 central\_frame

```
EphemerisRefFrame jeod::EmptySpaceEphemeris::central_frame [protected]
```

The sole ephemeris frame for this model.

trick\_units(-)

Definition at line 200 of file simple\_ephemerides.hh.

Referenced by ephem\_build\_tree(), initialize\_model(), and set\_name().

#### 8.12.5.2 central\_point

```
EphemerisPoint jeod::EmptySpaceEphemeris::central_point [protected]
```

The [EphemerisPoint](#) that represents the center of an empty universe.

trick\_units(-)

Definition at line 195 of file simple\_ephemerides.hh.

Referenced by EmptySpaceEphemeris(), ephem\_initialize(), initialize\_model(), and set\_name().

The documentation for this class was generated from the following files:

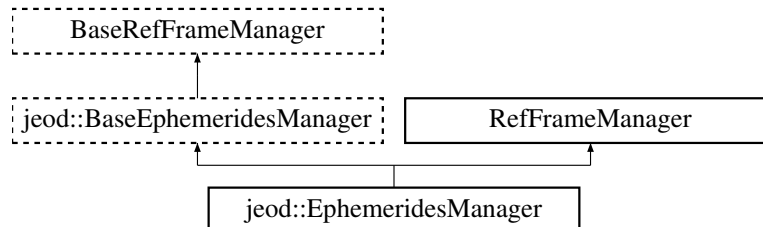
- [simple\\_ephemerides.hh](#)
- [simple\\_ephemerides.cc](#)

## 8.13 jeod::EphemeridesManager Class Reference

The [EphemeridesManager](#) class manages the ephemeris models in a simulation.

```
#include <ephem_manager.hh>
```

Inheritance diagram for jeod::EphemeridesManager:



### Public Member Functions

- [EphemeridesManager](#) ()  
*EphemeridesManager* default constructor.
- [~EphemeridesManager](#) () override  
*EphemeridesManager* destructor.
- [EphemeridesManager](#) (const [EphemeridesManager](#) &)=delete
- [EphemeridesManager](#) & operator= (const [EphemeridesManager](#) &)=delete
- bool [ref\\_frame\\_tree\\_needs\\_rebuild](#) () const  
*Query if the reference frame tree needs to be rebuilt.*
- void [ephem\\_note\\_tree\\_status\\_change](#) () override  
*Denote that the reference frame tree needs to be rebuilt.*
- void [add\\_planet](#) (BasePlanet &planet) override  
*Add a planet to the planets registry.*
- void [add\\_planet](#) (Planet &planet) override  
*Add a planet to the registry.*
- BasePlanet \* [find\\_base\\_planet](#) (const std::string &name) const override  
*Find the planet with the given name.*
- Planet \* [find\\_planet](#) (const std::string &name) const override  
*Find the planet with the given name.*
- unsigned int [get\\_num\\_planets](#) () const override  
*Return number of registered planets.*
- void [add\\_ephemeris](#) (EphemerisInterface &ephem\_if) override  
*Add an ephemeris model to the list of managed models.*
- void [clear\\_added\\_ephemerides](#) () override  
*Deactivate any registered ephemeris items and remove them from the list.*
- void [disable\\_add\\_ephemeris](#) () override  
*Make subsequent calls to add\_ephemeris deactivate the specified ephemeris model instead of adding it to the list of managed models.*
- void [add\\_ephem\\_item](#) (EphemerisItem &ephem\_item) override  
*Add an ephemeris item to the set of ephemeris items known to the ephemerides manager.*
- EphemerisItem \* [find\\_ephem\\_item](#) (const std::string &name) const override  
*Find the first registered EphemerisItem with the given name.*
- EphemerisOrientation \* [find\\_ephem\\_angle](#) (const std::string &name) const override

- Find the [EphemerisOrientation](#) with the given name.
- [EphemerisPoint](#) \* [find\\_ephem\\_point](#) (const std::string &name) const override
  - Find the [EphemerisPoint](#) with the given name.
- void [add\\_integ\\_frame](#) ([EphemerisRefFrame](#) &ref\_frame) override
  - Add a frame to the reference frame and integration frame lists.
- [EphemerisRefFrame](#) \* [find\\_integ\\_frame](#) (const std::string &name) const override
  - Find the integration frame with the given name.
- bool [is\\_integ\\_frame](#) (const RefFrame &ref\_frame) const override
  - Determine if supplied frame is an integration frame.
- unsigned int [find\\_integ\\_frame\\_index](#) (const [EphemerisRefFrame](#) &ref\_frame) const override
  - Find the index of provided frame in the integration frames vector.
- const std::vector< [EphemerisRefFrame](#) \* > & [get\\_integ\\_frames](#) () const override
  - Get a copy of the vector of integration frames.
- void [add\\_ref\\_frame](#) (RefFrame &ref\_frame) override
  - Add a reference frame to the reference frame registry.
- void [set\\_target\\_frame](#) (RefFrame &ref\_frame)
  - Set the target-frame reference for the ref-frame and all known EphemItems with similar target-frame names.
- void [initialize\\_ephemerides](#) ()
  - Initialize the ephemeris models.
- void [activate\\_ephemerides](#) ()
  - Activate ephemeris items based on frame subscription status, activate ephemeris models, and build the reference frame tree.
- void [update\\_ephemerides](#) ()
  - Update each ephemeris model.

## Protected Attributes

- bool [single\\_ephem\\_mode](#) {}
  - Set via a call to [disable\\_add\\_ephemeris](#), typically to allow a simple ephemeris model to be active with all other models made inactive.
- bool [regenerate\\_ref\\_frame\\_tree](#) {}
  - Set when the reference frame tree needs to be regenerated.
- double [update\\_time](#) {}
  - Time of last update.
- JeodPointerVector< BasePlanet >::type [planets](#)
  - The planets in a simulation, typically defined at the S\_define level.
- JeodPointerVector< [EphemerisInterface](#) >::type [ephemerides](#)
  - The ephemerides models managed by this [EphemeridesManager](#).
- JeodPointerVector< [EphemerisItem](#) >::type [ephem\\_items](#)
  - The heads of the ephemeris item lists.
- JeodPointerVector< [EphemerisRefFrame](#) >::type [integ\\_frames](#)
  - List of reference frames that are not rotating with respect to the root node of the reference frame tree.

## Friends

- class [InputProcessor](#)
- void [init\\_attrjeod\\_\\_EphemeridesManager](#) ()

### 8.13.1 Detailed Description

The [EphemeridesManager](#) class manages the ephemeris models in a simulation.

The primary functions of a [EphemeridesManager](#) are to:

- Maintain lists of planets, ephemeris models, ephemeris items, and integration frames, and to provide lookup methods for these lists.
- Dynamically determine which ephemerides are needed in a simulation.
- Initialize ephemeris models and keep them in sync with the rest of the simulation.

Definition at line 89 of file `ephem_manager.hh`.

### 8.13.2 Constructor & Destructor Documentation

#### 8.13.2.1 [EphemeridesManager\(\)](#) [1/2]

```
jeod::EphemeridesManager::EphemeridesManager ( )
```

[EphemeridesManager](#) default constructor.

Definition at line 58 of file `ephem_manager.cc`.

References `ephem_items`, `ephemerides`, `integ_frames`, and `planets`.

#### 8.13.2.2 [~EphemeridesManager\(\)](#)

```
jeod::EphemeridesManager::~~EphemeridesManager ( ) [override]
```

[EphemeridesManager](#) destructor.

Definition at line 76 of file `ephem_manager.cc`.

References `ephem_items`, `ephemerides`, `integ_frames`, and `planets`.

#### 8.13.2.3 [EphemeridesManager\(\)](#) [2/2]

```
jeod::EphemeridesManager::EphemeridesManager (
    const EphemeridesManager & ) [delete]
```



### 8.13.3 Member Function Documentation

#### 8.13.3.1 activate\_ephemerides()

```
void jeod::EphemeridesManager::activate_ephemerides ( )
```

Activate ephemeris items based on frame subscription status, activate ephemeris models, and build the reference frame tree.

Definition at line 635 of file `ephem_manager.cc`.

References `jeod::EphemerisItem::disconnect_from_tree()`, `jeod::EphemerisInterface::ephem_activate()`, `jeod::EphemerisInterface::ephem_build_tree()`, `ephem_items`, `ephemerides`, and `regenerate_ref_frame_tree`.

Referenced by `update_ephemerides()`.

#### 8.13.3.2 add\_ephem\_item()

```
void jeod::EphemeridesManager::add_ephem_item (
    EphemerisItem & ephem_item ) [override], [virtual]
```

Add an ephemeris item to the set of ephemeris items known to the ephemerides manager.

Each ephemeris model calls this method for each ephemeris item represented by that ephemeris model. The provided item is added to

- The `ephem_items` list if the provided item's name is unique or
- The tail of the list of items with the same name if an item with the provided item's name is already in the `ephem_items` list.

Multiple ephemerides models might represent the same conceptual item. The `ephem_items` list contains only items with unique names. These head items link to other items with the same name via the items' next data members, which form a singly-linked list of commonly-named items.

#### Assumptions and limitations:

- The item must have a valid name.
- Only one item with a given name can be enabled.

#### Parameters

<i>ephem_item</i>	Ephemeris item to be added to the registry.
-------------------	---

Implements [jeod::BaseEphemeridesManager](#).

Definition at line 263 of file ephemer\_manager.cc.

References `jeod::EphemerisItem::disable()`, `jeod::EphemeridesMessages::duplicate_entry`, `ephem_items`, `find_←  
_ephem_item()`, `jeod::EphemerisItem::get_enabled_item()`, `jeod::EphemerisInterface::get_name()`, `jeod::←  
EphemerisItem::get_name()`, `jeod::EphemerisItem::get_next()`, `jeod::EphemerisItem::get_owner()`, `jeod::←  
EphemeridesMessages::inconsistent_setup`, `jeod::EphemeridesMessages::internal_error`, `jeod::EphemerisItem←  
::is_enabled()`, `jeod::EphemerisItem::set_head()`, `jeod::EphemerisItem::set_manager()`, `jeod::EphemerisItem::set←  
_next()`, `jeod::EphemerisItem::set_target_frame()`, `jeod::EphemeridesMessages::single_ephem_mode`, `single_←  
ephem_mode`, `jeod::EphemerisItem::Translation`, and `jeod::EphemerisItem::updates_what()`.

Referenced by `jeod::De4xxEphemeris::initialize_items()`, `jeod::EmptySpaceEphemeris::initialize_model()`, and `jeod::SinglePlanetEphemeris::initialize_model()`.

### 8.13.3.3 add\_ephemeris()

```
void jeod::EphemeridesManager::add_ephemeris (
    EphemerisInterface & ephem_if ) [override], [virtual]
```

Add an ephemeris model to the list of managed models.

#### Assumptions and limitations:

- Ephemeris models must be registered with the ephemerides manager in dependency order: Models with no dependencies are registered first, followed by models that depend on these base models, and so on.

#### Parameters

<i>ephem_← _if</i>	Ephemeris model to be added to the registry.
------------------------	--

Implements `jeod::BaseEphemeridesManager`.

Definition at line 207 of file ephemer\_manager.cc.

References `ephemerides`.

Referenced by `jeod::EmptySpaceEphemeris::initialize_model()`, `jeod::De4xxEphemeris::initialize_model()`, and `jeod::SinglePlanetEphemeris::initialize_model()`.

### 8.13.3.4 add\_integ\_frame()

```
void jeod::EphemeridesManager::add_integ_frame (
    EphemerisRefFrame & ref_frame ) [override], [virtual]
```

Add a frame to the reference frame and integration frame lists.

## Parameters

<i>ref_frame</i>	Integration frame to be added to the registries
------------------	---

Implements [jeod::BaseEphemeridesManager](#).

Definition at line 434 of file ephem\_manager.cc.

References [add\\_ref\\_frame\(\)](#), and [integ\\_frames](#).

Referenced by [jeod::De4xxEphemeris::initialize\\_items\(\)](#), and [jeod::EmptySpaceEphemeris::initialize\\_model\(\)](#).

8.13.3.5 [add\\_planet\(\)](#) [1/2]

```
void jeod::EphemeridesManager::add_planet (
    BasePlanet & planet ) [override], [virtual]
```

Add a planet to the planets registry.

## Parameters

<i>planet</i>	Planet to be added to the registry.
---------------	-------------------------------------

Implements [jeod::BaseEphemeridesManager](#).

Definition at line 104 of file ephem\_manager.cc.

References [jeod::EphemeridesMessages::duplicate\\_entry](#), [find\\_base\\_planet\(\)](#), and [planets](#).

Referenced by [add\\_planet\(\)](#).

8.13.3.6 [add\\_planet\(\)](#) [2/2]

```
void jeod::EphemeridesManager::add_planet (
    Planet & planet ) [override], [virtual]
```

Add a planet to the registry.

## Parameters

<i>planet</i>	Planet to be added to the registry.
---------------	-------------------------------------

Implements [jeod::BaseEphemeridesManager](#).

Definition at line 85 of file find\_planet.cc.

References `add_planet()`.

#### 8.13.3.7 `add_ref_frame()`

```
void jeod::EphemeridesManager::add_ref_frame (
    RefFrame & ref_frame ) [override]
```

Add a reference frame to the reference frame registry.

##### Parameters

<code>ref_frame</code>	Reference frame to be added to the registry
------------------------	---

Definition at line 539 of file `ephem_manager.cc`.

References `set_target_frame()`.

Referenced by `add_integ_frame()`.

#### 8.13.3.8 `clear_added_ephemerides()`

```
void jeod::EphemeridesManager::clear_added_ephemerides ( ) [override], [virtual]
```

Deactivate any registered ephemeris items and remove them from the list.

Implements [jeod::BaseEphemeridesManager](#).

Definition at line 216 of file `ephem_manager.cc`.

References `ephem_items`, `ephemerides`, and `jeod::EphemeridesMessages::single_ephem_mode`.

#### 8.13.3.9 `disable_add_ephemeris()`

```
void jeod::EphemeridesManager::disable_add_ephemeris ( ) [override], [virtual]
```

Make subsequent calls to `add_ephemeris` deactivate the specified ephemeris model instead of adding it to the list of managed models.

##### Note

This is an irrevocable act.

**Assumptions and limitations:**

- This method is typically used after clearing the ephemerides model list and then adding the one allowed ephemerides model:

```
EphemeridesManager::clear_added_ephemerides();
EphemeridesManager::add_ephemeris (model);
EphemeridesManager::add_ephem_item (item);
EphemeridesManager::disable_add_ephemeris ();
```

Implements [jeod::BaseEphemeridesManager](#).

Definition at line 192 of file ephemer\_manager.cc.

References [single\\_ephem\\_mode](#).

**8.13.3.10 ephemer\_note\_tree\_status\_change()**

```
void jeod::EphemeridesManager::ephemer_note_tree_status_change ( ) [override], [virtual]
```

Denote that the reference frame tree needs to be rebuilt.

Implements [jeod::BaseEphemeridesManager](#).

Definition at line 91 of file ephemer\_manager.cc.

References [regenerate\\_ref\\_frame\\_tree](#).

**8.13.3.11 find\_base\_planet()**

```
BasePlanet * jeod::EphemeridesManager::find_base_planet (
    const std::string & name ) const [override], [virtual]
```

Find the planet with the given name.

**Parameters**

<i>name</i>	Planet name.
-------------	--------------

**Returns**

Found planet; NULL if not found.

Implements [jeod::BaseEphemeridesManager](#).

Definition at line 144 of file ephemer\_manager.cc.

References [planets](#).

Referenced by [add\\_planet\(\)](#), [jeod::SinglePlanetEphemeris::ephemer\\_initialize\(\)](#), [jeod::PropagatedPlanet::ephemer\\_initialize\(\)](#), and [find\\_planet\(\)](#).

#### 8.13.3.12 find\_ephem\_angle()

```
EphemerisOrientation * jeod::EphemeridesManager::find_ephem_angle (
    const std::string & name ) const [override], [virtual]
```

Find the [EphemerisOrientation](#) with the given name.

##### Parameters

<i>name</i>	Ephemeris angle name
-------------	----------------------

##### Returns

Found ephemeris angle

Implements [jeod::BaseEphemeridesManager](#).

Definition at line 381 of file ephem\_manager.cc.

References [find\\_ephem\\_item\(\)](#), and [jeod::EphemeridesMessages::invalid\\_item](#).

#### 8.13.3.13 find\_ephem\_item()

```
EphemerisItem * jeod::EphemeridesManager::find_ephem_item (
    const std::string & name ) const [override], [virtual]
```

Find the first registered [EphemerisItem](#) with the given name.

##### Parameters

<i>name</i>	Ephemeris item name
-------------	---------------------

##### Returns

Found ephemeris item

Implements [jeod::BaseEphemeridesManager](#).

Definition at line 361 of file ephem\_manager.cc.

References [ephem\\_items](#).

Referenced by [add\\_ephem\\_item\(\)](#), [find\\_ephem\\_angle\(\)](#), [find\\_ephem\\_point\(\)](#), and [set\\_target\\_frame\(\)](#).

#### 8.13.3.14 find\_ephem\_point()

```
EphemerisPoint * jeod::EphemeridesManager::find_ephem_point (
    const std::string & name ) const [override], [virtual]
```

Find the [EphemerisPoint](#) with the given name.

## Parameters

<i>name</i>	Ephemeris point name
-------------	----------------------

## Returns

Found ephemeris point

Implements [jeod::BaseEphemeridesManager](#).

Definition at line 406 of file ephem\_manager.cc.

References [find\\_ephem\\_item\(\)](#), and [jeod::EphemeridesMessages::invalid\\_item](#).

## 8.13.3.15 find\_integ\_frame()

```
EphemerisRefFrame * jeod::EphemeridesManager::find_integ_frame (  
    const std::string & name ) const [override], [virtual]
```

Find the integration frame with the given name.

## Parameters

<i>name</i>	Integration frame name
-------------	------------------------

## Returns

Found integration frame

Implements [jeod::BaseEphemeridesManager](#).

Definition at line 449 of file ephem\_manager.cc.

References [integ\\_frames](#).

## 8.13.3.16 find\_integ\_frame\_index()

```
unsigned int jeod::EphemeridesManager::find_integ_frame_index (  
    const EphemerisRefFrame & ref_frame ) const [override], [virtual]
```

Find the index of provided frame in the integration frames vector.

## Parameters

<i>ref_frame</i>	Reference to be found
------------------	-----------------------

**Returns**

Index of found frame

Implements [jeod::BaseEphemeridesManager](#).

Definition at line 500 of file ephem\_manager.cc.

References integ\_frames, and jeod::EphemeridesMessages::invalid\_item.

**8.13.3.17 find\_planet()**

```
Planet * jeod::EphemeridesManager::find_planet (
    const std::string & name ) const [override], [virtual]
```

Find the planet with the given name.

**Parameters**

<i>name</i>	Planet name
-------------	-------------

**Returns**

Found planet, as a Planet rather than a BasePlanet

Implements [jeod::BaseEphemeridesManager](#).

Definition at line 49 of file find\_planet.cc.

References find\_base\_planet(), and jeod::EphemeridesMessages::invalid\_item.

**8.13.3.18 get\_integ\_frames()**

```
const std::vector< EphemerisRefFrame * > & jeod::EphemeridesManager::get_integ_frames ( )
const [override], [virtual]
```

Get a copy of the vector of integration frames.

**Returns**

Copy of integration frames vector

Implements [jeod::BaseEphemeridesManager](#).

Definition at line 468 of file ephem\_manager.cc.

References integ\_frames.



**8.13.3.19 get\_num\_planets()**

```
unsigned int jeod::EphemeridesManager::get_num_planets ( ) const [override], [virtual]
```

Return number of registered planets.

**Returns**

: Number of registered planets.

Implements [jeod::BaseEphemeridesManager](#).

Definition at line 169 of file `ephem_manager.cc`.

References `planets`.

Referenced by `jeod::SinglePlanetEphemeris::ephem_initialize()`.

**8.13.3.20 initialize\_ephemerides()**

```
void jeod::EphemeridesManager::initialize_ephemerides ( )
```

Initialize the ephemeris models.

Definition at line 599 of file `ephem_manager.cc`.

References `ephemerides`, and `regenerate_ref_frame_tree`.

**8.13.3.21 is\_integ\_frame()**

```
bool jeod::EphemeridesManager::is_integ_frame (
    const RefFrame & ref_frame ) const [override], [virtual]
```

Determine if supplied frame is an integration frame.

**Parameters**

<i>ref_frame</i>	Reference frame to test
------------------	-------------------------

**Returns**

True if the frame is a registered integration frame, false otherwise

Implements [jeod::BaseEphemeridesManager](#).

Definition at line 478 of file `ephem_manager.cc`.

References `integ_frames`.

### 8.13.3.22 operator=()

```
EphemeridesManager& jeod::EphemeridesManager::operator= (
    const EphemeridesManager & ) [delete]
```

### 8.13.3.23 ref\_frame\_tree\_needs\_rebuild()

```
bool jeod::EphemeridesManager::ref_frame_tree_needs_rebuild ( ) const [inline]
```

Query if the reference frame tree needs to be rebuilt.

#### Returns

regenerate\_ref\_frame\_tree data member.

Definition at line 110 of file ephemerides\_manager.hh.

### 8.13.3.24 set\_target\_frame()

```
void jeod::EphemeridesManager::set_target_frame (
    RefFrame & ref_frame )
```

Set the target-frame reference for the ref-frame and all known EphemerisItems with similar target-frame names.

#### Parameters

<i>ref_frame</i>	Reference frame to be used as the target-frame.
------------------	---

Definition at line 551 of file ephemerides\_manager.cc.

References find\_ephem\_item(), jeod::EphemeridesMessages::inconsistent\_setup, and jeod::EphemerisItem::set\_target\_frame().

Referenced by add\_ref\_frame(), and jeod::PropagatedPlanet::ephemeris\_initialize().

### 8.13.3.25 update\_ephemerides()

```
void jeod::EphemeridesManager::update_ephemerides ( )
```

Update each ephemeris model.

Definition at line 614 of file ephemerides\_manager.cc.

References activate\_ephemerides(), jeod::EphemerisInterface::ephemeris\_update(), ephemerides, and regenerate\_ref\_frame\_tree.

## 8.13.4 Friends And Related Function Documentation

### 8.13.4.1 init\_attrjeod\_\_EphemeridesManager

```
void init_attrjeod__EphemeridesManager ( ) [friend]
```

### 8.13.4.2 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 92 of file ephem\_manager.hh.

## 8.13.5 Field Documentation

### 8.13.5.1 ephem\_items

```
JeodPointerVector<EphemerisItem>::type jeod::EphemeridesManager::ephem_items [protected]
```

The heads of the ephemeris item lists.

All items in one of these sublists share the same name. The members of the ephem\_items list have distinct names.  
trick\_io(\*\*)

Definition at line 229 of file ephem\_manager.hh.

Referenced by activate\_ephemerides(), add\_ephem\_item(), clear\_added\_ephemerides(), EphemeridesManager(), find\_ephem\_item(), and ~EphemeridesManager().

### 8.13.5.2 ephemerides

```
JeodPointerVector<EphemerisInterface>::type jeod::EphemeridesManager::ephemerides [protected]
```

The ephemerides models managed by this [EphemeridesManager](#).

trick\_io(\*\*)

Definition at line 222 of file ephem\_manager.hh.

Referenced by activate\_ephemerides(), add\_ephemeris(), clear\_added\_ephemerides(), EphemeridesManager(), initialize\_ephemerides(), update\_ephemerides(), and ~EphemeridesManager().

### 8.13.5.3 integ\_frames

```
JeodPointerVector<EphemerisRefFrame>::type jeod::EphemeridesManager::integ_frames [protected]
```

List of reference frames that are not rotating with respect to the root node of the reference frame tree.

trick\_io(\*\*)

Definition at line 235 of file ephemer\_manager.hh.

Referenced by add\_integ\_frame(), EphemeridesManager(), find\_integ\_frame(), find\_integ\_frame\_index(), get\_integ\_frames(), is\_integ\_frame(), and ~EphemeridesManager().

### 8.13.5.4 planets

```
JeodPointerVector<BasePlanet>::type jeod::EphemeridesManager::planets [protected]
```

The planets in a simulation, typically defined at the S\_define level.

trick\_io(\*\*)

Definition at line 217 of file ephemer\_manager.hh.

Referenced by add\_planet(), EphemeridesManager(), find\_base\_planet(), get\_num\_planets(), and ~EphemeridesManager().

### 8.13.5.5 regenerate\_ref\_frame\_tree

```
bool jeod::EphemeridesManager::regenerate_ref_frame_tree {} [protected]
```

Set when the reference frame tree needs to be regenerated.

trick\_units(-)

Definition at line 207 of file ephemer\_manager.hh.

Referenced by activate\_ephemerides(), ephemer\_note\_tree\_status\_change(), initialize\_ephemerides(), and update\_ephemerides().

### 8.13.5.6 single\_ephem\_mode

```
bool jeod::EphemeridesManager::single_ephem_mode {} [protected]
```

Set via a call to disable\_add\_ephemeris, typically to allow a simple ephemeris model to be active with all other models made inactive.

trick\_units(-)

Definition at line 202 of file ephemer\_manager.hh.

Referenced by add\_ephem\_item(), and disable\_add\_ephemeris().

## 8.13.5.7 update\_time

```
double jeod::EphemeridesManager::update_time {} [protected]
```

Time of last update.

trick\_units(s)

Definition at line 212 of file ephem\_manager.hh.

The documentation for this class was generated from the following files:

- [ephem\\_manager.hh](#)
- [ephem\\_manager.cc](#)
- [find\\_planet.cc](#)

## 8.14 jeod::EphemeridesMessages Class Reference

Specifies the message IDs used in the Ephemerides model.

```
#include <ephem_messages.hh>
```

## Public Member Functions

- [EphemeridesMessages](#) ()=delete
- [EphemeridesMessages](#) (const [EphemeridesMessages](#) &)=delete
- [EphemeridesMessages](#) & operator= (const [EphemeridesMessages](#) &)=delete

## Static Public Attributes

- static const char \* [inconsistent\\_setup](#) = "environment/ephemerides/" "inconsistent\_setup"  
*Error issued when the ephemeris model configuration is inconsistent.*
- static const char \* [file\\_error](#) = "environment/ephemerides/" "file\_error"  
*Error issued when the ephemeris file cannot be opened for input.*
- static const char \* [unsupported\\_architecture](#) = "environment/ephemerides/" "unsupported\_architecture"  
*Error issued for machine architectures that do not conform to the architecture assumptions:*
- static const char \* [garbage\\_file](#) = "environment/ephemerides/" "garbage\_file"  
*Error issued when the ephemeris file appears to be garbage.*
- static const char \* [time\\_not\\_in\\_range](#) = "environment/ephemerides/" "time\_not\_in\_range"  
*Error issued when the ephemeris file does not contain data for the requested time.*
- static const char \* [item\\_not\\_in\\_file](#) = "environment/ephemerides/" "item\_not\_in\_file"  
*Error issued when the ephemeris file does not contain data for the requested item.*
- static const char \* [null\\_pointer](#) = "environment/ephemerides/" "null\_pointer"  
*Issued when a pointer should be non-NULL but isn't.*
- static const char \* [duplicate\\_entry](#) = "environment/ephemerides/" "duplicate\_entry"  
*Issued on request to add a pointer to a list a second time.*
- static const char \* [invalid\\_name](#) = "environment/ephemerides/" "invalid\_name"  
*Issued when a name is invalid – empty, a duplicate, ...*
- static const char \* [invalid\\_item](#) = "environment/ephemerides/" "invalid\_item"  
*Issued when something other than a name is invalid.*
- static const char \* [single\\_ephem\\_mode](#) = "environment/ephemerides/" "single\_ephem\_mode"  
*Issued when the ephemeris manager is rejecting add\_ephemeris calls.*
- static const char \* [internal\\_error](#) = "environment/ephemerides/" "internal\_error"  
*Issued when some internal error occurred.*
- static const char \* [debug](#) = "environment/ephemerides/" "debug"  
*Used to send a message about a non-error condition.*

## Friends

- class [InputProcessor](#)
- void [init\\_attrjeod\\_\\_EphemeridesMessages](#) ()

### 8.14.1 Detailed Description

Specifies the message IDs used in the Ephemerides model.

#### Assumptions and Limitations

- This is a complete catalog of the messages sent by the ephemerides model.
- This is not an exhaustive list of all the things that can go awry.

Definition at line 83 of file `ephem_messages.hh`.

### 8.14.2 Constructor & Destructor Documentation

#### 8.14.2.1 EphemeridesMessages() [1/2]

```
jeod::EphemeridesMessages::EphemeridesMessages ( ) [delete]
```

#### 8.14.2.2 EphemeridesMessages() [2/2]

```
jeod::EphemeridesMessages::EphemeridesMessages (
    const EphemeridesMessages & ) [delete]
```

### 8.14.3 Member Function Documentation

#### 8.14.3.1 operator=()

```
EphemeridesMessages& jeod::EphemeridesMessages::operator= (
    const EphemeridesMessages & ) [delete]
```

### 8.14.4 Friends And Related Function Documentation

#### 8.14.4.1 init\_attrjeod\_\_EphemeridesMessages

```
void init_attrjeod__EphemeridesMessages ( ) [friend]
```

#### 8.14.4.2 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 85 of file ephem\_messages.hh.

### 8.14.5 Field Documentation

#### 8.14.5.1 debug

```
char const * jeod::EphemeridesMessages::debug = "environment/ephemerides/" "debug" [static]
```

Used to send a message about a non-error condition.

trick\_units(–)

Definition at line 158 of file ephem\_messages.hh.

Referenced by jeod::De4xxFile::open().

#### 8.14.5.2 duplicate\_entry

```
char const * jeod::EphemeridesMessages::duplicate_entry = "environment/ephemerides/" "duplicate↵_entry" [static]
```

Issued on request to add a pointer to a list a second time.

trick\_units(–)

Definition at line 132 of file ephem\_messages.hh.

Referenced by jeod::EphemeridesManager::add\_ephem\_item(), and jeod::EphemeridesManager::add\_planet().

#### 8.14.5.3 file\_error

```
char const * jeod::EphemeridesMessages::file_error = "environment/ephemerides/" "file_error"
[static]
```

Error issued when the ephemeris file cannot be opened for input.

trick\_units(—)

Definition at line 96 of file ephem\_messages.hh.

Referenced by jeod::De4xxFile::close(), jeod::De4xxFile::open(), jeod::De4xxFile::pre\_initialize(), and jeod::De4xxFile::update().

#### 8.14.5.4 garbage\_file

```
char const * jeod::EphemeridesMessages::garbage_file = "environment/ephemerides/" "garbage_↵
file" [static]
```

Error issued when the ephemeris file appears to be garbage.

trick\_units(—)

Definition at line 110 of file ephem\_messages.hh.

Referenced by jeod::De4xxFile::pre\_initialize().

#### 8.14.5.5 inconsistent\_setup

```
char const * jeod::EphemeridesMessages::inconsistent_setup = "environment/ephemerides/" "inconsistent_↵
_setup" [static]
```

Error issued when the ephemeris model configuration is inconsistent.

trick\_units(—)

Definition at line 91 of file ephem\_messages.hh.

Referenced by jeod::De4xxEphemeris::activate\_em\_nodes(), jeod::EphemeridesManager::add\_ephem\_↵  
item(), jeod::De4xxEphemeris::ephem\_build\_tree(), jeod::EmptySpaceEphemeris::ephem\_initialize(), jeod::↵  
SinglePlanetEphemeris::ephem\_initialize(), jeod::PropagatedPlanet::ephem\_initialize(), jeod::De4xxEphemeris↵  
::initialize\_items(), jeod::PropagatedPlanet::initialize\_model(), jeod::De4xxEphemeris::initialize\_time(), jeod::↵  
EphemerisRefFrame::set\_active\_status(), jeod::PropagatedPlanet::set\_mode(), jeod::SinglePointEphemeris::set↵  
\_name(), and jeod::EphemeridesManager::set\_target\_frame().



#### 8.14.5.6 internal\_error

```
char const * jeod::EphemeridesMessages::internal_error = "environment/ephemerides/" "internal_↵  
_error" [static]
```

Issued when some internal error occurred.

These errors should never happen. `trick_units(-)`

Definition at line 153 of file `ephem_messages.hh`.

Referenced by `jeod::SinglePointEphemeris::activate()`, `jeod::De4xxEphemeris::activate()`, `jeod::Propagated↵  
Planet::activate()`, `jeod::EphemeridesManager::add_ephem_item()`, `jeod::EphemerisOrientation::note_frame_↵  
status_change()`, `jeod::EphemerisPoint::note_frame_status_change()`, `jeod::De4xxFile::pre_initialize()`, and `jeod↵  
::De4xxFile::update()`.

#### 8.14.5.7 invalid\_item

```
char const * jeod::EphemeridesMessages::invalid_item = "environment/ephemerides/" "invalid_↵  
item" [static]
```

Issued when something other than a name is invalid.

`trick_units(-)`

Definition at line 142 of file `ephem_messages.hh`.

Referenced by `jeod::EphemerisItem::activate()`, `jeod::EphemeridesManager::find_ephem_angle()`, `jeod::↵  
EphemeridesManager::find_ephem_point()`, `jeod::EphemeridesManager::find_integ_frame_index()`, `jeod::↵  
EphemeridesManager::find_planet()`, and `jeod::EphemerisItem::set_target_frame()`.

#### 8.14.5.8 invalid\_name

```
char const * jeod::EphemeridesMessages::invalid_name = "environment/ephemerides/" "invalid_↵  
name" [static]
```

Issued when a name is invalid – empty, a duplicate, ...

`trick_units(-)`

Definition at line 137 of file `ephem_messages.hh`.

Referenced by `jeod::EphemerisItem::set_name()`, and `jeod::EphemerisItem::validate_name()`.

#### 8.14.5.9 item\_not\_in\_file

```
char const * jeod::EphemeridesMessages::item_not_in_file = "environment/ephemerides/" "item_↵  
not_in_file" [static]
```

Error issued when the ephemeris file does not contain data for the requested item.

trick\_units(–)

Definition at line 122 of file ephem\_messages.hh.

Referenced by jeod::De4xxFile::update().

#### 8.14.5.10 null\_pointer

```
char const * jeod::EphemeridesMessages::null_pointer = "environment/ephemerides/" "null_↵  
pointer" [static]
```

Issued when a pointer should be non-NULL but isn't.

trick\_units(–)

Definition at line 127 of file ephem\_messages.hh.

#### 8.14.5.11 single\_ephem\_mode

```
char const * jeod::EphemeridesMessages::single_ephem_mode = "environment/ephemerides/" "single_↵  
_ephem_mode" [static]
```

Issued when the ephemeris manager is rejecting add\_ephemeris calls.

trick\_units(–)

Definition at line 147 of file ephem\_messages.hh.

Referenced by jeod::EphemeridesManager::add\_ephem\_item(), and jeod::EphemeridesManager::clear\_added\_↵  
ephemerides().

#### 8.14.5.12 time\_not\_in\_range

```
char const * jeod::EphemeridesMessages::time_not_in_range = "environment/ephemerides/" "time_↵  
not_in_range" [static]
```

Error issued when the ephemeris file does not contain data for the requested time.

trick\_units(–)

Definition at line 116 of file ephem\_messages.hh.

Referenced by jeod::De4xxFile::initialize().

## 8.14.5.13 unsupported\_architecture

```
char const * jeod::EphemeridesMessages::unsupported_architecture = "environment/ephemerides/"
"unsupported_architecture" [static]
```

Error issued for machine architectures that do not conform to the architecture assumptions:

- char = 8 bits
- int32\_t = 4 bytes (32 bits)
- double = 8 bytes (64 bits) `trick_units(-)`

Definition at line 105 of file `ephem_messages.hh`.

The documentation for this class was generated from the following files:

- [ephem\\_messages.hh](#)
- [ephem\\_messages.cc](#)

## 8.15 jeod::EphemerisDataItemMeta Struct Reference

Structure containing the header metadata for sizing/locating the data entries with the data segments.

```
#include <de4xx_file.hh>
```

## Data Fields

- uint32\_t [offset](#)  
*Offsets into coeffs array.*
- uint32\_t [nterms](#)  
*Chebyshev polynomial terms.*
- uint32\_t [npoly](#)  
*Number polynomials per data block.*

## 8.15.1 Detailed Description

Structure containing the header metadata for sizing/locating the data entries with the data segments.

Definition at line 143 of file `de4xx_file.hh`.

## 8.15.2 Field Documentation

### 8.15.2.1 npoly

```
uint32_t jeod::EphemerisDataItemMeta::npoly
```

Number polynomials per data block.

trick\_units(-)

Definition at line 158 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::interpolate().

### 8.15.2.2 nterms

```
uint32_t jeod::EphemerisDataItemMeta::nterms
```

Chebyshev polynomial terms.

trick\_units(-)

Definition at line 153 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::interpolate(), and jeod::De4xxFile::pre\_initialize().

### 8.15.2.3 offset

```
uint32_t jeod::EphemerisDataItemMeta::offset
```

Offsets into coeffs array.

trick\_units(-)

Definition at line 148 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::interpolate(), and jeod::De4xxFile::pre\_initialize().

The documentation for this struct was generated from the following file:

- [de4xx\\_file.hh](#)

## 8.16 jeod::EphemerisDataSegmentMeta Struct Reference

Metadata implied from each data segment.

```
#include <de4xx_file.hh>
```

## Data Fields

- `uint32_t num_recs`  
*The number of records in the file.*
- `double start_epoch`  
*Julian date of start of file.*
- `double stop_epoch`  
*Julian date of end of file.*

### 8.16.1 Detailed Description

Metadata implied from each data segment.

Definition at line 164 of file `de4xx_file.hh`.

### 8.16.2 Field Documentation

#### 8.16.2.1 num\_recs

```
uint32_t jeod::EphemerisDataSegmentMeta::num_recs
```

The number of records in the file.

`trick_units(-)`

Definition at line 169 of file `de4xx_file.hh`.

Referenced by `jeod::De4xxFile::pre_initialize()`, and `jeod::De4xxFile::update()`.

#### 8.16.2.2 start\_epoch

```
double jeod::EphemerisDataSegmentMeta::start_epoch
```

Julian date of start of file.

`trick_units(day)`

Definition at line 174 of file `de4xx_file.hh`.

Referenced by `jeod::De4xxFile::initialize()`, and `jeod::De4xxFile::pre_initialize()`.

### 8.16.2.3 stop\_epoch

```
double jeod::EphemerisDataSegmentMeta::stop_epoch
```

Julian date of end of file.

trick\_units(day)

Definition at line 179 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::pre\_initialize().

The documentation for this struct was generated from the following file:

- [de4xx\\_file.hh](#)

## 8.17 jeod::EphemerisDataSetMeta Struct Reference

Container for the metadata from the DE model header.

```
#include <de4xx_file.hh>
```

### Data Fields

- uint32\_t [number\\_file\\_items](#)  
*Return the number of ephemeris items provided in DE data.*
- double [start\\_epoch](#)  
*Julian date of start of dataset.*
- double [stop\\_epoch](#)  
*Julian date of end of dataset.*
- double [delta\\_epoch](#)  
*Julian period length of each segment.*
- uint32\_t [number\\_segments](#)  
*Number of ascp files (segments) provided by DE model.*
- uint32\_t [ncoeff](#)  
*Size of each data record throughout the dataset.*
- double [de\\_constants](#) [[De4xxBase::De4xx\\_Const\\_MaxConsts](#)]  
*Array of supplied constants required by JEOD.*

### 8.17.1 Detailed Description

Container for the metadata from the DE model header.

Definition at line 100 of file de4xx\_file.hh.

### 8.17.2 Field Documentation

### 8.17.2.1 de\_constants

```
double jeod::EphemerisDataSetMeta::de_constants[De4xxBase::De4xx_Const_MaxConsts]
```

Array of supplied constants required by JEOD.

Definition at line 136 of file de4xx\_file.hh.

Referenced by `jeod::De4xxFile::initialize()`, `jeod::De4xxEphemeris::initialize_file()`, and `jeod::De4xxFile::pre_initialize()`.

### 8.17.2.2 delta\_epoch

```
double jeod::EphemerisDataSetMeta::delta_epoch
```

Julian period length of each segment.

`trick_units(day)`

Definition at line 121 of file de4xx\_file.hh.

Referenced by `jeod::De4xxFile::initialize()`, `jeod::De4xxFile::interpolate()`, `jeod::De4xxFile::time_is_in_range()`, and `jeod::De4xxFile::update()`.

### 8.17.2.3 ncoeff

```
uint32_t jeod::EphemerisDataSetMeta::ncoeff
```

Size of each data record throughout the dataset.

`trick_units(-)`

Definition at line 131 of file de4xx\_file.hh.

Referenced by `jeod::De4xxFile::update()`.

### 8.17.2.4 number\_file\_items

```
uint32_t jeod::EphemerisDataSetMeta::number_file_items
```

Return the number of ephemeris items provided in DE data.

(e.g., 13 for DE405/421, 15 for DE440)

Definition at line 106 of file de4xx\_file.hh.

Referenced by `jeod::De4xxFile::interpolate()`, `jeod::De4xxFile::open()`, `jeod::De4xxFile::pre_initialize()`, and `jeod::De4xxFile::update()`.

### 8.17.2.5 number\_segments

```
uint32_t jeod::EphemerisDataSetMeta::number_segments
```

Number of ascp files (segments) provided by DE model.

trick\_units(-)

Definition at line 126 of file de4xx\_file.hh.

Referenced by jeod::De4xxFile::pre\_initialize(), and jeod::De4xxFile::update().

### 8.17.2.6 start\_epoch

```
double jeod::EphemerisDataSetMeta::start_epoch
```

Julian date of start of dataset.

trick\_units(day)

Definition at line 111 of file de4xx\_file.hh.

### 8.17.2.7 stop\_epoch

```
double jeod::EphemerisDataSetMeta::stop_epoch
```

Julian date of end of dataset.

trick\_units(day)

Definition at line 116 of file de4xx\_file.hh.

The documentation for this struct was generated from the following file:

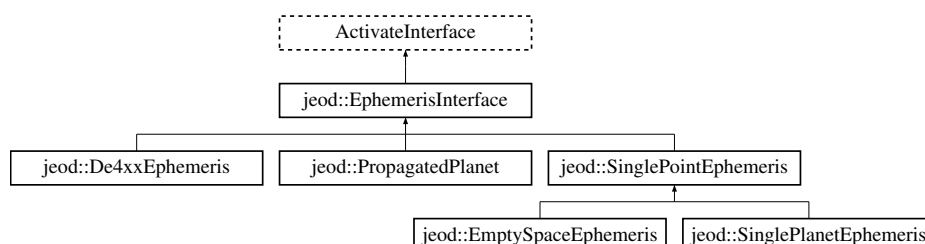
- [de4xx\\_file.hh](#)

## 8.18 jeod::EphemerisInterface Class Reference

Interface class that specifies minimal functionality of an ephemeris model.

```
#include <ephem_interface.hh>
```

Inheritance diagram for jeod::EphemerisInterface:





## Public Member Functions

- [~EphemerisInterface](#) () override=default
- virtual double [timestamp](#) () const =0  
*Indicates when class was last updated.*
- virtual std::string [get\\_name](#) () const =0  
*Identify the model.*
- virtual void [ephem\\_initialize](#) (EphemeridesManager &manager)=0  
*Initialize the model.*
- virtual void [ephem\\_activate](#) (EphemeridesManager &manager)=0  
*Activate the model.*
- virtual void [ephem\\_build\\_tree](#) (EphemeridesManager &manager)=0  
*Build the model's contribution to the reference frame tree.*
- virtual void [ephem\\_update](#) ()=0  
*Update the model.*

## Friends

- class [InputProcessor](#)
- void [init\\_attrjeod\\_\\_EphemerisInterface](#) ()

### 8.18.1 Detailed Description

Interface class that specifies minimal functionality of an ephemeris model.

Definition at line 79 of file `ephem_interface.hh`.

### 8.18.2 Constructor & Destructor Documentation

#### 8.18.2.1 ~EphemerisInterface()

```
jeod::EphemerisInterface::~~EphemerisInterface ( ) [override], [default]
```

### 8.18.3 Member Function Documentation

#### 8.18.3.1 ephem\_activate()

```
virtual void jeod::EphemerisInterface::ephem_activate (
    EphemeridesManager & manager ) [pure virtual]
```

Activate the model.

**Parameters**

<code>in, out</code>	<code>manager</code>	Ephemerides manager
----------------------	----------------------	---------------------

Implemented in [jeod::PropagatedPlanet](#), [jeod::SinglePlanetEphemeris](#), [jeod::De4xxEphemeris](#), [jeod::EmptySpaceEphemeris](#), and [jeod::SinglePointEphemeris](#).

Referenced by `jeod::EphemeridesManager::activate_ephemerides()`.

**8.18.3.2 ephemer\_build\_tree()**

```
virtual void jeod::EphemerisInterface::ephemer_build_tree (
    EphemeridesManager & manager ) [pure virtual]
```

Build the model's contribution to the reference frame tree.

**Parameters**

<code>in, out</code>	<code>manager</code>	Ephemerides manager
----------------------	----------------------	---------------------

Implemented in [jeod::PropagatedPlanet](#), [jeod::SinglePlanetEphemeris](#), [jeod::De4xxEphemeris](#), [jeod::EmptySpaceEphemeris](#), and [jeod::SinglePointEphemeris](#).

Referenced by `jeod::EphemeridesManager::activate_ephemerides()`.

**8.18.3.3 ephemer\_initialize()**

```
virtual void jeod::EphemerisInterface::ephemer_initialize (
    EphemeridesManager & manager ) [pure virtual]
```

Initialize the model.

**Parameters**

<code>in, out</code>	<code>manager</code>	Ephemerides manager
----------------------	----------------------	---------------------

Implemented in [jeod::PropagatedPlanet](#), [jeod::SinglePlanetEphemeris](#), [jeod::De4xxEphemeris](#), [jeod::EmptySpaceEphemeris](#), and [jeod::SinglePointEphemeris](#).

**8.18.3.4 ephemer\_update()**

```
virtual void jeod::EphemerisInterface::ephemer_update ( ) [pure virtual]
```

Update the model.

Implemented in [jeod::PropagatedPlanet](#), [jeod::De4xxEphemeris](#), and [jeod::SinglePointEphemeris](#).

Referenced by [jeod::EphemeridesManager::update\\_ephemerides\(\)](#).

#### 8.18.3.5 get\_name()

```
virtual std::string jeod::EphemerisInterface::get_name ( ) const [pure virtual]
```

Identify the model.

##### Returns

Model name

Implemented in [jeod::PropagatedPlanet](#), [jeod::De4xxEphemeris](#), and [jeod::SinglePointEphemeris](#).

Referenced by [jeod::EphemeridesManager::add\\_ephem\\_item\(\)](#).

#### 8.18.3.6 timestamp()

```
virtual double jeod::EphemerisInterface::timestamp ( ) const [pure virtual]
```

Indicates when class was last updated.

##### Returns

Time of last update  
Units: s

Implemented in [jeod::PropagatedPlanet](#), [jeod::De4xxEphemeris](#), and [jeod::SinglePointEphemeris](#).

## 8.18.4 Friends And Related Function Documentation

#### 8.18.4.1 init\_attrjeod\_\_EphemerisInterface

```
void init_attrjeod__EphemerisInterface ( ) [friend]
```

### 8.18.4.2 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 81 of file `ephem_interface.hh`.

The documentation for this class was generated from the following file:

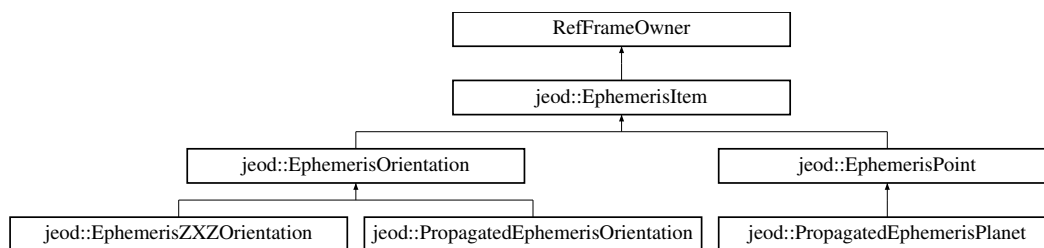
- [ephem\\_interface.hh](#)

## 8.19 jeod::EphemerisItem Class Reference

The [EphemerisItem](#) class is the base class for representing an item that is modeled in an ephemeris model.

```
#include <ephem_item.hh>
```

Inheritance diagram for `jeod::EphemerisItem`:



### Public Types

- enum [TargetAspect](#) { [Translation](#) = 0, [Rotation](#) = 1 }
- Defines the aspect of the target frame that will be modified by the [EphemerisItem](#) object.*

### Public Member Functions

- [EphemerisItem](#) ()=default
- [~EphemerisItem](#) () override=default
- [EphemerisItem](#) (const [EphemerisItem](#) &)=delete
- [EphemerisItem](#) & operator= (const [EphemerisItem](#) &)=delete
- virtual void [set\\_name](#) (const std::string &new\_name)  
*Name an ephemeris item.*
- virtual void [set\\_name](#) (const std::string &pname, const std::string &fname)  
*Name an ephemeris item.*
- std::string [get\\_name](#) () const  
*Return the name.*
- virtual void [set\\_timestamp](#) (double time)  
*Set the update time of this item.*
- double [timestamp](#) () const  
*Return the update time of this item.*
- virtual void [set\\_owner](#) ([EphemerisInterface](#) \*new\_owner)

- Set the owner of this item.*
- EphemerisInterface \* [get\\_owner](#) () const
- Return the owner of this item.*
- virtual void [set\\_manager](#) (BaseEphemeridesManager \*new\_manager)
- Set the manager of this item.*
- BaseEphemeridesManager \* [get\\_manager](#) () const
- Return the manager of this item.*
- virtual void [set\\_next](#) (EphemerisItem \*next\_item)
- Set the next item.*
- EphemerisItem \* [get\\_next](#) () const
- Get the next item.*
- virtual void [set\\_head](#) (EphemerisItem \*head\_item)
- Set the head item.*
- EphemerisItem \* [get\\_head](#) () const
- Get the head item.*
- virtual void [set\\_target\\_frame](#) (EphemerisRefFrame &frame)
- Set the target frame.*
- EphemerisRefFrame \* [get\\_target\\_frame](#) () const
- Get the target frame.*
- virtual void [enable](#) ()
- Enable an EphemerisItem object.*
- virtual void [disable](#) ()
- Disable an EphemerisItem object.*
- bool [is\\_enabled](#) () const
- Return enabled status.*
- EphemerisItem \* [get\\_enabled\\_item](#) () const
- Get the item marked as enabled, if any.*
- virtual void [activate](#) ()
- Activate a EphemerisItem object.*
- virtual void [deactivate](#) ()
- Deactivate a EphemerisItem object.*
- bool [is\\_active](#) () const
- Return activity status.*
- bool [is\\_activatable](#) () const
- Is the item activatable?*
- void [validate\\_name](#) (const char \*file, unsigned int line, const std::string &new\_value, const std::string &old\_value, const std::string &variable\_name)
- Name an ephemeris item.*
- virtual TargetAspect [updates\\_what](#) () const =0
- Identifies which part of the target frame does the object updates.*
- virtual std::string [default\\_suffix](#) () const =0
- The default suffix for the item.*
- virtual void [disconnect\\_from\\_tree](#) ()=0
- Disconnect the item from the reference frame tree.*

## Protected Member Functions

- virtual void [set\\_name\\_internal](#) (const std::string &new\_name)
- Name an ephemeris item.*

## Protected Attributes

- `std::string name`  
*The name of the item.*
- `EphemerisInterface * owner {}`  
*The ephemeris model that owns this object.*
- `BaseEphemeridesManager * manager {}`  
*The ephemeris manager that manages this object.*
- `EphemerisRefFrame * target_frame {}`  
*The reference frame whose non-constant state is set by this object.*
- `EphemerisItem * head {}`  
*The first ephemeris item with the same name as this item.*
- `EphemerisItem * next {}`  
*The next ephemeris item with the same name as this item.*
- `double update_time {}`  
*Time of last update, dynamic time seconds.*
- `bool enabled {}`  
*Is the item enabled?*
- `bool active {}`  
*Is the item active?*

## Friends

- class `InputProcessor`
- void `init_attrjeod__EphemerisItem ()`

### 8.19.1 Detailed Description

The `EphemerisItem` class is the base class for representing an item that is modeled in an ephemeris model.

Ephemeris items form the bridge between the reference frame model and the ephemeris models. An `EphemerisItem`

- Has a name, which is not necessarily unique. Ephemeris items with the same name are linked to one another to form a linked list.
- Has a target reference frame. This is the ephemeris reference frame which has the same name as the ephemeris item.
- Can be enabled or disabled. At most one item of a set of commonly-named items can be enabled, and only if a correspondingly-named ephemeris reference frame exists. Ownership of the correspondingly-named ephemeris reference frame transfers to the enabled ephemeris item. When an ephemeris item is disabled, the ephemeris model that owns the ephemeris item should not operate on the correspondingly-named reference frame.
- Can be active or inactive. Disabled items must always be inactive. The activity level of the enabled item for a set of commonly-named items is automatically maintained to be the same as that of the target frame.

The ephemeris model that owns an active ephemeris item is responsible for ensuring that the correspondingly-named ephemeris reference frame is a part of the active reference frame tree and for updating that reference frame's state.

Definition at line 104 of file `ephem_item.hh`.

## 8.19.2 Member Enumeration Documentation

### 8.19.2.1 TargetAspect

```
enum jeod::EphemerisItem::TargetAspect
```

Defines the aspect of the target frame that will be modified by the [EphemerisItem](#) object.

Enumerator

Translation	
Rotation	

Definition at line 113 of file ephemeris\_item.hh.

## 8.19.3 Constructor & Destructor Documentation

### 8.19.3.1 EphemerisItem() [1/2]

```
jeod::EphemerisItem::EphemerisItem ( ) [default]
```

### 8.19.3.2 ~EphemerisItem()

```
jeod::EphemerisItem::~~EphemerisItem ( ) [override], [default]
```

### 8.19.3.3 EphemerisItem() [2/2]

```
jeod::EphemerisItem::EphemerisItem (
    const EphemerisItem & ) [delete]
```

## 8.19.4 Member Function Documentation

#### 8.19.4.1 activate()

```
void jeod::EphemerisItem::activate ( ) [virtual]
```

Activate a [EphemerisItem](#) object.

Definition at line 297 of file `ephem_item.cc`.

References `active`, `jeod::EphemeridesMessages::invalid_item`, `is_activatable()`, and `name`.

Referenced by `jeod::De4xxEphemeris::activate_em_nodes()`, `jeod::EphemerisOrientation::note_frame_status_change()`, `jeod::EphemerisPoint::note_frame_status_change()`, and `set_target_frame()`.

#### 8.19.4.2 deactivate()

```
void jeod::EphemerisItem::deactivate ( ) [inline], [virtual]
```

Deactivate a [EphemerisItem](#) object.

Definition at line 111 of file `ephem_item_inline.hh`.

References `active`.

Referenced by `jeod::EphemerisOrientation::note_frame_status_change()`, and `jeod::EphemerisPoint::note_frame_status_change()`.

#### 8.19.4.3 default\_suffix()

```
virtual std::string jeod::EphemerisItem::default_suffix ( ) const [pure virtual]
```

The default suffix for the item.

Implemented in [jeod::EphemerisOrientation](#), and [jeod::EphemerisPoint](#).

Referenced by `set_name()`.

#### 8.19.4.4 disable()

```
void jeod::EphemerisItem::disable ( ) [inline], [virtual]
```

Disable an [EphemerisItem](#) object.

Definition at line 269 of file `ephem_item.cc`.

References `active`, `enabled`, `jeod::BaseEphemeridesManager::ephem_note_tree_status_change()`, `manager`, and `target_frame`.

Referenced by `jeod::EphemeridesManager::add_ephem_item()`, `enable()`, `jeod::EmptySpaceEphemeris::ephem_initialize()`, `jeod::SinglePlanetEphemeris::ephem_initialize()`, `jeod::De4xxEphemeris::initialize_items()`, and `jeod::PropagatedPlanet::set_mode()`.



#### 8.19.4.5 disconnect\_from\_tree()

```
virtual void jeod::EphemerisItem::disconnect_from_tree ( ) [pure virtual]
```

Disconnect the item from the reference frame tree.

Implemented in [jeod::EphemerisOrientation](#), and [jeod::EphemerisPoint](#).

Referenced by [jeod::EphemeridesManager::activate\\_ephemerides\(\)](#).

#### 8.19.4.6 enable()

```
void jeod::EphemerisItem::enable ( ) [virtual]
```

Enable an [EphemerisItem](#) object.

Reimplemented in [jeod::EphemerisOrientation](#).

Definition at line 231 of file `ephem_item.cc`.

References [active](#), [disable\(\)](#), [enabled](#), [jeod::BaseEphemeridesManager::ephem\\_note\\_tree\\_status\\_change\(\)](#), [get\\_enabled\\_item\(\)](#), [manager](#), and [target\\_frame](#).

Referenced by [jeod::De4xxEphemeris::activate\\_em\\_nodes\(\)](#), [jeod::De4xxEphemeris::De4xxEphemeris\(\)](#), [jeod::EmptySpaceEphemeris::EmptySpaceEphemeris\(\)](#), [jeod::EphemerisOrientation::enable\(\)](#), [jeod::PropagatedPlanet::set\\_mode\(\)](#), and [jeod::SinglePlanetEphemeris::SinglePlanetEphemeris\(\)](#).

#### 8.19.4.7 get\_enabled\_item()

```
EphemerisItem * jeod::EphemerisItem::get_enabled_item ( ) const [inline]
```

Get the item marked as enabled, if any.

##### Returns

Enabled item

Definition at line 210 of file `ephem_item_inline.hh`.

References [enabled](#), [head](#), and [next](#).

Referenced by [jeod::De4xxEphemeris::activate\\_nodes\(\)](#), [jeod::EphemeridesManager::add\\_ephem\\_item\(\)](#), [jeod::EphemerisOrientation::enable\(\)](#), [enable\(\)](#), and [set\\_target\\_frame\(\)](#).

#### 8.19.4.8 `get_head()`

```
EphemerisItem * jeod::EphemerisItem::get_head ( ) const [inline]
```

Get the head item.

##### Returns

Root item

Definition at line 174 of file `ephem_item_inline.hh`.

References `head`.

#### 8.19.4.9 `get_manager()`

```
BaseEphemeridesManager * jeod::EphemerisItem::get_manager ( ) const [inline]
```

Return the manager of this item.

##### Returns

Object manager

Definition at line 156 of file `ephem_item_inline.hh`.

References `manager`.

#### 8.19.4.10 `get_name()`

```
std::string jeod::EphemerisItem::get_name ( ) const [inline]
```

Return the name.

##### Returns

Void

Definition at line 76 of file `ephem_item_inline.hh`.

References `name`.

Referenced by `jeod::EphemeridesManager::add_ephem_item()`, and `jeod::De4xxEphemeris::De4xxEphemeris()`.

#### 8.19.4.11 get\_next()

```
EphemerisItem * jeod::EphemerisItem::get_next ( ) const [inline]
```

Get the next item.

##### Returns

Next item

Definition at line 192 of file ephemeris\_item\_inline.hh.

References next.

Referenced by jeod::EphemeridesManager::add\_ephem\_item().

#### 8.19.4.12 get\_owner()

```
EphemerisInterface * jeod::EphemerisItem::get_owner ( ) const [inline]
```

Return the owner of this item.

##### Returns

Frame owner

Definition at line 138 of file ephemeris\_item\_inline.hh.

References owner.

Referenced by jeod::EphemeridesManager::add\_ephem\_item().

#### 8.19.4.13 get\_target\_frame()

```
EphemerisRefFrame * jeod::EphemerisItem::get_target_frame ( ) const [inline]
```

Get the target frame.

##### Returns

Target frame

Definition at line 201 of file ephemeris\_item\_inline.hh.

References target\_frame.

Referenced by jeod::SinglePlanetEphemeris::ephemeris\_build\_tree(), jeod::EmptySpaceEphemeris::ephemeris\_initialize(), jeod::De4xxEphemeris::ephemeris\_initialize(), jeod::SinglePlanetEphemeris::ephemeris\_initialize(), and jeod::PropagatedPlanet::ephemeris\_initialize().

#### 8.19.4.14 is\_activatable()

```
bool jeod::EphemerisItem::is_activatable ( ) const
```

Is the item activatable?

##### Returns

True if item can be activated.

Definition at line 317 of file ephemeris\_item.cc.

References active, enabled, head, and next.

Referenced by activate().

#### 8.19.4.15 is\_active()

```
bool jeod::EphemerisItem::is_active ( ) const [inline]
```

Return activity status.

##### Returns

Is item active?

Definition at line 120 of file ephemeris\_item\_inline.hh.

References active.

Referenced by jeod::De4xxEphemeris::activate\_nodes().

#### 8.19.4.16 is\_enabled()

```
bool jeod::EphemerisItem::is_enabled ( ) const [inline]
```

Return enabled status.

##### Returns

Is item enabled?

Definition at line 103 of file ephemeris\_item\_inline.hh.

References enabled.

Referenced by jeod::EphemeridesManager::add\_ephem\_item().

#### 8.19.4.17 operator=()

```
EphemerisItem& jeod::EphemerisItem::operator= (
    const EphemerisItem & ) [delete]
```

#### 8.19.4.18 set\_head()

```
void jeod::EphemerisItem::set_head (
    EphemerisItem * head_item ) [inline], [virtual]
```

Set the head item.

## Parameters

in, out	<i>head_item</i>	Root item
---------	------------------	-----------

Definition at line 165 of file `ephem_item_inline.hh`.

References `head`.

Referenced by `jeod::EphemeridesManager::add_ephem_item()`.

8.19.4.19 `set_manager()`

```
void jeod::EphemerisItem::set_manager (
    BaseEphemeridesManager * new_manager ) [inline], [virtual]
```

Set the manager of this item.

## Parameters

in	<i>new_manager</i>	New owner
----	--------------------	-----------

Definition at line 147 of file `ephem_item_inline.hh`.

References `manager`.

Referenced by `jeod::EphemeridesManager::add_ephem_item()`.

8.19.4.20 `set_name()` [1/2]

```
void jeod::EphemerisItem::set_name (
    const std::string & new_name ) [virtual]
```

Name an ephemeris item.

## Parameters

in	<i>new_name</i>	New name
----	-----------------	----------

Definition at line 107 of file `ephem_item.cc`.

References `default_suffix()`, `jeod::EphemeridesMessages::invalid_name`, `name`, `set_name_internal()`, and `validate_name()`.

Referenced by `jeod::De4xxEphemeris::De4xxEphemeris()`, `jeod::PropagatedPlanet::initialize_model()`, `jeod::EmptySpaceEphemeris::set_name()`, and `jeod::SinglePlanetEphemeris::set_name()`.

#### 8.19.4.21 `set_name()` [2/2]

```
void jeod::EphemerisItem::set_name (
    const std::string & pname,
    const std::string & fname ) [virtual]
```

Name an ephemeris item.

##### Parameters

in	<i>pname</i>	Planet name
in	<i>fname</i>	Frame name

Definition at line 93 of file `ephem_item.cc`.

References `name`, `set_name_internal()`, and `validate_name()`.

#### 8.19.4.22 `set_name_internal()`

```
void jeod::EphemerisItem::set_name_internal (
    const std::string & new_name ) [protected], [virtual]
```

Name an ephemeris item.

##### Parameters

in	<i>new_name</i>	New name
----	-----------------	----------

Definition at line 139 of file `ephem_item.cc`.

References `name`.

Referenced by `set_name()`.

#### 8.19.4.23 `set_next()`

```
void jeod::EphemerisItem::set_next (
    EphemerisItem * next_item ) [inline], [virtual]
```

Set the next item.

##### Parameters

in, out	<i>next_item</i>	Next item
---------	------------------	-----------

Definition at line 183 of file `ephem_item_inline.hh`.

References next.

Referenced by jeod::EphemeridesManager::add\_ephem\_item().

#### 8.19.4.24 set\_owner()

```
void jeod::EphemerisItem::set_owner (
    EphemerisInterface * new_owner ) [inline], [virtual]
```

Set the owner of this item.

##### Parameters

in	<i>new_owner</i>	New owner
----	------------------	-----------

Definition at line 129 of file ephemeris\_item\_inline.hh.

References owner.

Referenced by jeod::De4xxEphemeris::De4xxEphemeris(), jeod::EmptySpaceEphemeris::EmptySpaceEphemeris(), jeod::PropagatedPlanet::PropagatedPlanet(), and jeod::SinglePlanetEphemeris::SinglePlanetEphemeris().

#### 8.19.4.25 set\_target\_frame()

```
void jeod::EphemerisItem::set_target_frame (
    EphemerisRefFrame & frame ) [virtual]
```

Set the target frame.

All ephemeris items that share a common name must point to the same target frame.

##### Parameters

in	<i>frame</i>	Target frame
----	--------------	--------------

Definition at line 151 of file ephemeris\_item.cc.

References activate(), get\_enabled\_item(), head, jeod::EphemeridesMessages::invalid\_item, jeod::BaseEphemeridesManager::is\_integ\_frame(), manager, name, next, set\_target\_frame(), target\_frame, Translation, and updates\_what().

Referenced by jeod::EphemeridesManager::add\_ephem\_item(), set\_target\_frame(), and jeod::EphemeridesManager::set\_target\_frame().

**8.19.4.26 set\_timestamp()**

```
void jeod::EphemerisItem::set_timestamp (
    double time ) [inline], [virtual]
```

Set the update time of this item.

**Parameters**

in	<i>time</i>	Time Units: s
----	-------------	------------------

Definition at line 85 of file `ephem_item_inline.hh`.

References `update_time`.

**8.19.4.27 timestamp()**

```
double jeod::EphemerisItem::timestamp ( ) const [inline]
```

Return the update time of this item.

**Returns**

Time of last update  
Units: s

Definition at line 94 of file `ephem_item_inline.hh`.

References `update_time`.

**8.19.4.28 updates\_what()**

```
virtual TargetAspect jeod::EphemerisItem::updates_what ( ) const [pure virtual]
```

Identifies which part of the target frame does the object updates.

Implemented in [jeod::EphemerisOrientation](#), and [jeod::EphemerisPoint](#).

Referenced by `jeod::EphemeridesManager::add_ephem_item()`, and `set_target_frame()`.

**8.19.4.29 validate\_name()**

```
void jeod::EphemerisItem::validate_name (
    const char * file,
    unsigned int line,
    const std::string & new_value,
    const std::string & old_value,
    const std::string & variable_name )
```

Name an ephemeris item.



## Parameters

in	<i>file</i>	Usually <b>FILE</b>
in	<i>line</i>	Usually <b>LINE</b>
in	<i>new_value</i>	Value to check
in	<i>old_value</i>	Current value
in	<i>variable_name</i>	Variable name

Definition at line 66 of file ephemeris\_item.cc.

References jeod::EphemeridesMessages::invalid\_name, and manager.

Referenced by set\_name().

## 8.19.5 Friends And Related Function Documentation

### 8.19.5.1 init\_attrjeod\_\_EphemerisItem

```
void init_attrjeod__EphemerisItem ( ) [friend]
```

### 8.19.5.2 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 106 of file ephemeris\_item.hh.

## 8.19.6 Field Documentation

### 8.19.6.1 active

```
bool jeod::EphemerisItem::active {} [protected]
```

Is the item active?

- An item can be activated only if it is enabled. The enable and activate methods assure that this is the case.
- Activity is determined by the activity of the target frame, which is in turn determined by the reference frame subscription model.trick\_units(-)

Definition at line 263 of file ephemeris\_item.hh.

Referenced by activate(), deactivate(), disable(), jeod::EphemerisPoint::disconnect\_from\_tree(), enable(), is\_↔activatable(), and is\_active().

### 8.19.6.2 enabled

```
bool jeod::EphemerisItem::enabled {} [protected]
```

Is the item enabled?

- An item can be enabled only if the data associated with the item such as the translational state of a planet exist somewhere in the simulation.
- Only one of a set of ephemeris items that share the same name can be enabled. The enable method ensures that this is the case.
- Exactly one of a set of ephemeris items that share same name should be enabled if some other simulation agent depends on the data associated with an ephemeris item. Ensuring that this is the case is the responsibility of the ephemeris models and the users of those models.

Definition at line 254 of file ephem\_item.hh.

Referenced by `disable()`, `jeod::EphemerisOrientation::enable()`, `enable()`, `get_enabled_item()`, `is_activatable()`, `is_enabled()`, `jeod::PropagatedEphemerisPlanet::update()`, and `jeod::PropagatedEphemerisOrientation::update()`.

### 8.19.6.3 head

```
EphemerisItem* jeod::EphemerisItem::head {} [protected]
```

The first ephemeris item with the same name as this item.

`trick_units(-)`

Definition at line 231 of file ephem\_item.hh.

Referenced by `get_enabled_item()`, `get_head()`, `is_activatable()`, `set_head()`, and `set_target_frame()`.

### 8.19.6.4 manager

```
BaseEphemeridesManager* jeod::EphemerisItem::manager {} [protected]
```

The ephemeris manager that manages this object.

`trick_units(-)`

Definition at line 221 of file ephem\_item.hh.

Referenced by `disable()`, `enable()`, `get_manager()`, `set_manager()`, `set_target_frame()`, and `validate_name()`.

## 8.19.6.5 name

```
std::string jeod::EphemerisItem::name [protected]
```

The name of the item.

trick\_units(—)

Definition at line 211 of file ephemeris\_item.hh.

Referenced by activate(), get\_name(), set\_name(), set\_name\_internal(), and set\_target\_frame().

## 8.19.6.6 next

```
EphemerisItem* jeod::EphemerisItem::next {} [protected]
```

The next ephemeris item with the same name as this item.

trick\_units(—)

Definition at line 236 of file ephemeris\_item.hh.

Referenced by get\_enabled\_item(), get\_next(), is\_activatable(), set\_next(), and set\_target\_frame().

## 8.19.6.7 owner

```
EphemerisInterface* jeod::EphemerisItem::owner {} [protected]
```

The ephemeris model that owns this object.

trick\_units(—)

Definition at line 216 of file ephemeris\_item.hh.

Referenced by get\_owner(), and set\_owner().

## 8.19.6.8 target\_frame

```
EphemerisRefFrame* jeod::EphemerisItem::target_frame {} [protected]
```

The reference frame whose non-constant state is set by this object.

trick\_units(—)

Definition at line 226 of file ephemeris\_item.hh.

Referenced by disable(), jeod::EphemerisPoint::disconnect\_from\_tree(), enable(), get\_target\_frame(), jeod::EphemerisPoint::initialize\_state(), jeod::EphemerisOrientation::note\_frame\_status\_change(), jeod::EphemerisPoint::note\_frame\_status\_change(), jeod::EphemerisZXZOrientation::propagate(), set\_target\_frame(), jeod::EphemerisPoint::update(), jeod::EphemerisZXZOrientation::update(), jeod::PropagatedEphemerisPlanet::update(), jeod::PropagatedEphemerisOrientation::update(), and jeod::EphemerisPoint::update\_scaled().

### 8.19.6.9 update\_time

```
double jeod::EphemerisItem::update_time {} [protected]
```

Time of last update, dynamic time seconds.

trick\_units(s)

Definition at line 241 of file ephemeris.hh.

Referenced by `jeod::EphemerisZXZOrientation::propagate()`, `jeod::EphemerisPoint::update()`, `jeod::EphemerisZXZOrientation::update()`, `jeod::PropagatedEphemerisPlanet::update()`, `jeod::PropagatedEphemerisOrientation::update()`, and `jeod::EphemerisPoint::update_scaled()`.

The documentation for this class was generated from the following files:

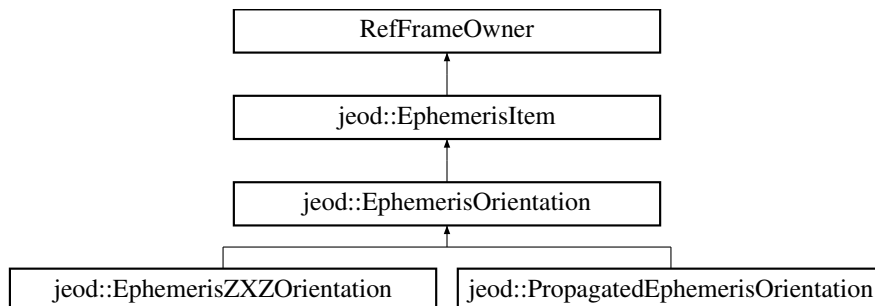
- [ephemeris.hh](#)
- [ephemeris\\_inline.hh](#)
- [ephemeris.cc](#)

## 8.20 jeod::EphemerisOrientation Class Reference

An [EphemerisOrientation](#) object updates the rotational state of an ephemeris reference frame.

```
#include <ephemeris_orient.hh>
```

Inheritance diagram for `jeod::EphemerisOrientation`:



### Public Member Functions

- [EphemerisOrientation](#) ()=default
- [~EphemerisOrientation](#) () override=default
- [EphemerisOrientation](#) (const [EphemerisOrientation](#) &)=delete
- [EphemerisOrientation](#) & operator= (const [EphemerisOrientation](#) &)=delete
- [TargetAspect updates\\_what](#) () const override
 

*Specify the aspect of the target frame updated by the object.*
- void [enable](#) () override
 

*Enable a [EphemerisItem](#) object.*
- void [note\\_frame\\_status\\_change](#) (RefFrame \*frame) override
 

*Null implementation.*
- std::string [default\\_suffix](#) () const override
 

*Return the default suffix for this item class, i.e., "pfix".*
- void [disconnect\\_from\\_tree](#) () override
 

*Disconnect the item from the tree; this is a no-op for an [EphemerisOrientation](#).*

## Protected Attributes

- bool [subscribed\\_to\\_inertial](#) {}

*A subscription to the planet's inertial frame is issued whenever the planet's planet-fixed frame is active to ensure that the planet-fixed frame is a part of the ref frame tree.*

## Friends

- class [InputProcessor](#)
- void [init\\_attrjeod\\_\\_EphemerisOrientation](#) ()

## Additional Inherited Members

### 8.20.1 Detailed Description

An [EphemerisOrientation](#) object updates the rotational state of an ephemeris reference frame.

Definition at line 86 of file `ephem_orient.hh`.

### 8.20.2 Constructor & Destructor Documentation

#### 8.20.2.1 EphemerisOrientation() [1/2]

```
jeod::EphemerisOrientation::EphemerisOrientation ( ) [default]
```

#### 8.20.2.2 ~EphemerisOrientation()

```
jeod::EphemerisOrientation::~~EphemerisOrientation ( ) [override], [default]
```

#### 8.20.2.3 EphemerisOrientation() [2/2]

```
jeod::EphemerisOrientation::EphemerisOrientation (
    const EphemerisOrientation & ) [delete]
```

### 8.20.3 Member Function Documentation

### 8.20.3.1 default\_suffix()

```
std::string jeod::EphemerisOrientation::default_suffix ( ) const [override], [virtual]
```

Return the default suffix for this item class, i.e., "pfix".

#### Returns

Default suffix

Implements [jeod::EphemerisItem](#).

Definition at line 137 of file `ephem_orient.cc`.

### 8.20.3.2 disconnect\_from\_tree()

```
void jeod::EphemerisOrientation::disconnect_from_tree ( ) [override], [virtual]
```

Disconnect the item from the tree; this is a no-op for an [EphemerisOrientation](#).

Implements [jeod::EphemerisItem](#).

Definition at line 146 of file `ephem_orient.cc`.

### 8.20.3.3 enable()

```
void jeod::EphemerisOrientation::enable ( ) [override], [virtual]
```

Enable a [EphemerisItem](#) object.

Reimplemented from [jeod::EphemerisItem](#).

Definition at line 68 of file `ephem_orient.cc`.

References [jeod::EphemerisItem::enable\(\)](#), [jeod::EphemerisItem::enabled](#), [jeod::EphemerisItem::get\\_enabled\\_↔item\(\)](#), and [subscribed\\_to\\_inertial](#).

Referenced by [jeod::De4xxEphemeris::De4xxEphemeris\(\)](#), and [jeod::PropagatedPlanet::set\\_mode\(\)](#).

### 8.20.3.4 note\_frame\_status\_change()

```
void jeod::EphemerisOrientation::note_frame_status_change (
    RefFrame * frame ) [override]
```

Null implementation.

## Parameters

in	<i>frame</i>	Frame whose status has changed
----	--------------	--------------------------------

Definition at line 92 of file ephem\_orient.cc.

References [jeod::EphemerisItem::activate\(\)](#), [jeod::EphemerisItem::deactivate\(\)](#), [jeod::EphemeridesMessages::internal\\_error](#), [subscribed\\_to\\_inertial](#), and [jeod::EphemerisItem::target\\_frame](#).

## 8.20.3.5 operator=()

```
EphemerisOrientation& jeod::EphemerisOrientation::operator= (
    const EphemerisOrientation & ) [delete]
```

## 8.20.3.6 updates\_what()

```
EphemerisItem::TargetAspect jeod::EphemerisOrientation::updates_what ( ) const [override],
[virtual]
```

Specify the aspect of the target frame updated by the object.

[EphemerisOrientation](#) objects update the rotational state.

## Returns

Target of object

Implements [jeod::EphemerisItem](#).

Definition at line 60 of file ephem\_orient.cc.

References [jeod::EphemerisItem::Rotation](#).

## 8.20.4 Friends And Related Function Documentation

## 8.20.4.1 init\_attrjeod\_\_EphemerisOrientation

```
void init_attrjeod__EphemerisOrientation ( ) [friend]
```

#### 8.20.4.2 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 88 of file ephemeris\_orient.hh.

### 8.20.5 Field Documentation

#### 8.20.5.1 subscribed\_to\_inertial

```
bool jeod::EphemerisOrientation::subscribed_to_inertial {} [protected]
```

A subscription to the planet's inertial frame is issued whenever the planet's planet-fixed frame is active to ensure that the the planet-fixed frame is a part of the ref frame tree.

This flag is set when such a subscription is made. `trick_units(-)`

Definition at line 119 of file ephemeris\_orient.hh.

Referenced by `enable()`, and `note_frame_status_change()`.

The documentation for this class was generated from the following files:

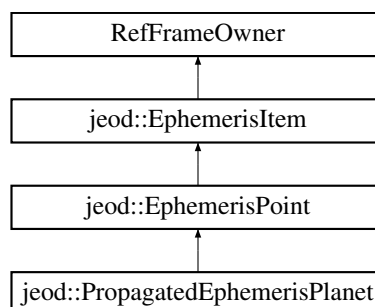
- [ephemeris\\_orient.hh](#)
- [ephemeris\\_orient.cc](#)

## 8.21 jeod::EphemerisPoint Class Reference

An [EphemerisPoint](#) object updates the translational state of an ephemeris reference frame.

```
#include <ephemeris_point.hh>
```

Inheritance diagram for jeod::EphemerisPoint:





## Public Member Functions

- [EphemerisPoint](#) ()=default
- [~EphemerisPoint](#) () override=default
- [EphemerisPoint](#) (const [EphemerisPoint](#) &)=delete
- [EphemerisPoint](#) & [operator=](#) (const [EphemerisPoint](#) &)=delete
- [TargetAspect](#) [updates\\_what](#) () const override
 

*Specify the aspect of the target frame updated by the object.*
- `std::string` [default\\_suffix](#) () const override
 

*Return the default suffix for this item class, i.e., "inertial".*
- void [disconnect\\_from\\_tree](#) () override
 

*Disconnect the associated inertial frame from the tree.*
- void [note\\_frame\\_status\\_change](#) (RefFrame \*frame) override
 

*Set active status to correspond with that of the inertial frame.*
- virtual void [initialize\\_state](#) ()
 

*Zero-out the inertial frame's translational state.*
- virtual void [update](#) (const double \*pos, const double \*vel, double time)
 

*Update the inertial frame's translational state.*
- virtual void [update\\_scaled](#) (const double \*pos, const double \*vel, double scale, double time)
 

*Update the inertial frame's translational state.*

## Friends

- class [InputProcessor](#)
- void [init\\_attrjeod\\_\\_EphemerisPoint](#) ()

## Additional Inherited Members

### 8.21.1 Detailed Description

An [EphemerisPoint](#) object updates the translational state of an ephemeris reference frame.

Definition at line 84 of file `ephem_point.hh`.

### 8.21.2 Constructor & Destructor Documentation

#### 8.21.2.1 [EphemerisPoint\(\)](#) [1/2]

```
jeod::EphemerisPoint::EphemerisPoint ( ) [default]
```

#### 8.21.2.2 [~EphemerisPoint\(\)](#)

```
jeod::EphemerisPoint::~~EphemerisPoint ( ) [override], [default]
```

### 8.21.2.3 EphemerisPoint() [2/2]

```
jeod::EphemerisPoint::EphemerisPoint (
    const EphemerisPoint & ) [delete]
```

## 8.21.3 Member Function Documentation

### 8.21.3.1 default\_suffix()

```
std::string jeod::EphemerisPoint::default_suffix ( ) const [override], [virtual]
```

Return the default suffix for this item class, i.e., "inertial".

#### Returns

Default suffix

Implements [jeod::EphemerisItem](#).

Definition at line 87 of file `ephem_point.cc`.

### 8.21.3.2 disconnect\_from\_tree()

```
void jeod::EphemerisPoint::disconnect_from_tree ( ) [override], [virtual]
```

Disconnect the associated inertial frame from the tree.

Implements [jeod::EphemerisItem](#).

Definition at line 95 of file `ephem_point.cc`.

References [jeod::EphemerisItem::active](#), and [jeod::EphemerisItem::target\\_frame](#).

### 8.21.3.3 initialize\_state()

```
void jeod::EphemerisPoint::initialize_state ( ) [inline], [virtual]
```

Zero-out the inertial frame's translational state.

Definition at line 108 of file `ephem_point.cc`.

References [jeod::EphemerisItem::target\\_frame](#).

### 8.21.3.4 note\_frame\_status\_change()

```
void jeod::EphemerisPoint::note_frame_status_change (
    RefFrame * frame ) [override]
```

Set active status to correspond with that of the inertial frame.

## Parameters

in	<i>frame</i>	Frame whose status has changed
----	--------------	--------------------------------

Definition at line 59 of file ephemeris\_point.cc.

References `jeod::EphemerisItem::activate()`, `jeod::EphemerisItem::deactivate()`, `jeod::EphemeridesMessages::internal_error`, and `jeod::EphemerisItem::target_frame`.

## 8.21.3.5 operator=()

```
EphemerisPoint& jeod::EphemerisPoint::operator= (
    const EphemerisPoint & ) [delete]
```

## 8.21.3.6 update()

```
void jeod::EphemerisPoint::update (
    const double * position,
    const double * velocity,
    double time ) [virtual]
```

Update the inertial frame's translational state.

## Parameters

in	<i>position</i>	Position wrt parent Units: M
in	<i>velocity</i>	Velocity wrt parent Units: M/s
in	<i>time</i>	Timestamp Units: s

Definition at line 122 of file ephemeris\_point.cc.

References `jeod::EphemerisItem::target_frame`, and `jeod::EphemerisItem::update_time`.

Referenced by `jeod::De4xxEphemeris::ephemeris_update()`.

## 8.21.3.7 update\_scaled()

```
void jeod::EphemerisPoint::update_scaled (
    const double * position,
    const double * velocity,
    double scale,
    double time ) [virtual]
```

Update the inertial frame's translational state.

**Parameters**

in	<i>position</i>	Position wrt parent Units: M
in	<i>velocity</i>	Velocity wrt parent Units: M/s
in	<i>scale</i>	Scale factor
in	<i>time</i>	Timestamp Units: s

Definition at line 139 of file `ephem_point.cc`.

References `jeod::EphemerisItem::target_frame`, and `jeod::EphemerisItem::update_time`.

Referenced by `jeod::De4xxEphemeris::ephem_update()`.

**8.21.3.8 updates\_what()**

```
EphemerisItem::TargetAspect jeod::EphemerisPoint::updates_what ( ) const [override], [virtual]
```

Specify the aspect of the target frame updated by the object.

[EphemerisPoint](#) objects update the translational state.

**Returns**

Target of object

Implements [jeod::EphemerisItem](#).

Definition at line 154 of file `ephem_point.cc`.

References `jeod::EphemerisItem::Translation`.

**8.21.4 Friends And Related Function Documentation****8.21.4.1 init\_attrjeod\_\_EphemerisPoint**

```
void init_attrjeod__EphemerisPoint ( ) [friend]
```

## 8.21.4.2 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 86 of file `ephem_point.hh`.

The documentation for this class was generated from the following files:

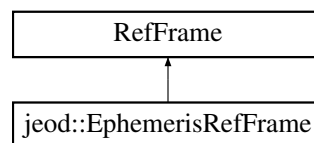
- [ephem\\_point.hh](#)
- [ephem\\_point.cc](#)

## 8.22 jeod::EphemerisRefFrame Class Reference

An [EphemerisRefFrame](#) is a [RefFrame](#) whose state is set by an ephemeris model.

```
#include <ephem_ref_frame.hh>
```

Inheritance diagram for `jeod::EphemerisRefFrame`:



## Public Member Functions

- [EphemerisRefFrame](#) ()=default
- [~EphemerisRefFrame](#) () override=default
- [EphemerisRefFrame](#) (const [EphemerisRefFrame](#) &)=delete
- [EphemerisRefFrame](#) & operator= (const [EphemerisRefFrame](#) &)=delete
- virtual void [set\\_ephem\\_manager](#) ([BaseEphemeridesManager](#) \*manager)  
Set the [EphemerisRefFrame](#)'s owner.

## Protected Member Functions

- void [set\\_active\\_status](#) (bool new\_status) override  
Augment [RefFrame::set\\_active\\_status](#) by notifying the ephemerides manager that the tree might need to be rebuilt.

## Protected Attributes

- [BaseEphemeridesManager](#) \* [ephem\\_manager](#) {}  
The ephemerides manager to which notifications of changes in ephemeris reference frame activity status are sent.

## Friends

- class [InputProcessor](#)
- void [init\\_attrjeod\\_\\_EphemerisRefFrame](#) ()

### 8.22.1 Detailed Description

An [EphemerisRefFrame](#) is a RefFrame whose state is set by an ephemeris model.

Ephemeris reference frames come in three basic flavors:

- Planet-centered inertial frames. These are non-rotating frames whose origin is the center of mass of some planet (the Sun is a planet) and whose translational motion is (for now) assumed to be due to gravitation only. The orientation with respect to inertial is the identity transformation.
- Barycenter inertial frames. These are non-rotating frames whose origin is the center of mass of two or more planets.
- Planet-fixed frames. These are rotating frames whose origin is the center of mass of some planet (see IS↔SUE) and that rotate with the planet in question. The parent is always a planet-centered inertial frame with a zero translation offset between the planet-centered inertial and planet-fixed frames.

Only planet-centered inertial and barycenter inertial frames can serve as integration frames or as the root of the reference frame tree.

Definition at line 98 of file ephemeris\_ref\_frame.hh.

### 8.22.2 Constructor & Destructor Documentation

#### 8.22.2.1 EphemerisRefFrame() [1/2]

```
jeod::EphemerisRefFrame::EphemerisRefFrame ( ) [default]
```

#### 8.22.2.2 ~EphemerisRefFrame()

```
jeod::EphemerisRefFrame::~~EphemerisRefFrame ( ) [override], [default]
```

#### 8.22.2.3 EphemerisRefFrame() [2/2]

```
jeod::EphemerisRefFrame::EphemerisRefFrame (
    const EphemerisRefFrame & ) [delete]
```

### 8.22.3 Member Function Documentation

### 8.22.3.1 operator=()

```
EphemerisRefFrame& jeod::EphemerisRefFrame::operator= (
    const EphemerisRefFrame & ) [delete]
```

### 8.22.3.2 set\_active\_status()

```
void jeod::EphemerisRefFrame::set_active_status (
    bool new_status ) [override], [protected]
```

Augment RefFrame::set\_active\_status by notifying the ephemerides manager that the tree might need to be rebuilt.

**Parameters**

in	<i>new_status</i>	Active status
----	-------------------	---------------

Definition at line 60 of file `ephem_ref_frame.cc`.

References `ephem_manager`, `jeod::BaseEphemeridesManager::ephem_note_tree_status_change()`, and `jeod::EphemeridesMessages::inconsistent_setup`.

**8.22.3.3 set\_ephem\_manager()**

```
void jeod::EphemerisRefFrame::set_ephem_manager (
    BaseEphemeridesManager * manager ) [virtual]
```

Set the [EphemerisRefFrame](#)'s owner.

**Parameters**

in, out	<i>manager</i>	Ephemeris manager
---------	----------------	-------------------

Definition at line 50 of file `ephem_ref_frame.cc`.

References `ephem_manager`.

**8.22.4 Friends And Related Function Documentation****8.22.4.1 init\_attrjeod\_\_EphemerisRefFrame**

```
void init_attrjeod__EphemerisRefFrame ( ) [friend]
```

**8.22.4.2 InputProcessor**

```
friend class InputProcessor [friend]
```

Definition at line 100 of file `ephem_ref_frame.hh`.

**8.22.5 Field Documentation**



## 8.22.5.1 ephemeris\_manager

```
BaseEphemeridesManager* jeod::EphemerisRefFrame::ephemeris_manager {} [protected]
```

The ephemerides manager to which notifications of changes in ephemeris reference frame activity status are sent.

trick\_units(-)

Definition at line 123 of file ephemeris\_ref\_frame.hh.

Referenced by set\_active\_status(), and set\_ephem\_manager().

The documentation for this class was generated from the following files:

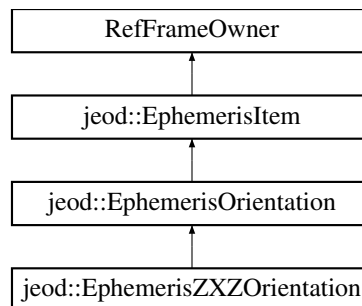
- [ephemeris\\_ref\\_frame.hh](#)
- [ephemeris\\_ref\\_frame.cc](#)

## 8.23 jeod::EphemerisZXZOrientation Class Reference

The [EphemerisZXZOrientation](#) is an [EphemerisOrientation](#) subclass that updates orientation based on an Z-X-Z Euler sequence and the time derivatives of this sequence.

```
#include <ephemeris_orient_zxz.hh>
```

Inheritance diagram for jeod::EphemerisZXZOrientation:



## Public Member Functions

- [EphemerisZXZOrientation](#) ()=default
- [~EphemerisZXZOrientation](#) () override=default
- [EphemerisZXZOrientation](#) (const [EphemerisZXZOrientation](#) &)=delete
- [EphemerisZXZOrientation](#) & operator= (const [EphemerisZXZOrientation](#) &)=delete
- const double \* [get\\_euler\\_angles](#) () const  
*Return the Euler angles.*
- void [get\\_euler\\_angles](#) (double \*angles) const  
*Return the Euler angles.*
- const double \* [get\\_euler\\_rates](#) () const  
*Return the Euler rates.*
- void [get\\_euler\\_rates](#) (double \*rates) const  
*Return the Euler angles.*
- virtual void [update](#) (const double \*angles, const double \*derivs, double time)  
*Compute a JEOD rotational state given a 3-1-3 inertial-to-planet-fixed Euler sequence and the time derivatives of the Euler angles.*
- virtual void [propagate](#) (double to\_time)  
*Propagate the orientation to the current time.*

## Protected Attributes

- double [euler\\_angle\\_313](#) [3] {}  
*Astronomical (zxz) Euler angles.*
- double [euler\\_rate\\_313](#) [3] {}  
*Time derivatives of the yz Euler angles.*

## Friends

- class [InputProcessor](#)
- void [init\\_attrjeod\\_\\_EphemerisZXZOrientation](#) ()

## Additional Inherited Members

### 8.23.1 Detailed Description

The [EphemerisZXZOrientation](#) is an [EphemerisOrientation](#) subclass that updates orientation based on an Z-X-Z Euler sequence and the time derivatives of this sequence.

Definition at line 88 of file `ephem_orient_zxz.hh`.

### 8.23.2 Constructor & Destructor Documentation

#### 8.23.2.1 EphemerisZXZOrientation() [1/2]

```
jeod::EphemerisZXZOrientation::EphemerisZXZOrientation ( ) [default]
```

#### 8.23.2.2 ~EphemerisZXZOrientation()

```
jeod::EphemerisZXZOrientation::~~EphemerisZXZOrientation ( ) [override], [default]
```

#### 8.23.2.3 EphemerisZXZOrientation() [2/2]

```
jeod::EphemerisZXZOrientation::EphemerisZXZOrientation (
    const EphemerisZXZOrientation & ) [delete]
```

### 8.23.3 Member Function Documentation

**8.23.3.1** `get_euler_angles()` [1/2]

```
const double * jeod::EphemerisZXZOrientation::get_euler_angles ( ) const
```

Return the Euler angles.

**Returns**

Euler angles

Definition at line 79 of file `ephem_orient_zxz.cc`.

References `euler_angle_313`.

**8.23.3.2** `get_euler_angles()` [2/2]

```
void jeod::EphemerisZXZOrientation::get_euler_angles (
    double * angles ) const
```

Return the Euler angles.

**Parameters**

out	<i>angles</i>	Euler angles Units: r
-----	---------------	--------------------------

Definition at line 88 of file `ephem_orient_zxz.cc`.

References `euler_angle_313`.

**8.23.3.3** `get_euler_rates()` [1/2]

```
const double * jeod::EphemerisZXZOrientation::get_euler_rates ( ) const
```

Return the Euler rates.

**Returns**

Euler rates

Definition at line 99 of file `ephem_orient_zxz.cc`.

References `euler_rate_313`.

**8.23.3.4** `get_euler_rates()` [2/2]

```
void jeod::EphemerisZXZOrientation::get_euler_rates (
    double * rates ) const
```

Return the Euler angles.

**Parameters**

out	<i>rates</i>	Euler rates Units: r/s
-----	--------------	---------------------------

Definition at line 108 of file ephemer\_orient\_zxz.cc.

References euler\_rate\_313.

**8.23.3.5 operator=()**

```
EphemerisZXZOrientation& jeod::EphemerisZXZOrientation::operator= (
    const EphemerisZXZOrientation & ) [delete]
```

**8.23.3.6 propagate()**

```
void jeod::EphemerisZXZOrientation::propagate (
    double to_time ) [virtual]
```

Propagate the orientation to the current time.

**Assumptions and Limitations**

- The orientation has been computed.
- Rotation is constant during the update interval.

**Parameters**

in	<i>to_time</i>	Target dynamic time Units: s
----	----------------	---------------------------------

Definition at line 123 of file ephemer\_orient\_zxz.cc.

References EPSILON\_TIME, jeod::EphemerisItem::target\_frame, TAYLOR\_CUTOFF, and jeod::EphemerisItem↵  
::update\_time.

Referenced by jeod::De4xxEphemeris::propagate\_lunar\_rnp().

**8.23.3.7 update()**

```
void jeod::EphemerisZXZOrientation::update (
    const double * angles,
```

```
const double * derivs,  
double time ) [virtual]
```

Compute a JEOD rotational state given a 3-1-3 inertial-to-planet-fixed Euler sequence and the time derivatives of the Euler angles.

**Parameters**

in	<i>angles</i>	zxz Euler angles Units: r
in	<i>derivs</i>	zxz Euler angle time derivatives Units: r/s
in	<i>time</i>	Update time Units: s

Definition at line 184 of file ephemeris\_orient\_zxz.cc.

References `euler_angle_313`, `euler_rate_313`, `jeod::EphemerisItem::target_frame`, and `jeod::EphemerisItem::update_time`.

Referenced by `jeod::De4xxEphemeris::ephem_update()`.

## 8.23.4 Friends And Related Function Documentation

### 8.23.4.1 `init_attrjeod__EphemerisZXZOrientation`

```
void init_attrjeod__EphemerisZXZOrientation ( ) [friend]
```

### 8.23.4.2 `InputProcessor`

```
friend class InputProcessor [friend]
```

Definition at line 90 of file ephemeris\_orient\_zxz.hh.

## 8.23.5 Field Documentation

### 8.23.5.1 `euler_angle_313`

```
double jeod::EphemerisZXZOrientation::euler_angle_313[3] {} [protected]
```

Astronomical (zxz) Euler angles.

`trick_units(rad)`

Definition at line 121 of file ephemeris\_orient\_zxz.hh.

Referenced by `get_euler_angles()`, and `update()`.

## 8.23.5.2 euler\_rate\_313

```
double jeod::EphemerisZXZOrientation::euler_rate_313[3] {} [protected]
```

Time derivatives of the zyz Euler angles.

trick\_units(rad/s)

Definition at line 126 of file ephemeris\_zxz.hh.

Referenced by get\_euler\_rates(), and update().

The documentation for this class was generated from the following files:

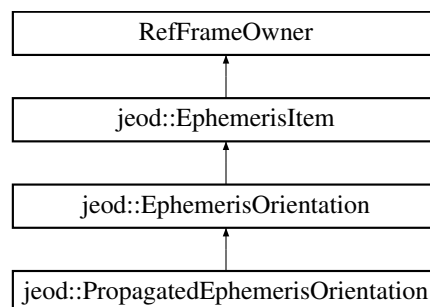
- [ephemeris\\_zxz.hh](#)
- [ephemeris\\_zxz.cc](#)

## 8.24 jeod::PropagatedEphemerisOrientation Class Reference

A [PropagatedEphemerisOrientation](#) is an [EphemerisOrientation](#) whose state is coupled with the rotational state of a DynBody reference frame.

```
#include <propagated_planet.hh>
```

Inheritance diagram for jeod::PropagatedEphemerisOrientation:



## Public Member Functions

- [PropagatedEphemerisOrientation](#) (DynBody &dyn\_body, BodyRefFrame &frame)  
*PropagatedEphemerisOrientation non-default constructor.*
- [~PropagatedEphemerisOrientation](#) () override=default
- [PropagatedEphemerisOrientation](#) (const [PropagatedEphemerisOrientation](#) &)=delete
- [PropagatedEphemerisOrientation](#) & operator= (const [PropagatedEphemerisOrientation](#) &)=delete
- virtual void [update](#) (double time)  
*Copy rotational state from/to the body reference frame.*

## Protected Attributes

- DynBody & [body](#)  
*The dynamic body whose state is tied to that of the planet.*
- BodyRefFrame & [body\\_ref\\_frame](#)  
*The body reference frame whose rotational state is coupled with that of the planet's planet-fixed frame.*

## Friends

- class [InputProcessor](#)
- void [init\\_attrjeod\\_\\_PropagatedEphemerisOrientation](#) ()

## Additional Inherited Members

### 8.24.1 Detailed Description

A [PropagatedEphemerisOrientation](#) is an [EphemerisOrientation](#) whose state is coupled with the rotational state of a DynBody reference frame.

This class is intended for use by the [PropagatedPlanet](#) class. Use outside of the [PropagatedPlanet](#) is not sanctioned.

The class acts analogously to the class [PropagatedEphemerisPlanet](#), but for rotation rather than translation. See [PropagatedEphemerisPlanet](#) for a description of the behavior of the class.

Definition at line 155 of file `propagated_planet.hh`.

### 8.24.2 Constructor & Destructor Documentation

#### 8.24.2.1 [PropagatedEphemerisOrientation](#)() [1/2]

```
jeod::PropagatedEphemerisOrientation::PropagatedEphemerisOrientation (
    DynBody & dyn_body,
    BodyRefFrame & frame )
```

[PropagatedEphemerisOrientation](#) non-default constructor.

#### Parameters

<i>in, out</i>	<i>dyn_body</i>	The DynBody that represents the planet
<i>in, out</i>	<i>frame</i>	The body reference frame

Definition at line 112 of file `propagated_planet.cc`.

#### 8.24.2.2 [~PropagatedEphemerisOrientation](#)()

```
jeod::PropagatedEphemerisOrientation::~~PropagatedEphemerisOrientation ( ) [override], [default]
```



### 8.24.2.3 PropagatedEphemerisOrientation() [2/2]

```
jeod::PropagatedEphemerisOrientation::PropagatedEphemerisOrientation (
    const PropagatedEphemerisOrientation & ) [delete]
```

## 8.24.3 Member Function Documentation

### 8.24.3.1 operator=()

```
PropagatedEphemerisOrientation& jeod::PropagatedEphemerisOrientation::operator= (
    const PropagatedEphemerisOrientation & ) [delete]
```

### 8.24.3.2 update()

```
void jeod::PropagatedEphemerisOrientation::update (
    double dyn_time ) [virtual]
```

Copy rotational state from/to the body reference frame.

#### Parameters

in	<i>dyn_time</i>	Dynamic time seconds Units: s
----	-----------------	----------------------------------

Definition at line 123 of file `propagated_planet.cc`.

References `body`, `body_ref_frame`, `jeod::EphemerisItem::enabled`, `jeod::EphemerisItem::target_frame`, and `jeod::EphemerisItem::update_time`.

Referenced by `jeod::PropagatedPlanet::ephem_update()`.

## 8.24.4 Friends And Related Function Documentation

### 8.24.4.1 init\_attrjeod\_\_PropagatedEphemerisOrientation

```
void init_attrjeod__PropagatedEphemerisOrientation ( ) [friend]
```

#### 8.24.4.2 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 157 of file propagated\_planet.hh.

### 8.24.5 Field Documentation

#### 8.24.5.1 body

```
DynBody& jeod::PropagatedEphemerisOrientation::body [protected]
```

The dynamic body whose state is tied to that of the planet.

trick\_units(—)

Definition at line 172 of file propagated\_planet.hh.

Referenced by update().

#### 8.24.5.2 body\_ref\_frame

```
BodyRefFrame& jeod::PropagatedEphemerisOrientation::body_ref_frame [protected]
```

The body reference frame whose rotational state is coupled with that of the planet's planet-fixed frame.

trick\_units(—)

Definition at line 178 of file propagated\_planet.hh.

Referenced by update().

The documentation for this class was generated from the following files:

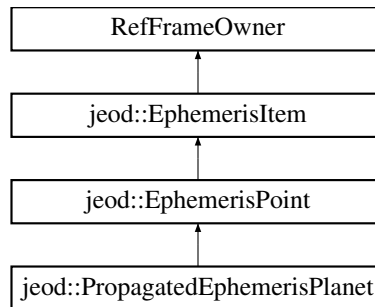
- [propagated\\_planet.hh](#)
- [propagated\\_planet.cc](#)

## 8.25 jeod::PropagatedEphemerisPlanet Class Reference

A [PropagatedEphemerisPlanet](#) is an [EphemerisPoint](#) whose state is coupled with the translational state of a Dyn↔Body reference frame.

```
#include <propagated_planet.hh>
```

Inheritance diagram for jeod::PropagatedEphemerisPlanet:



### Public Member Functions

- [PropagatedEphemerisPlanet](#) (DynBody &dyn\_body, BodyRefFrame &frame)  
*PropagatedEphemerisPlanet non-default constructor.*
- [~PropagatedEphemerisPlanet](#) () override=default
- [PropagatedEphemerisPlanet](#) (const [PropagatedEphemerisPlanet](#) &)=delete
- [PropagatedEphemerisPlanet](#) & operator= (const [PropagatedEphemerisPlanet](#) &)=delete
- virtual void [update](#) (double time)  
*Copy rotational state from/to the body reference frame.*
- virtual void [update](#) (const double \*pos, const double \*vel, double time)  
*Update the inertial frame's translational state.*

### Protected Attributes

- DynBody & [body](#)  
*The dynamic body whose state is tied to that of the planet.*
- BodyRefFrame & [body\\_ref\\_frame](#)  
*The body reference frame whose translational state is coupled with that of the planet's inertial frame.*

### Friends

- class [InputProcessor](#)
- void [init\\_attrjeod\\_\\_PropagatedEphemerisPlanet](#) ()

## Additional Inherited Members

### 8.25.1 Detailed Description

A [PropagatedEphemerisPlanet](#) is an [EphemerisPoint](#) whose state is coupled with the translational state of a DynBody reference frame.

This class is intended for use by the [PropagatedPlanet](#) class. Use outside of the [PropagatedPlanet](#) is not sanctioned.

The inherited enabled flag takes on an additional meaning in this derived class. The base class meaning of this flag is that the ephemeris item, or the ephemeris model that owns the item, is responsible for maintaining the translational state of the target frame when the item is enabled but not when the item is disabled.

For this class, when the enabled flag is set still means that the item is responsible for maintaining the translational state of the target ephemeris reference frame. The dynamic body serves as the source of this state. When the enabled flag is clear, some other model is assumed to be responsible for maintaining the target frame state. The target frame state serves as the source of the dynamic body's state when the enabled flag is clear. A [PropagatedEphemerisPlanet](#) is an [EphemerisPoint](#) whose state is coupled with the translational state of a DynBody reference frame.

This class is intended for use by the [PropagatedPlanet](#) class. Use outside of the [PropagatedPlanet](#) is not sanctioned.

The class acts analogously to the class [PropagatedEphemerisOrientation](#), but for translation rather than rotation. See [PropagatedEphemerisOrientation](#) for a description of the behavior of the class.

Definition at line 117 of file `propagated_planet.hh`.

### 8.25.2 Constructor & Destructor Documentation

#### 8.25.2.1 [PropagatedEphemerisPlanet\(\)](#) [1/2]

```
jeod::PropagatedEphemerisPlanet::PropagatedEphemerisPlanet (
    DynBody & dyn_body,
    BodyRefFrame & frame )
```

[PropagatedEphemerisPlanet](#) non-default constructor.

#### Parameters

<i>in, out</i>	<i>dyn_body</i>	The DynBody that represents the planet
<i>in, out</i>	<i>frame</i>	The body reference frame

Definition at line 155 of file `propagated_planet.cc`.

## 8.25.2.2 ~PropagatedEphemerisPlanet()

```
jeod::PropagatedEphemerisPlanet::~~PropagatedEphemerisPlanet ( ) [override], [default]
```

## 8.25.2.3 PropagatedEphemerisPlanet() [2/2]

```
jeod::PropagatedEphemerisPlanet::PropagatedEphemerisPlanet (
    const PropagatedEphemerisPlanet & ) [delete]
```

## 8.25.3 Member Function Documentation

## 8.25.3.1 operator=()

```
PropagatedEphemerisPlanet& jeod::PropagatedEphemerisPlanet::operator= (
    const PropagatedEphemerisPlanet & ) [delete]
```

## 8.25.3.2 update() [1/2]

```
void jeod::EphemerisPoint::update
```

Update the inertial frame's translational state.

## Parameters

in	<i>position</i>	Position wrt parent Units: M
in	<i>velocity</i>	Velocity wrt parent Units: M/s
in	<i>time</i>	Timestamp Units: s

Definition at line 122 of file ephemeris\_point.cc.

## 8.25.3.3 update() [2/2]

```
void jeod::PropagatedEphemerisPlanet::update (
    double dyn_time ) [virtual]
```

Copy rotational state from/to the body reference frame.

**Parameters**

in	<i>dyn_time</i>	Dynamic time seconds Units: s
----	-----------------	----------------------------------

Definition at line 80 of file propagated\_planet.cc.

References `body`, `body_ref_frame`, `jeod::EphemerisItem::enabled`, `jeod::EphemerisItem::target_frame`, and `jeod::EphemerisItem::update_time`.

Referenced by `jeod::PropagatedPlanet::ephem_update()`.

**8.25.4 Friends And Related Function Documentation****8.25.4.1 init\_attrjeod\_\_PropagatedEphemerisPlanet**

```
void init_attrjeod__PropagatedEphemerisPlanet ( ) [friend]
```

**8.25.4.2 InputProcessor**

```
friend class InputProcessor [friend]
```

Definition at line 119 of file propagated\_planet.hh.

**8.25.5 Field Documentation****8.25.5.1 body**

```
DynBody& jeod::PropagatedEphemerisPlanet::body [protected]
```

The dynamic body whose state is tied to that of the planet.

`trick_units(-)`

Definition at line 135 of file propagated\_planet.hh.

Referenced by `update()`.

## 8.25.5.2 body\_ref\_frame

```
BodyRefFrame& jeod::PropagatedEphemerisPlanet::body_ref_frame [protected]
```

The body reference frame whose translational state is coupled with that of the planet's inertial frame.

trick\_units(—)

Definition at line 141 of file propagated\_planet.hh.

Referenced by update().

The documentation for this class was generated from the following files:

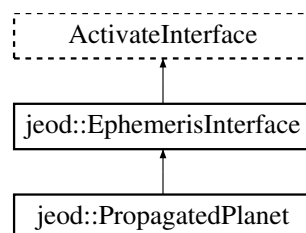
- [propagated\\_planet.hh](#)
- [propagated\\_planet.cc](#)

## 8.26 jeod::PropagatedPlanet Class Reference

The [PropagatedPlanet](#) ephemeris model provides planetary state via a DynBody object whose state is propagated using the JEOD state integration techniques.

```
#include <propagated_planet.hh>
```

Inheritance diagram for jeod::PropagatedPlanet:



## Public Types

- enum [Mode](#) { [TransFromPlanet\\_RotFromPlanet](#) = 0, [TransFromPlanet\\_RotFromBody](#) = 1, [TransFromBody\\_RotFromPlanet](#) = 2, [TransFromBody\\_RotFromBody](#) = 3 }

*Defines the modes in which an active [PropagatedPlanet](#) object operates.*

## Public Member Functions

- [PropagatedPlanet](#) ()  
*PropagatedPlanet* default constructor.
- [~PropagatedPlanet](#) () override=default
- [PropagatedPlanet](#) (const [PropagatedPlanet](#) &)=delete
- [PropagatedPlanet](#) & [operator=](#) (const [PropagatedPlanet](#) &)=delete
- void [initialize\\_model](#) (const TimeManager &time\_manager, DynManager &dyn\_manager)  
*Initialize a [PropagatedPlanet](#) model.*
- void [activate](#) () override  
*Nominally, activate the object.*
- void [deactivate](#) () override  
*Deactivate the [PropagatedPlanet](#) object.*
- double [timestamp](#) () const override  
*Return time of last update.*
- std::string [get\\_name](#) () const override  
*Return model name.*
- void [ephem\\_initialize](#) ([EphemeridesManager](#) &ephem\_manager) override  
*Mark appropriate items in the model as active.*
- void [ephem\\_activate](#) ([EphemeridesManager](#) &ephem\_manager) override  
*Activate ephemerides.*
- void [ephem\\_build\\_tree](#) ([EphemeridesManager](#) &ephem\_manager) override  
*Construct the ephemeris model portions of the reference frame tree.*
- void [ephem\\_update](#) () override  
*Update ephemerides for subscribed items.*
- void [set\\_commanded\\_mode](#) ([Mode](#) new\_mode)  
*Setter for the commanded mode.*

## Data Fields

- std::string [planet\\_name](#)  
*The name of the planet.*
- std::string [parent\\_name](#)  
*The name of the parent frame.*
- DynBody [body](#)  
*The dynamic body whose state is tied to that of the planet.*
- [Mode](#) [commanded\\_mode](#) {[TransFromPlanet](#), [RotFromPlanet](#)}  
*The mode in which the model should operate.*

## Protected Member Functions

- void [set\\_mode](#) ()  
*Change the behavior of a [PropagatedPlanet](#).*



## Protected Attributes

- bool `initialized` {}  
*Has the model been initialized?*
- Mode `mode` {TransFromPlanet\_RotFromPlanet}  
*The mode in which the model is operating.*
- std::string `ident`  
*Model name; used for reporting errors.*
- bool `active` {true}  
*Is the planet present and marked as active?*
- double `update_time` {-99e99}  
*Time of last update, dynamic time seconds.*
- BasePlanet \* `planet` {}  
*The planet tied to the body.*
- EphemerisRefFrame \* `parent_frame` {}  
*The parent of the planet.*
- DynManager \* `dyn_manager` {}  
*The dynamics manager.*
- const TimeDyn \* `time_dyn` {}  
*The source of dynamic time information.*
- PropagatedEphemerisPlanet `ephem_planet`  
*The ephemeris item that couples the translational states of the body's composite body frame and the planet's inertial frame.*
- PropagatedEphemerisOrientation `ephem_orient`  
*The ephemeris item that couples the rotational states of the body's composite body frame and the planet's planet-fixed frame.*

## Friends

- class `InputProcessor`
- void `init_attrjeod__PropagatedPlanet` ()

### 8.26.1 Detailed Description

The `PropagatedPlanet` ephemeris model provides planetary state via a `DynBody` object whose state is propagated using the JEOD state integration techniques.

Scenarios in which a simulation will use a `PropagatedPlanet` object include:

- An object such as an asteroid for which an ephemeris model is not readily available.
- An object such as a planet that is represented in some other ephemeris model but the simulation developer wants the planet to be propagated to ensure that the planet and the vehicles operating in the vicinity of the planet obey the same laws of physics.

The `PropagatedPlanet` model provides mechanisms that accommodate these scenarios. The class defines multiple modes in which a propagated planet object operates. In all modes, the model ensures consistency between the translational states of the dynamic body's composite frame and the planet's planet-centered frame and between the rotational states of the dynamic body's composite frame and the planet's planet-fixed frame.

Definition at line 199 of file `propagated_planet.hh`.

## 8.26.2 Member Enumeration Documentation

### 8.26.2.1 Mode

```
enum jeod::PropagatedPlanet::Mode
```

Defines the modes in which an active [PropagatedPlanet](#) object operates.

A [PropagatedPlanet](#) contains a BasePlanet pointer [PropagatedPlanet::planet](#) and a DynBody [PropagatedPlanet::body](#). The translational states of the planet-centered inertial frame and the body's composite\_body frame are tied to one another, as are the rotational states of the planet-fixed frame and the the body's composite\_body frame. This enum identifies which of the planet or the body is the source of translational and the the rotational parts of the state.

#### Enumerator

TransFromPlanet_RotFromPlanet	
TransFromPlanet_RotFromBody	
TransFromBody_RotFromPlanet	
TransFromBody_RotFromBody	

Definition at line 214 of file propagated\_planet.hh.

## 8.26.3 Constructor & Destructor Documentation

### 8.26.3.1 PropagatedPlanet() [1/2]

```
jeod::PropagatedPlanet::PropagatedPlanet ( )
```

[PropagatedPlanet](#) default constructor.

Definition at line 165 of file propagated\_planet.cc.

References `ephem_orient`, `ephem_planet`, and `jeod::EphemerisItem::set_owner()`.

### 8.26.3.2 ~PropagatedPlanet()

```
jeod::PropagatedPlanet::~~PropagatedPlanet ( ) [override], [default]
```

### 8.26.3.3 PropagatedPlanet() [2/2]

```
jeod::PropagatedPlanet::PropagatedPlanet (
    const PropagatedPlanet & ) [delete]
```

## 8.26.4 Member Function Documentation

### 8.26.4.1 activate()

```
void jeod::PropagatedPlanet::activate ( ) [override]
```

Nominally, activate the object.

In the case of a [PropagatedPlanet](#) object, an inactive object cannot be activated.

Definition at line 179 of file propagated\_planet.cc.

References [active](#), and [jeod::EphemeridesMessages::internal\\_error](#).

### 8.26.4.2 deactivate()

```
void jeod::PropagatedPlanet::deactivate ( ) [override]
```

Deactivate the [PropagatedPlanet](#) object.

Definition at line 193 of file propagated\_planet.cc.

References [active](#).

### 8.26.4.3 ephem\_activate()

```
void jeod::PropagatedPlanet::ephem_activate (
    EphemeridesManager & ephem_manager ) [override], [virtual]
```

Activate ephemerides.

#### Parameters

<i>in, out</i>	<i>ephem_manager</i>	Ephemerides manager
----------------	----------------------	---------------------

Implements [jeod::EphemerisInterface](#).

Definition at line 396 of file propagated\_planet.cc.

References body, mode, TransFromBody\_RotFromBody, TransFromBody\_RotFromPlanet, and TransFromPlanet↵\_RotFromBody.

#### 8.26.4.4 ephemerides\_build\_tree()

```
void jeod::PropagatedPlanet::ephemerides_build_tree (
    EphemeridesManager & ephemerides_manager ) [override], [virtual]
```

Construct the ephemeris model portions of the reference frame tree.

##### Parameters

in, out	<i>ephemerides_manager</i>	Ephemerides manager
---------	----------------------------	---------------------

Implements [jeod::EphemerisInterface](#).

Definition at line 410 of file propagated\_planet.cc.

References active, parent\_frame, and planet.

#### 8.26.4.5 ephemerides\_initialize()

```
void jeod::PropagatedPlanet::ephemerides_initialize (
    EphemeridesManager & ephemerides_manager ) [override], [virtual]
```

Mark appropriate items in the model as active.

##### Parameters

in, out	<i>ephemerides_manager</i>	Ephemerides manager
---------	----------------------------	---------------------

Implements [jeod::EphemerisInterface](#).

Definition at line 294 of file propagated\_planet.cc.

References active, ephemerides\_orient, ephemerides\_planet, jeod::EphemeridesManager::find\_base\_planet(), jeod::↵EphemerisItem::get\_target\_frame(), jeod::EphemeridesMessages::inconsistent\_setup, planet, planet\_name, set↵\_mode(), and jeod::EphemeridesManager::set\_target\_frame().

#### 8.26.4.6 ephemerides\_update()

```
void jeod::PropagatedPlanet::ephemerides_update ( ) [override], [virtual]
```

Update ephemerides for subscribed items.

Implements [jeod::EphemerisInterface](#).

Definition at line 429 of file propagated\_planet.cc.

References [active](#), [body](#), [commanded\\_mode](#), [dyn\\_manager](#), [ephem\\_orient](#), [ephem\\_planet](#), [initialized](#), [mode](#), [set\\_mode\(\)](#), [time\\_dyn](#), [TransFromBody\\_RotFromBody](#), [jeod::PropagatedEphemerisPlanet::update\(\)](#), [jeod::PropagatedEphemerisOrientation::update\(\)](#), and [update\\_time](#).

#### 8.26.4.7 get\_name()

```
std::string jeod::PropagatedPlanet::get_name ( ) const [override], [virtual]
```

Return model name.

##### Returns

Name

Implements [jeod::EphemerisInterface](#).

Definition at line 211 of file propagated\_planet.cc.

References [ident](#).

#### 8.26.4.8 initialize\_model()

```
void jeod::PropagatedPlanet::initialize_model (
    const TimeManager & time_manager,
    DynManager & dyn_manager_ref )
```

Initialize a [PropagatedPlanet](#) model.

##### Assumptions and Limitations

- This method must be called after the ephemeris model that defines the parent frame has been initialized.

##### Parameters

in	<i>time_manager</i>	Time manager
in, out	<i>dyn_manager_ref</i>	Dynamics manager

Definition at line 225 of file propagated\_planet.cc.

References [active](#), [body](#), [dyn\\_manager](#), [ephem\\_orient](#), [ephem\\_planet](#), [ident](#), [jeod::EphemeridesMessages::inconsistent\\_setup](#), [parent\\_frame](#), [parent\\_name](#), [planet\\_name](#), [jeod::EphemerisItem::set\\_name\(\)](#), and [time\\_dyn](#).

#### 8.26.4.9 operator=()

```
PropagatedPlanet& jeod::PropagatedPlanet::operator= (
    const PropagatedPlanet & ) [delete]
```

#### 8.26.4.10 set\_commanded\_mode()

```
void jeod::PropagatedPlanet::set_commanded_mode (
    PropagatedPlanet::Mode new_mode )
```

Setter for the commanded mode.

##### Parameters

in	<i>new_mode</i>	New commanded mode
----	-----------------	--------------------

Definition at line 344 of file propagated\_planet.cc.

References commanded\_mode.

#### 8.26.4.11 set\_mode()

```
void jeod::PropagatedPlanet::set_mode ( ) [protected]
```

Change the behavior of a [PropagatedPlanet](#).

Definition at line 352 of file propagated\_planet.cc.

References commanded\_mode, jeod::EphemerisItem::disable(), dyn\_manager, jeod::EphemerisOrientation↵::enable(), jeod::EphemerisItem::enable(), ephemer\_orient, ephemer\_planet, jeod::EphemeridesMessages↵::inconsistent\_setup, mode, TransFromBody\_RotFromBody, TransFromBody\_RotFromPlanet, TransFromPlanet\_↵RotFromBody, and TransFromPlanet\_RotFromPlanet.

Referenced by ephemer\_initialize(), and ephemer\_update().

#### 8.26.4.12 timestamp()

```
double jeod::PropagatedPlanet::timestamp ( ) const [override], [virtual]
```

Return time of last update.

##### Returns

Timestamp  
Units: day

Implements [jeod::EphemerisInterface](#).

Definition at line 202 of file propagated\_planet.cc.

References update\_time.

## 8.26.5 Friends And Related Function Documentation

### 8.26.5.1 init\_attrjeod\_\_PropagatedPlanet

```
void init_attrjeod__PropagatedPlanet ( ) [friend]
```

### 8.26.5.2 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 201 of file propagated\_planet.hh.

## 8.26.6 Field Documentation

### 8.26.6.1 active

```
bool jeod::PropagatedPlanet::active {true} [protected]
```

Is the planet present and marked as active?

```
trick_units(-)
```

Definition at line 321 of file propagated\_planet.hh.

Referenced by activate(), deactivate(), ephemer\_build\_tree(), ephemer\_initialize(), ephemer\_update(), and initialize\_model().

### 8.26.6.2 body

```
DynBody jeod::PropagatedPlanet::body
```

The dynamic body whose state is tied to that of the planet.

```
trick_units(-)
```

Definition at line 288 of file propagated\_planet.hh.

Referenced by ephemer\_activate(), ephemer\_update(), and initialize\_model().

### 8.26.6.3 commanded\_mode

```
Mode jeod::PropagatedPlanet::commanded_mode {TransFromPlanet_RotFromPlanet}
```

The mode in which the model should operate.

trick\_units(–)

Definition at line 293 of file propagated\_planet.hh.

Referenced by ephem\_update(), set\_commanded\_mode(), and set\_mode().

### 8.26.6.4 dyn\_manager

```
DynManager* jeod::PropagatedPlanet::dyn_manager {} [protected]
```

The dynamics manager.

trick\_units(–)

Definition at line 341 of file propagated\_planet.hh.

Referenced by ephem\_update(), initialize\_model(), and set\_mode().

### 8.26.6.5 ephem\_orient

```
PropagatedEphemerisOrientation jeod::PropagatedPlanet::ephem_orient [protected]
```

The ephemeris item that couples the rotational states of the body's composite body frame and the planet's planet-fixed frame.

trick\_units(–)

Definition at line 358 of file propagated\_planet.hh.

Referenced by ephem\_initialize(), ephem\_update(), initialize\_model(), PropagatedPlanet(), and set\_mode().

### 8.26.6.6 ephem\_planet

```
PropagatedEphemerisPlanet jeod::PropagatedPlanet::ephem_planet [protected]
```

The ephemeris item that couples the translational states of the body's composite body frame and the planet's inertial frame.

trick\_units(–)

Definition at line 352 of file propagated\_planet.hh.

Referenced by ephem\_initialize(), ephem\_update(), initialize\_model(), PropagatedPlanet(), and set\_mode().



#### 8.26.6.7 ident

```
std::string jeod::PropagatedPlanet::ident [protected]
```

Model name; used for reporting errors.

trick\_units(—)

Definition at line 316 of file propagated\_planet.hh.

Referenced by get\_name(), and initialize\_model().

#### 8.26.6.8 initialized

```
bool jeod::PropagatedPlanet::initialized {} [protected]
```

Has the model been initialized?

trick\_units(—)

Definition at line 306 of file propagated\_planet.hh.

Referenced by ephem\_update().

#### 8.26.6.9 mode

```
Mode jeod::PropagatedPlanet::mode {TransFromPlanet_RotFromPlanet} [protected]
```

The mode in which the model is operating.

trick\_units(—)

Definition at line 311 of file propagated\_planet.hh.

Referenced by ephem\_activate(), ephem\_update(), and set\_mode().

#### 8.26.6.10 parent\_frame

```
EphemerisRefFrame* jeod::PropagatedPlanet::parent_frame {} [protected]
```

The parent of the planet.

trick\_units(—)

Definition at line 336 of file propagated\_planet.hh.

Referenced by ephem\_build\_tree(), and initialize\_model().

#### 8.26.6.11 parent\_name

```
std::string jeod::PropagatedPlanet::parent_name
```

The name of the parent frame.

This is used at initialization time only.`trick_units(-)`

Definition at line 283 of file `propagated_planet.hh`.

Referenced by `initialize_model()`.

#### 8.26.6.12 planet

```
BasePlanet* jeod::PropagatedPlanet::planet {} [protected]
```

The planet tied to the body.

`trick_units(-)`

Definition at line 331 of file `propagated_planet.hh`.

Referenced by `ephem_build_tree()`, and `ephem_initialize()`.

#### 8.26.6.13 planet\_name

```
std::string jeod::PropagatedPlanet::planet_name
```

The name of the planet.

This is used at initialization time only.`trick_units(-)`

Definition at line 277 of file `propagated_planet.hh`.

Referenced by `ephem_initialize()`, and `initialize_model()`.

#### 8.26.6.14 time\_dyn

```
const TimeDyn* jeod::PropagatedPlanet::time_dyn {} [protected]
```

The source of dynamic time information.

`trick_units(-)`

Definition at line 346 of file `propagated_planet.hh`.

Referenced by `ephem_update()`, and `initialize_model()`.

## 8.26.6.15 update\_time

```
double jeod::PropagatedPlanet::update_time {-99e99} [protected]
```

Time of last update, dynamic time seconds.

trick\_units(s)

Definition at line 326 of file propagated\_planet.hh.

Referenced by ephem\_update(), and timestamp().

The documentation for this class was generated from the following files:

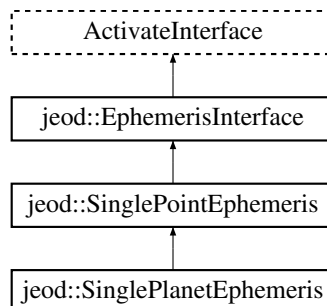
- [propagated\\_planet.hh](#)
- [propagated\\_planet.cc](#)

## 8.27 jeod::SinglePlanetEphemeris Class Reference

A space with one gravitation body has one ephemeris point.

```
#include <simple_ephemerides.hh>
```

Inheritance diagram for jeod::SinglePlanetEphemeris:



### Public Member Functions

- [SinglePlanetEphemeris](#) ()  
Construct an *SinglePlanetEphemeris* object.
- [~SinglePlanetEphemeris](#) () override=default
- [SinglePlanetEphemeris](#) (const [SinglePlanetEphemeris](#) &)=delete
- [SinglePlanetEphemeris](#) & operator= (const [SinglePlanetEphemeris](#) &)=delete
- void [set\\_name](#) (const std::string &frame\_name) override  
Set the name of a *SinglePlanetEphemeris* object.
- void [initialize\\_model](#) ([EphemeridesManager](#) &ephem\_manager) override  
Initialize a *SinglePlanetEphemeris* object.
- void [ephem\\_initialize](#) ([EphemeridesManager](#) &ephem\_manager) override  
Initialize a *SinglePlanetEphemeris* object.
- void [ephem\\_activate](#) ([EphemeridesManager](#) &ephem\_manager) override  
Activate a *SinglePlanetEphemeris* object.
- void [ephem\\_build\\_tree](#) ([EphemeridesManager](#) &ephem\_manager) override  
Build the reference frame tree with the central frame as the root.

## Protected Attributes

- [EphemerisPoint](#) `central_point`

The [EphemerisPoint](#) that represents the center of a simple universe.

## Friends

- class [InputProcessor](#)
- void [init\\_attrjeod\\_\\_SinglePlanetEphemeris](#) ()

### 8.27.1 Detailed Description

A space with one gravitation body has one ephemeris point.

Note well: A [SinglePlanetEphemeris](#) does not contain a Planet object. The planet must be specified elsewhere.

Definition at line 208 of file `simple_ephemerides.hh`.

### 8.27.2 Constructor & Destructor Documentation

#### 8.27.2.1 [SinglePlanetEphemeris\(\)](#) [1/2]

```
jeod::SinglePlanetEphemeris::SinglePlanetEphemeris ( )
```

Construct an [SinglePlanetEphemeris](#) object.

Definition at line 219 of file `simple_ephemerides.cc`.

References `central_point`, `jeod::EphemerisItem::enable()`, and `jeod::EphemerisItem::set_owner()`.

#### 8.27.2.2 [~SinglePlanetEphemeris\(\)](#)

```
jeod::SinglePlanetEphemeris::~~SinglePlanetEphemeris ( ) [override], [default]
```

#### 8.27.2.3 [SinglePlanetEphemeris\(\)](#) [2/2]

```
jeod::SinglePlanetEphemeris::SinglePlanetEphemeris (
    const SinglePlanetEphemeris & ) [delete]
```

### 8.27.3 Member Function Documentation

#### 8.27.3.1 [ephem\\_activate\(\)](#)

```
void jeod::SinglePlanetEphemeris::ephem_activate (
    EphemeridesManager & ephem_manager ) [override], [virtual]
```

Activate a [SinglePlanetEphemeris](#) object.

## Parameters

in, out	<i>ephem_manager</i>	Ephemerides manager
---------	----------------------	---------------------

Implements [jeod::SinglePointEphemeris](#).

Definition at line 321 of file simple\_ephemerides.cc.

## 8.27.3.2 ephem\_build\_tree()

```
void jeod::SinglePlanetEphemeris::ephem_build_tree (
    EphemeridesManager & ephem_manager ) [override], [virtual]
```

Build the reference frame tree with the central frame as the root.

## Parameters

in, out	<i>ephem_manager</i>	Ephemerides manager
---------	----------------------	---------------------

Implements [jeod::SinglePointEphemeris](#).

Definition at line 330 of file simple\_ephemerides.cc.

References [jeod::SinglePointEphemeris::active](#), [central\\_point](#), and [jeod::EphemerisItem::get\\_target\\_frame\(\)](#).

## 8.27.3.3 ephem\_initialize()

```
void jeod::SinglePlanetEphemeris::ephem_initialize (
    EphemeridesManager & ephem_manager ) [override], [virtual]
```

Initialize a [SinglePlanetEphemeris](#) object.

## Parameters

in, out	<i>ephem_manager</i>	Ephemerides manager
---------	----------------------	---------------------

Implements [jeod::SinglePointEphemeris](#).

Definition at line 269 of file simple\_ephemerides.cc.

References [jeod::SinglePointEphemeris::active](#), [central\\_point](#), [jeod::SinglePointEphemeris::deactivate\(\)](#), [jeod::EphemerisItem::disable\(\)](#), [jeod::EphemeridesManager::find\\_base\\_planet\(\)](#), [jeod::EphemeridesManager::get\\_num\\_planets\(\)](#), [jeod::EphemerisItem::get\\_target\\_frame\(\)](#), [jeod::SinglePointEphemeris::identifier](#), and [jeod::EphemeridesMessages::inconsistent\\_setup](#).

#### 8.27.3.4 initialize\_model()

```
void jeod::SinglePlanetEphemeris::initialize_model (
    EphemeridesManager & ephem_manager ) [override], [virtual]
```

Initialize a [SinglePlanetEphemeris](#) object.

##### Parameters

<i>in, out</i>	<i>ephem_manager</i>	Ephemerides manager
----------------	----------------------	---------------------

Implements [jeod::SinglePointEphemeris](#).

Definition at line 253 of file simple\_ephemerides.cc.

References [jeod::SinglePointEphemeris::active](#), [jeod::EphemeridesManager::add\\_ephem\\_item\(\)](#), [jeod::EphemeridesManager::add\\_ephemeris\(\)](#), and [central\\_point](#).

#### 8.27.3.5 operator=()

```
SinglePlanetEphemeris& jeod::SinglePlanetEphemeris::operator= (
    const SinglePlanetEphemeris & ) [delete]
```

#### 8.27.3.6 set\_name()

```
void jeod::SinglePlanetEphemeris::set_name (
    const std::string & new_name ) [override], [virtual]
```

Set the name of a [SinglePlanetEphemeris](#) object.

##### Parameters

<i>in, out</i>	<i>new_name</i>	Central point name
----------------	-----------------	--------------------

Reimplemented from [jeod::SinglePointEphemeris](#).

Definition at line 229 of file simple\_ephemerides.cc.

References [central\\_point](#), [jeod::SinglePointEphemeris::set\\_name\(\)](#), and [jeod::EphemerisItem::set\\_name\(\)](#).

### 8.27.4 Friends And Related Function Documentation

## 8.27.4.1 init\_attrjeod\_\_SinglePlanetEphemeris

```
void init_attrjeod__SinglePlanetEphemeris ( ) [friend]
```

## 8.27.4.2 InputProcessor

```
friend class InputProcessor [friend]
```

Definition at line 210 of file simple\_ephemerides.hh.

## 8.27.5 Field Documentation

## 8.27.5.1 central\_point

```
EphemerisPoint jeod::SinglePlanetEphemeris::central_point [protected]
```

The [EphemerisPoint](#) that represents the center of a simple universe.

trick\_units(—)

Definition at line 234 of file simple\_ephemerides.hh.

Referenced by [ephem\\_build\\_tree\(\)](#), [ephem\\_initialize\(\)](#), [initialize\\_model\(\)](#), [set\\_name\(\)](#), and [SinglePlanetEphemeris\(\)](#).

The documentation for this class was generated from the following files:

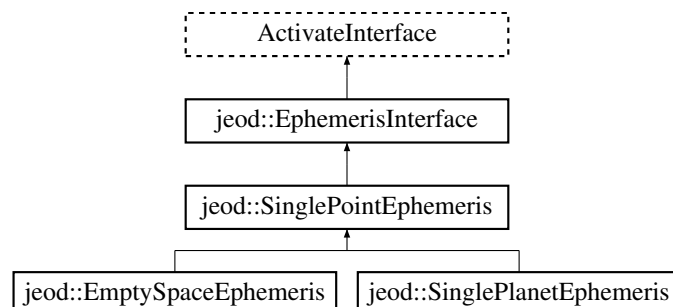
- [simple\\_ephemerides.hh](#)
- [simple\\_ephemerides.cc](#)

## 8.28 jeod::SinglePointEphemeris Class Reference

A [SinglePointEphemeris](#) has one ephemeris point.

```
#include <simple_ephemerides.hh>
```

Inheritance diagram for jeod::SinglePointEphemeris:



## Public Member Functions

- [SinglePointEphemeris](#) ()=default
- [~SinglePointEphemeris](#) () override=default
- [SinglePointEphemeris](#) (const [SinglePointEphemeris](#) &)=delete
- [SinglePointEphemeris](#) & [operator=](#) (const [SinglePointEphemeris](#) &)=delete
- virtual void [set\\_name](#) (const std::string &new\_name)  
*Set the name of a [SinglePointEphemeris](#) object.*
- void [activate](#) () override  
*Nominally, activate the model.*
- void [deactivate](#) () override  
*Deactivate the model.*
- double [timestamp](#) () const override  
*Retrieve the timestamp.*
- std::string [get\\_name](#) () const override  
*Retrieve the identifier.*
- void [ephem\\_update](#) () override  
*Update the ephemerides, which in this case is a no-op.*
- virtual void [initialize\\_model](#) ([EphemeridesManager](#) &manager)=0  
*Register the model and its ephemeris points.*
- void [ephem\\_initialize](#) ([EphemeridesManager](#) &manager) override=0  
*Initialize the ephemerides.*
- void [ephem\\_activate](#) ([EphemeridesManager](#) &manager) override=0  
*Activate the model.*
- void [ephem\\_build\\_tree](#) ([EphemeridesManager](#) &manager) override=0  
*Build the model's contribution to the reference frame tree.*

## Protected Attributes

- std::string [identifier](#)  
*Identifier for this model.*
- double [update\\_time](#) {}  
*Time of last update, dynamic time seconds.*
- bool [active](#) {true}  
*Is the model active?*

## Friends

- class [InputProcessor](#)
- void [init\\_attrjeod\\_\\_SinglePointEphemeris](#) ()

### 8.28.1 Detailed Description

A [SinglePointEphemeris](#) has one ephemeris point.

Definition at line 83 of file `simple_ephemerides.hh`.



## 8.28.2 Constructor & Destructor Documentation

### 8.28.2.1 SinglePointEphemeris() [1/2]

```
jeod::SinglePointEphemeris::SinglePointEphemeris ( ) [default]
```

### 8.28.2.2 ~SinglePointEphemeris()

```
jeod::SinglePointEphemeris::~~SinglePointEphemeris ( ) [override], [default]
```

### 8.28.2.3 SinglePointEphemeris() [2/2]

```
jeod::SinglePointEphemeris::SinglePointEphemeris (
    const SinglePointEphemeris & ) [delete]
```

## 8.28.3 Member Function Documentation

### 8.28.3.1 activate()

```
void jeod::SinglePointEphemeris::activate ( ) [override]
```

Nominally, activate the model.

Here, reject the request.

Definition at line 56 of file simple\_ephemerides.cc.

References `active`, and `jeod::EphemeridesMessages::internal_error`.

### 8.28.3.2 deactivate()

```
void jeod::SinglePointEphemeris::deactivate ( ) [override]
```

Deactivate the model.

Definition at line 70 of file simple\_ephemerides.cc.

References `active`.

Referenced by `jeod::EmptySpaceEphemeris::ephem_initialize()`, and `jeod::SinglePlanetEphemeris::ephem_initialize()`.

### 8.28.3.3 ephem\_activate()

```
void jeod::SinglePointEphemeris::ephem_activate (
    EphemeridesManager & manager ) [override], [pure virtual]
```

Activate the model.

**Parameters**

<code>in, out</code>	<code>manager</code>	Ephemerides manager
----------------------	----------------------	---------------------

Implements [jeod::EphemerisInterface](#).

Implemented in [jeod::SinglePlanetEphemeris](#), and [jeod::EmptySpaceEphemeris](#).

**8.28.3.4 ephem\_build\_tree()**

```
void jeod::SinglePointEphemeris::ephem_build_tree (
    EphemeridesManager & manager ) [override], [pure virtual]
```

Build the model's contribution to the reference frame tree.

**Parameters**

<code>in, out</code>	<code>manager</code>	Ephemerides manager
----------------------	----------------------	---------------------

Implements [jeod::EphemerisInterface](#).

Implemented in [jeod::SinglePlanetEphemeris](#), and [jeod::EmptySpaceEphemeris](#).

**8.28.3.5 ephem\_initialize()**

```
void jeod::SinglePointEphemeris::ephem_initialize (
    EphemeridesManager & manager ) [override], [pure virtual]
```

Initialize the ephemerides.

**Parameters**

<code>in, out</code>	<code>manager</code>	Ephemerides manager
----------------------	----------------------	---------------------

Implements [jeod::EphemerisInterface](#).

Implemented in [jeod::SinglePlanetEphemeris](#), and [jeod::EmptySpaceEphemeris](#).

**8.28.3.6 ephem\_update()**

```
void jeod::SinglePointEphemeris::ephem_update ( ) [inline], [override], [virtual]
```

Update the ephemerides, which in this case is a no-op.

Implements [jeod::EphemerisInterface](#).

Definition at line 258 of file simple\_ephemerides.hh.

#### 8.28.3.7 get\_name()

```
std::string jeod::SinglePointEphemeris::get_name ( ) const [inline], [override], [virtual]
```

Retrieve the identifier.

##### Returns

Identifier

Implements [jeod::EphemerisInterface](#).

Definition at line 250 of file simple\_ephemerides.hh.

#### 8.28.3.8 initialize\_model()

```
virtual void jeod::SinglePointEphemeris::initialize_model (
    EphemeridesManager & manager ) [pure virtual]
```

Register the model and its ephemeris points.

##### Parameters

in, out	<i>manager</i>	Ephemerides manager
---------	----------------	---------------------

Implemented in [jeod::SinglePlanetEphemeris](#), and [jeod::EmptySpaceEphemeris](#).

#### 8.28.3.9 operator=()

```
SinglePointEphemeris& jeod::SinglePointEphemeris::operator= (
    const SinglePointEphemeris & ) [delete]
```

#### 8.28.3.10 set\_name()

```
void jeod::SinglePointEphemeris::set_name (
    const std::string & new_name ) [virtual]
```

Set the name of a [SinglePointEphemeris](#) object.

**Parameters**

<code>in, out</code>	<code>new_name</code>	Central point name
----------------------	-----------------------	--------------------

Reimplemented in [jeod::SinglePlanetEphemeris](#), and [jeod::EmptySpaceEphemeris](#).

Definition at line 79 of file `simple_ephemerides.cc`.

References identifier, and `jeod::EphemeridesMessages::inconsistent_setup`.

Referenced by `jeod::EmptySpaceEphemeris::set_name()`, and `jeod::SinglePlanetEphemeris::set_name()`.

**8.28.3.11 timestamp()**

```
double jeod::SinglePointEphemeris::timestamp ( ) const [inline], [override], [virtual]
```

Retrieve the timestamp.

**Returns**

Timestamp  
Units: s

Implements [jeod::EphemerisInterface](#).

Definition at line 241 of file `simple_ephemerides.hh`.

**8.28.4 Friends And Related Function Documentation****8.28.4.1 init\_attrjeod\_\_SinglePointEphemeris**

```
void init_attrjeod__SinglePointEphemeris ( ) [friend]
```

**8.28.4.2 InputProcessor**

```
friend class InputProcessor [friend]
```

Definition at line 85 of file `simple_ephemerides.hh`.

**8.28.5 Field Documentation**

### 8.28.5.1 active

```
bool jeod::SinglePointEphemeris::active {true} [protected]
```

Is the model active?

trick\_units(—)

Definition at line 163 of file simple\_ephemerides.hh.

Referenced by activate(), deactivate(), jeod::EmptySpaceEphemeris::ephem\_build\_tree(), jeod::SinglePlanetEphemeris::ephem\_build\_tree(), jeod::SinglePlanetEphemeris::ephem\_initialize(), jeod::EmptySpaceEphemeris::initialize\_model(), and jeod::SinglePlanetEphemeris::initialize\_model().

### 8.28.5.2 identifier

```
std::string jeod::SinglePointEphemeris::identifier [protected]
```

Identifier for this model.

trick\_units(—)

Definition at line 153 of file simple\_ephemerides.hh.

Referenced by jeod::EmptySpaceEphemeris::ephem\_initialize(), jeod::SinglePlanetEphemeris::ephem\_initialize(), and set\_name().

### 8.28.5.3 update\_time

```
double jeod::SinglePointEphemeris::update_time {} [protected]
```

Time of last update, dynamic time seconds.

trick\_units(s)

Definition at line 158 of file simple\_ephemerides.hh.

The documentation for this class was generated from the following files:

- [simple\\_ephemerides.hh](#)
- [simple\\_ephemerides.cc](#)



## Chapter 9

# File Documentation

### 9.1 `base_ephem_manager.hh` File Reference

Define the BaseEphemManager class, which defines the interfaces to the class EphemManager.

```
#include <vector>
#include "utils/ref_frames/include/base_ref_frame_manager.hh"
#include "utils/sim_interface/include/jeod_class.hh"
```

#### Data Structures

- class `jeod::BaseEphemeridesManager`

*The EphemManager class augments the RefFrameManager with ephemeris-related items.*

#### Namespaces

- `jeod`

*Namespace jeod.*

#### 9.1.1 Detailed Description

Define the BaseEphemManager class, which defines the interfaces to the class EphemManager.

### 9.2 `class_declarations.hh` File Reference

Forward declarations of classes defined in the DE4xx model.

#### Namespaces

- `jeod`

*Namespace jeod.*

### 9.2.1 Detailed Description

Forward declarations of classes defined in the DE4xx model.

## 9.3 class\_declarations.hh File Reference

Forward declarations of classes defined in models/environment/ephemerides/ephem\_interface files.

### Namespaces

- [jeod](#)

*Namespace jeod.*

### 9.3.1 Detailed Description

Forward declarations of classes defined in models/environment/ephemerides/ephem\_interface files.

## 9.4 class\_declarations.hh File Reference

Forward declarations of classes defined in models/environment/ephemerides/ephem\_item files.

### Namespaces

- [jeod](#)

*Namespace jeod.*

### 9.4.1 Detailed Description

Forward declarations of classes defined in models/environment/ephemerides/ephem\_item files.

## 9.5 de405\_0.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- [jeod::EphemerisDataSetMeta metaData](#)
- [jeod::EphemerisDataItemMeta itemData](#) [13]
- [jeod::EphemerisDataSegmentMeta segmentData](#) [31]
- double [segment\\_coeffs\\_0](#) [229][1018]



## 9.5.1 Variable Documentation

### 9.5.1.1 itemData

`jeod::EphemerisDataItemMeta` itemData[13]

**Initial value:**

```
= {
  { .offset = 3, .nterms = 14, .npoly = 4},
  { .offset = 171, .nterms = 10, .npoly = 2},
  { .offset = 231, .nterms = 13, .npoly = 2},
  { .offset = 309, .nterms = 11, .npoly = 1},
  { .offset = 342, .nterms = 8, .npoly = 1},
  { .offset = 366, .nterms = 7, .npoly = 1},
  { .offset = 387, .nterms = 6, .npoly = 1},
  { .offset = 405, .nterms = 6, .npoly = 1},
  { .offset = 423, .nterms = 6, .npoly = 1},
  { .offset = 441, .nterms = 13, .npoly = 8},
  { .offset = 753, .nterms = 11, .npoly = 2},
  { .offset = 819, .nterms = 10, .npoly = 4},
  { .offset = 899, .nterms = 10, .npoly = 4}
}
```

Definition at line 34 of file de405\_0.cc.

Referenced by `jeod::De4xxFile::interpolate()`, and `jeod::De4xxFile::pre_initialize()`.

### 9.5.1.2 metaData

`jeod::EphemerisDataSetMeta` metaData

**Initial value:**

```
= {
  .number_file_items = 13,
  .start_epoch = 2305424.50,
  .stop_epoch = 2525008.50,
  .delta_epoch = 32,
  .number_segments = 31,
  .ncoeff = 1018,
  .de_constants = {0.405000000000000000E+03,
    0.405000000000000000E+03, 0.149597870691000015E+09,
    0.813005600000000000044E+02, 0.2997924579999999984E+06,
    0.491254745145081187E-10, 0.724345248616270270E-09,
    0.899701134671249882E-09, 0.954953510577925806E-10,
    0.282534590952422643E-06, 0.845971518568065874E-07,
    0.129202491678196939E-07, 0.152435890078427628E-07,
    0.218869976542596968E-11, 0.295912208285591095E-03}
}
```

Definition at line 17 of file de405\_0.cc.

#### 9.5.1.3 segment\_coeffs\_0

```
double segment_coeffs_0[229][1018]
```

Definition at line 88 of file de405\_0.cc.

#### 9.5.1.4 segmentData

```
jeod::EphemerisDataSegmentMeta segmentData[31]
```

Definition at line 50 of file de405\_0.cc.

## 9.6 de405\_1.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_1](#) [229][1018]

#### 9.6.1 Variable Documentation

##### 9.6.1.1 segment\_coeffs\_1

```
double segment_coeffs_1[229][1018]
```

Definition at line 17 of file de405\_1.cc.

## 9.7 de405\_10.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_10](#) [229][1018]

### 9.7.1 Variable Documentation

#### 9.7.1.1 segment\_coeffs\_10

```
double segment_coeffs_10[229][1018]
```

Definition at line 17 of file de405\_10.cc.

## 9.8 de405\_11.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_11](#) [230][1018]

### 9.8.1 Variable Documentation

#### 9.8.1.1 segment\_coeffs\_11

```
double segment_coeffs_11[230][1018]
```

Definition at line 17 of file de405\_11.cc.

## 9.9 de405\_12.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_12](#) [229][1018]

### 9.9.1 Variable Documentation

#### 9.9.1.1 segment\_coeffs\_12

```
double segment_coeffs_12[229][1018]
```

Definition at line 17 of file de405\_12.cc.

### 9.10 de405\_13.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

#### Variables

- double [segment\\_coeffs\\_13](#) [229][1018]

#### 9.10.1 Variable Documentation

##### 9.10.1.1 segment\_coeffs\_13

```
double segment_coeffs_13[229][1018]
```

Definition at line 17 of file de405\_13.cc.

### 9.11 de405\_14.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

#### Variables

- double [segment\\_coeffs\\_14](#) [229][1018]

#### 9.11.1 Variable Documentation

##### 9.11.1.1 segment\_coeffs\_14

```
double segment_coeffs_14[229][1018]
```

Definition at line 17 of file de405\_14.cc.

## 9.12 de405\_15.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_15](#) [230][1018]

### 9.12.1 Variable Documentation

#### 9.12.1.1 segment\_coeffs\_15

```
double segment_coeffs_15[230][1018]
```

Definition at line 17 of file de405\_15.cc.

## 9.13 de405\_16.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_16](#) [229][1018]

### 9.13.1 Variable Documentation

#### 9.13.1.1 segment\_coeffs\_16

```
double segment_coeffs_16[229][1018]
```

Definition at line 17 of file de405\_16.cc.

## 9.14 de405\_17.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

## Variables

- double [segment\\_coeffs\\_17](#) [229][1018]

### 9.14.1 Variable Documentation

#### 9.14.1.1 segment\_coeffs\_17

```
double segment_coeffs_17[229][1018]
```

Definition at line 17 of file de405\_17.cc.

## 9.15 de405\_18.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

## Variables

- double [segment\\_coeffs\\_18](#) [229][1018]

### 9.15.1 Variable Documentation

#### 9.15.1.1 segment\_coeffs\_18

```
double segment_coeffs_18[229][1018]
```

Definition at line 17 of file de405\_18.cc.

## 9.16 de405\_19.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

## Variables

- double [segment\\_coeffs\\_19](#) [230][1018]

### 9.16.1 Variable Documentation

#### 9.16.1.1 segment\_coeffs\_19

```
double segment_coeffs_19[230][1018]
```

Definition at line 17 of file de405\_19.cc.

## 9.17 de405\_2.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_2](#) [229][1018]

### 9.17.1 Variable Documentation

#### 9.17.1.1 segment\_coeffs\_2

```
double segment_coeffs_2[229][1018]
```

Definition at line 17 of file de405\_2.cc.

## 9.18 de405\_20.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_20](#) [229][1018]

### 9.18.1 Variable Documentation

#### 9.18.1.1 `segment_coeffs_20`

```
double segment_coeffs_20[229][1018]
```

Definition at line 17 of file `de405_20.cc`.

### 9.19 `de405_21.cc` File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

#### Variables

- double [segment\\_coeffs\\_21](#) [229][1018]

#### 9.19.1 Variable Documentation

##### 9.19.1.1 `segment_coeffs_21`

```
double segment_coeffs_21[229][1018]
```

Definition at line 17 of file `de405_21.cc`.

### 9.20 `de405_22.cc` File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

#### Variables

- double [segment\\_coeffs\\_22](#) [230][1018]

#### 9.20.1 Variable Documentation

##### 9.20.1.1 `segment_coeffs_22`

```
double segment_coeffs_22[230][1018]
```

Definition at line 17 of file `de405_22.cc`.



## 9.21 de405\_23.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_23](#) [229][1018]

### 9.21.1 Variable Documentation

#### 9.21.1.1 segment\_coeffs\_23

```
double segment_coeffs_23[229][1018]
```

Definition at line 17 of file de405\_23.cc.

## 9.22 de405\_24.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_24](#) [229][1018]

### 9.22.1 Variable Documentation

#### 9.22.1.1 segment\_coeffs\_24

```
double segment_coeffs_24[229][1018]
```

Definition at line 17 of file de405\_24.cc.

## 9.23 de405\_25.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

## Variables

- double [segment\\_coeffs\\_25](#) [229][1018]

### 9.23.1 Variable Documentation

#### 9.23.1.1 segment\_coeffs\_25

```
double segment_coeffs_25[229][1018]
```

Definition at line 17 of file de405\_25.cc.

## 9.24 de405\_26.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

## Variables

- double [segment\\_coeffs\\_26](#) [230][1018]

### 9.24.1 Variable Documentation

#### 9.24.1.1 segment\_coeffs\_26

```
double segment_coeffs_26[230][1018]
```

Definition at line 17 of file de405\_26.cc.

## 9.25 de405\_27.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

## Variables

- double [segment\\_coeffs\\_27](#) [229][1018]

### 9.25.1 Variable Documentation

#### 9.25.1.1 segment\_coeffs\_27

```
double segment_coeffs_27[229][1018]
```

Definition at line 17 of file de405\_27.cc.

## 9.26 de405\_28.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_28](#) [229][1018]

### 9.26.1 Variable Documentation

#### 9.26.1.1 segment\_coeffs\_28

```
double segment_coeffs_28[229][1018]
```

Definition at line 17 of file de405\_28.cc.

## 9.27 de405\_29.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_29](#) [230][1018]

### 9.27.1 Variable Documentation

#### 9.27.1.1 `segment_coeffs_29`

```
double segment_coeffs_29[230][1018]
```

Definition at line 17 of file `de405_29.cc`.

### 9.28 `de405_3.cc` File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

#### Variables

- double `segment_coeffs_3` [229][1018]

#### 9.28.1 Variable Documentation

##### 9.28.1.1 `segment_coeffs_3`

```
double segment_coeffs_3[229][1018]
```

Definition at line 17 of file `de405_3.cc`.

### 9.29 `de405_30.cc` File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

#### Variables

- double `segment_coeffs_30` [13][1018]

#### 9.29.1 Variable Documentation

##### 9.29.1.1 `segment_coeffs_30`

```
double segment_coeffs_30[13][1018]
```

Definition at line 17 of file `de405_30.cc`.

## 9.30 de405\_4.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_4](#) [230][1018]

#### 9.30.1 Variable Documentation

##### 9.30.1.1 segment\_coeffs\_4

```
double segment_coeffs_4[230][1018]
```

Definition at line 17 of file de405\_4.cc.

## 9.31 de405\_5.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_5](#) [229][1018]

#### 9.31.1 Variable Documentation

##### 9.31.1.1 segment\_coeffs\_5

```
double segment_coeffs_5[229][1018]
```

Definition at line 17 of file de405\_5.cc.

## 9.32 de405\_6.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

## Variables

- double [segment\\_coeffs\\_6](#) [229][1018]

### 9.32.1 Variable Documentation

#### 9.32.1.1 segment\_coeffs\_6

```
double segment_coeffs_6[229][1018]
```

Definition at line 17 of file de405\_6.cc.

## 9.33 de405\_7.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

## Variables

- double [segment\\_coeffs\\_7](#) [229][1018]

### 9.33.1 Variable Documentation

#### 9.33.1.1 segment\_coeffs\_7

```
double segment_coeffs_7[229][1018]
```

Definition at line 17 of file de405\_7.cc.

## 9.34 de405\_8.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

## Variables

- double [segment\\_coeffs\\_8](#) [230][1018]

### 9.34.1 Variable Documentation

#### 9.34.1.1 segment\_coeffs\_8

```
double segment_coeffs_8[230][1018]
```

Definition at line 17 of file de405\_8.cc.

## 9.35 de405\_9.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_9](#) [229][1018]

### 9.35.1 Variable Documentation

#### 9.35.1.1 segment\_coeffs\_9

```
double segment_coeffs_9[229][1018]
```

Definition at line 17 of file de405\_9.cc.

## 9.36 de421\_0.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- [jeod::EphemerisDataSetMeta metaData](#)
- [jeod::EphemerisDataItemMeta itemData](#) [13]
- [jeod::EphemerisDataSegmentMeta segmentData](#) [2]
- double [segment\\_coeffs\\_0](#) [1713][1018]

### 9.36.1 Variable Documentation

#### 9.36.1.1 itemData

`jeod::EphemerisDataItemMeta` itemData[13]

**Initial value:**

```
= {
  { .offset = 3, .nterms = 14, .npoly = 4},
  { .offset = 171, .nterms = 10, .npoly = 2},
  { .offset = 231, .nterms = 13, .npoly = 2},
  { .offset = 309, .nterms = 11, .npoly = 1},
  { .offset = 342, .nterms = 8, .npoly = 1},
  { .offset = 366, .nterms = 7, .npoly = 1},
  { .offset = 387, .nterms = 6, .npoly = 1},
  { .offset = 405, .nterms = 6, .npoly = 1},
  { .offset = 423, .nterms = 6, .npoly = 1},
  { .offset = 441, .nterms = 13, .npoly = 8},
  { .offset = 753, .nterms = 11, .npoly = 2},
  { .offset = 819, .nterms = 10, .npoly = 4},
  { .offset = 899, .nterms = 10, .npoly = 4}
}
```

Definition at line 34 of file de421\_0.cc.

#### 9.36.1.2 metaData

`jeod::EphemerisDataSetMeta` metaData

**Initial value:**

```
= {
  .number_file_items = 13,
  .start_epoch = 2414992.50,
  .stop_epoch = 2524624.50,
  .delta_epoch = 32,
  .number_segments = 2,
  .ncoeff = 1018,
  .de_constants = {0.421000000000000000E+03,
    0.421000000000000000E+03, 0.149597870699626200E+09,
    0.813005690699153000E+02, 0.299792458000000000E+06,
    0.491254957186794000E-10, 0.724345233269844100E-09,
    0.899701140826804900E-09, 0.954954869562239000E-10,
    0.282534584085505000E-06, 0.845970607330847800E-07,
    0.129202482579265000E-07, 0.152435910924974000E-07,
    0.217844105199052000E-11, 0.295912208285591100E-03}
}
```

Definition at line 17 of file de421\_0.cc.



### 9.36.1.3 segment\_coeffs\_0

```
double segment_coeffs_0[1713][1018]
```

Definition at line 59 of file de421\_0.cc.

### 9.36.1.4 segmentData

```
jeod::EphemerisDataSegmentMeta segmentData[2]
```

#### Initial value:

```
= {  
    {.num_recs = 1713, .start_epoch = 2.4149925000000000E+06, .stop_epoch = 2.4698085000000000E+06},  
    {.num_recs = 1714, .start_epoch = 0.2469776500000000E+07, .stop_epoch = 0.2524624500000000E+07}  
}
```

Definition at line 50 of file de421\_0.cc.

## 9.37 de421\_1.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_1](#) [1714][1018]

### 9.37.1 Variable Documentation

#### 9.37.1.1 segment\_coeffs\_1

```
double segment_coeffs_1[1714][1018]
```

Definition at line 17 of file de421\_1.cc.

## 9.38 de440\_0.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

## Variables

- [jeod::EphemerisDataSetMeta metaData](#)
- [jeod::EphemerisDataItemMeta itemData \[15\]](#)
- [jeod::EphemerisDataSegmentMeta segmentData \[11\]](#)
- double [segment\\_coefs\\_0 \[1142\]\[1018\]](#)

### 9.38.1 Variable Documentation

#### 9.38.1.1 itemData

[jeod::EphemerisDataItemMeta itemData \[15\]](#)

##### Initial value:

```
= {
  { .offset = 3, .nterms = 14, .npoly = 4},
  { .offset = 171, .nterms = 10, .npoly = 2},
  { .offset = 231, .nterms = 13, .npoly = 2},
  { .offset = 309, .nterms = 11, .npoly = 1},
  { .offset = 342, .nterms = 8, .npoly = 1},
  { .offset = 366, .nterms = 7, .npoly = 1},
  { .offset = 387, .nterms = 6, .npoly = 1},
  { .offset = 405, .nterms = 6, .npoly = 1},
  { .offset = 423, .nterms = 6, .npoly = 1},
  { .offset = 441, .nterms = 13, .npoly = 8},
  { .offset = 753, .nterms = 11, .npoly = 2},
  { .offset = 819, .nterms = 10, .npoly = 4},
  { .offset = 899, .nterms = 10, .npoly = 4},
  { .offset = 1019, .nterms = 0, .npoly = 0},
  { .offset = 1019, .nterms = 0, .npoly = 0}
}
```

Definition at line 34 of file de440\_0.cc.

#### 9.38.1.2 metaData

[jeod::EphemerisDataSetMeta metaData](#)

##### Initial value:

```
= {
  .number_file_items = 15,
  .start_epoch = 2287184.50,
  .stop_epoch = 2688976.50,
  .delta_epoch = 32,
  .number_segments = 11,
  .ncoeff = 1018,
  .de_constants = {0.440000000000000000E+03,
    0.440000000000000000E+03, 0.149597870699999988E+09,
    0.813005682214972154E+02, 0.299792457999999984E+06,
    0.491250019488931818E-10, 0.724345233264411869E-09,
    0.899701139294734660E-09, 0.954954882972581189E-10,
    0.282534582522579175E-06, 0.845970599337629027E-07,
    0.129202656496823994E-07, 0.152435734788519386E-07,
    0.217509646489335811E-11, 0.295912208284119561E-03}
}
```

Definition at line 17 of file de440\_0.cc.

### 9.38.1.3 segment\_coeffs\_0

```
double segment_coeffs_0[1142][1018]
```

Definition at line 70 of file de440\_0.cc.

### 9.38.1.4 segmentData

```
jeod::EphemerisDataSegmentMeta segmentData[11]
```

**Initial value:**

```
= {
  { .num_recs = 1142, .start_epoch = 0.2287184500000000E+07, .stop_epoch = 0.2323728500000000E+07 },
  { .num_recs = 1142, .start_epoch = 0.2323696500000000E+07, .stop_epoch = 0.2360240500000000E+07 },
  { .num_recs = 1143, .start_epoch = 0.2360208500000000E+07, .stop_epoch = 0.2396784500000000E+07 },
  { .num_recs = 1142, .start_epoch = 0.2396752500000000E+07, .stop_epoch = 0.2433296500000000E+07 },
  { .num_recs = 1142, .start_epoch = 0.2433264500000000E+07, .stop_epoch = 0.2469808500000000E+07 },
  { .num_recs = 1143, .start_epoch = 0.2469776500000000E+07, .stop_epoch = 0.2506352500000000E+07 },
  { .num_recs = 1142, .start_epoch = 0.2506320500000000E+07, .stop_epoch = 0.2542864500000000E+07 },
  { .num_recs = 1143, .start_epoch = 0.2542832500000000E+07, .stop_epoch = 0.2579408500000000E+07 },
  { .num_recs = 1142, .start_epoch = 0.2579376500000000E+07, .stop_epoch = 0.2615920500000000E+07 },
  { .num_recs = 1142, .start_epoch = 0.2615888500000000E+07, .stop_epoch = 0.2652432500000000E+07 },
  { .num_recs = 1143, .start_epoch = 0.2652400500000000E+07, .stop_epoch = 0.2688976500000000E+07 }
}
```

Definition at line 52 of file de440\_0.cc.

## 9.39 de440\_1.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_1](#) [1142][1018]

### 9.39.1 Variable Documentation

#### 9.39.1.1 segment\_coeffs\_1

```
double segment_coeffs_1[1142][1018]
```

Definition at line 17 of file de440\_1.cc.

## 9.40 de440\_10.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_10](#) [1143][1018]

### 9.40.1 Variable Documentation

#### 9.40.1.1 segment\_coeffs\_10

```
double segment_coeffs_10[1143][1018]
```

Definition at line 17 of file de440\_10.cc.

## 9.41 de440\_2.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_2](#) [1143][1018]

### 9.41.1 Variable Documentation

#### 9.41.1.1 segment\_coeffs\_2

```
double segment_coeffs_2[1143][1018]
```

Definition at line 17 of file de440\_2.cc.

## 9.42 de440\_3.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

## Variables

- double [segment\\_coeffs\\_3](#) [1142][1018]

### 9.42.1 Variable Documentation

#### 9.42.1.1 segment\_coeffs\_3

```
double segment_coeffs_3[1142][1018]
```

Definition at line 17 of file de440\_3.cc.

## 9.43 de440\_4.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

## Variables

- double [segment\\_coeffs\\_4](#) [1142][1018]

### 9.43.1 Variable Documentation

#### 9.43.1.1 segment\_coeffs\_4

```
double segment_coeffs_4[1142][1018]
```

Definition at line 17 of file de440\_4.cc.

## 9.44 de440\_5.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

## Variables

- double [segment\\_coeffs\\_5](#) [1143][1018]

### 9.44.1 Variable Documentation

#### 9.44.1.1 `segment_coeffs_5`

```
double segment_coeffs_5[1143][1018]
```

Definition at line 17 of file `de440_5.cc`.

## 9.45 `de440_6.cc` File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_6](#) [1142][1018]

### 9.45.1 Variable Documentation

#### 9.45.1.1 `segment_coeffs_6`

```
double segment_coeffs_6[1142][1018]
```

Definition at line 17 of file `de440_6.cc`.

## 9.46 `de440_7.cc` File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_7](#) [1143][1018]

### 9.46.1 Variable Documentation

#### 9.46.1.1 segment\_coeffs\_7

```
double segment_coeffs_7[1143][1018]
```

Definition at line 17 of file de440\_7.cc.

## 9.47 de440\_8.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_8](#) [1142][1018]

#### 9.47.1 Variable Documentation

##### 9.47.1.1 segment\_coeffs\_8

```
double segment_coeffs_8[1142][1018]
```

Definition at line 17 of file de440\_8.cc.

## 9.48 de440\_9.cc File Reference

```
#include "environment/ephemerides/de4xx_ephem/include/de4xx_file.hh"
```

### Variables

- double [segment\\_coeffs\\_9](#) [1142][1018]

#### 9.48.1 Variable Documentation

##### 9.48.1.1 segment\_coeffs\_9

```
double segment_coeffs_9[1142][1018]
```

Definition at line 17 of file de440\_9.cc.

## 9.49 de4xx\_base.hh File Reference

Define data types for JPL ephemeris model.

```
#include <cstdint>
#include "utils/sim_interface/include/jeod_class.hh"
```

### Namespaces

- [jeod](#)  
*Namespace jeod.*
- [jeod::De4xxBase](#)  
*Defines enumerations used in the DE4xx ephemeris model.*

### Enumerations

- enum [jeod::De4xxBase::De4xxFileEntries](#) {  
[jeod::De4xxBase::De4xx\\_File\\_Mercury](#) = 0, [jeod::De4xxBase::De4xx\\_File\\_Venus](#) = 1, [jeod::De4xxBase::De4xx\\_File\\_EMbary](#)  
= 2, [jeod::De4xxBase::De4xx\\_File\\_Mars](#) = 3,  
[jeod::De4xxBase::De4xx\\_File\\_Jupiter](#) = 4, [jeod::De4xxBase::De4xx\\_File\\_Saturn](#) = 5, [jeod::De4xxBase::De4xx\\_File\\_Uranus](#)  
= 6, [jeod::De4xxBase::De4xx\\_File\\_Neptune](#) = 7,  
[jeod::De4xxBase::De4xx\\_File\\_Pluto](#) = 8, [jeod::De4xxBase::De4xx\\_File\\_Moon](#) = 9, [jeod::De4xxBase::De4xx\\_File\\_Sun](#)  
= 10, [jeod::De4xxBase::De4xx\\_File\\_ENutation](#) = 11,  
[jeod::De4xxBase::De4xx\\_File\\_LLibration](#) = 12, [jeod::De4xxBase::De4xx\\_File\\_LAngVel](#) = 13, [jeod::De4xxBase::De4xx\\_File\\_tt\\_t](#)  
= 14, [jeod::De4xxBase::De4xx\\_File\\_MaxEntries](#) }  
*Defines names for planetary body descriptors in the ephemeris file.*
- enum [jeod::De4xxBase::De4xxEphemConsts](#) {  
[jeod::De4xxBase::De4xx\\_Const\\_DENUM](#) = 0, [jeod::De4xxBase::De4xx\\_Const\\_LENUM](#), [jeod::De4xxBase::De4xx\\_Const\\_AU](#),  
[jeod::De4xxBase::De4xx\\_Const\\_EMERAT](#),  
[jeod::De4xxBase::De4xx\\_Const\\_CLIGHT](#), [jeod::De4xxBase::De4xx\\_Const\\_GM1](#), [jeod::De4xxBase::De4xx\\_Const\\_GM2](#),  
[jeod::De4xxBase::De4xx\\_Const\\_GMB](#),  
[jeod::De4xxBase::De4xx\\_Const\\_GM4](#), [jeod::De4xxBase::De4xx\\_Const\\_GM5](#), [jeod::De4xxBase::De4xx\\_Const\\_GM6](#),  
[jeod::De4xxBase::De4xx\\_Const\\_GM7](#),  
[jeod::De4xxBase::De4xx\\_Const\\_GM8](#), [jeod::De4xxBase::De4xx\\_Const\\_GM9](#), [jeod::De4xxBase::De4xx\\_Const\\_GMS](#),  
[jeod::De4xxBase::De4xx\\_Const\\_MaxConsts](#) }  
*Index aliases for the constants listed in the DE header that are used by JEOD.*
- enum [jeod::De4xxBase::De4xxEphemBodies](#) {  
[jeod::De4xxBase::De4xx\\_Ephem\\_Sun](#) = 0, [jeod::De4xxBase::De4xx\\_Ephem\\_Mercury](#) = 1, [jeod::De4xxBase::De4xx\\_Ephem\\_V](#)  
= 2, [jeod::De4xxBase::De4xx\\_Ephem\\_Earth](#) = 3,  
[jeod::De4xxBase::De4xx\\_Ephem\\_Mars](#) = 4, [jeod::De4xxBase::De4xx\\_Ephem\\_Jupiter](#) = 5, [jeod::De4xxBase::De4xx\\_Ephem\\_S](#)  
= 6, [jeod::De4xxBase::De4xx\\_Ephem\\_Uranus](#) = 7,  
[jeod::De4xxBase::De4xx\\_Ephem\\_Neptune](#) = 8, [jeod::De4xxBase::De4xx\\_Ephem\\_Pluto](#) = 9, [jeod::De4xxBase::De4xx\\_Ephem\\_](#)  
= 10, [jeod::De4xxBase::De4xx\\_Ephem\\_EMbary](#) = 11,  
[jeod::De4xxBase::De4xx\\_Ephem\\_SSbary](#) = 12, [jeod::De4xxBase::De4xx\\_Ephem\\_EML1](#) = 13, [jeod::De4xxBase::De4xx\\_Epher](#)  
= 14, [jeod::De4xxBase::De4xx\\_Ephem\\_LLibration](#) = 15,  
[jeod::De4xxBase::De4xx\\_Ephem\\_MaxBodies](#) }  
*Defines names for ephemeris items as represented in the JEOD DE4xx model.*



## Functions

- static const char \*point\_names [32] [jeod::De4xxBase::\\_\\_attribute\\_\\_](#) ((unused))
- static uint32\_t [jeod::De4xxBase::number\\_jeod\\_items](#) (int de\_version\_num \_\_attribute\_\_((unused)))  
*Total number of items in the JEOD ephemeris.*
- static uint32\_t [jeod::De4xxBase::number\\_trans\\_points](#) (int de\_version\_num \_\_attribute\_\_((unused)))  
*Total number of translational states in the JEOD ephemeris.*
- static uint32\_t [jeod::De4xxBase::number\\_grav\\_models](#) (int de\_version\_num \_\_attribute\_\_((unused)))  
*Number of gravity models in the JEOD ephemeris (Mercury to Sun + implied Earth) Currently only one possibility, but written for extensibility.*
- static uint32\_t [jeod::De4xxBase::number\\_physical\\_bodies](#) (int de\_version\_num \_\_attribute\_\_((unused)))  
*Number of bodies in the JEOD ephemeris (Planets + Pluto + Moon + Sun) Currently only one possibility, but written for extensibility.*

### 9.49.1 Detailed Description

Define data types for JPL ephemeris model.

## 9.50 de4xx\_ephem.cc File Reference

Define the methods of the classes defined in [de4xx\\_ephem.hh](#).

```
#include <cstddef>
#include <cstdio>
#include <sstream>
#include "environment/ephemerides/ephem_interface/include/ephem_messages.↵
hh"
#include "environment/ephemerides/ephem_manager/include/ephem_manager.hh"
#include "environment/planet/include/base_planet.hh"
#include "environment/time/include/time_dyn.hh"
#include "environment/time/include/time_manager.hh"
#include "environment/time/include/time_tt.hh"
#include "utils/math/include/numerical.hh"
#include "utils/math/include/vector3.hh"
#include "utils/memory/include/jeod_alloc.hh"
#include "utils/message/include/message_handler.hh"
#include "utils/named_item/include/named_item.hh"
#include "../include/de4xx_ephem.hh"
```

## Namespaces

- [jeod](#)  
*Namespace jeod.*

### 9.50.1 Detailed Description

Define the methods of the classes defined in [de4xx\\_ephem.hh](#).

## 9.51 de4xx\_ephem.hh File Reference

Define class for the De4xx ephemeris model.

```
#include <climits>
#include <string>
#include "environment/ephemerides/ephem_interface/include/ephem_interface.↵
hh"
#include "environment/ephemerides/ephem_interface/include/ephem_ref_frame.↵
hh"
#include "environment/ephemerides/ephem_item/include/ephem_item.hh"
#include "environment/ephemerides/ephem_item/include/ephem_orient_zxz.hh"
#include "environment/ephemerides/ephem_item/include/ephem_point.hh"
#include "environment/time/include/class_declarations.hh"
#include "utils/ref_frames/include/ref_frame_interface.hh"
#include "utils/sim_interface/include/jeod_class.hh"
#include "class_declarations.hh"
#include "de4xx_base.hh"
#include "de4xx_file.hh"
```

### Data Structures

- class [jeod::De4xxEphemItem](#)  
*Describes a point modeled in a DE4xx ephemeris file.*
- class [jeod::De4xxEphemeris](#)  
*The S\_define-level class that provides planetary ephemerides.*

### Namespaces

- [jeod](#)  
*Namespace jeod.*

#### 9.51.1 Detailed Description

Define class for the De4xx ephemeris model.

## 9.52 de4xx\_ephem\_dynmanager.cc File Reference

Wall off dependencies on the dynamics manager.

```
#include "dynamics/dyn_manager/include/dyn_manager.hh"
#include "environment/ephemerides/ephem_manager/include/ephem_manager.hh"
#include "environment/time/include/time_manager.hh"
#include "utils/message/include/message_handler.hh"
#include "../include/de4xx_ephem.hh"
```

## Namespaces

- [jeod](#)

*Namespace jeod.*

### 9.52.1 Detailed Description

Wall off dependencies on the dynamics manager.

## 9.53 de4xx\_file.cc File Reference

This file defines several utility functions used to read a binary JPL DE405 ephemeris file.

```
#include <cerrno>
#include <cstdint>
#include <cstdio>
#include <cstdlib>
#include <cstring>
#include <dlfcn.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
#include <fstream>
#include <ios>
#include <iostream>
#include <string>
#include "environment/ephemerides/ephem_interface/include/ephem_messages.↵
hh"
#include "utils/memory/include/jeod_alloc.hh"
#include "utils/message/include/message_handler.hh"
#include "../include/de4xx_file.hh"
```

## Namespaces

- [jeod](#)

*Namespace jeod.*

## Macros

- `#define __STDC_LIMIT_MACROS`

## Functions

- void [jeod::process\\_mem\\_usage](#) (double &vm\_usage, double &resident\_set)

### 9.53.1 Detailed Description

This file defines several utility functions used to read a binary JPL DE405 ephemeris file.

The functions are

open - Open an ephemeris file for input  
 close - Close a previously open ephemeris file  
 read\_record - Read a record from the ephemeris file  
 get\_string - Get a string from the current data record  
 get\_int - Get integer array from the current data record  
 get\_double - Get double array from the current data record

NOTA BENE – The functions defined in this file are intended for use by the top-level ephemeris functions only.

## 9.54 de4xx\_file.hh File Reference

Define the class responsible for reading the DE4xx ephemeris file.

```
#include <cstddef>
#include <cstdint>
#include <cstdio>
#include <limits>
#include "utils/container/include/simple_checkpointable.hh"
#include "utils/sim_interface/include/config.hh"
#include "utils/sim_interface/include/jeod_class.hh"
#include "de4xx_base.hh"
```

### Data Structures

- struct [jeod::EphemerisDataSetMeta](#)  
*Container for the metadata from the DE model header.*
- struct [jeod::EphemerisDataItemMeta](#)  
*Structure containing the header metadata for sizing/locating the data entries with the data segments.*
- struct [jeod::EphemerisDataSegmentMeta](#)  
*Metadata implied from each data segment.*
- class [jeod::De4xxFileSpec](#)  
*Specifies which file to use (user input initialization-time data).*
- class [jeod::De4xxFileIO](#)  
*Contains data used directly for reading the ephemeris file.*
- class [jeod::De4xxFileHeader](#)  
*Contains data extracted from the ephemeris file header.*
- class [jeod::De4xxFileItem](#)  
*Contains data regarding one of the items in a DE ephemeris file.*
- class [jeod::De4xxFileRefTime](#)  
*Contains timing reference data.*
- class [jeod::De4xxFileCoef](#)  
*Contains Chebychev polynomial coefficients and terms.*
- class [jeod::De4xxFileRestart](#)  
*The FILE pointer in a [De4xxFileIO](#) cannot be restored by Trick.*
- class [jeod::De4xxFile](#)  
*Provides the ability to read and interpret a DE4xx ephemeris file.*

## Namespaces

- [jeod](#)

*Namespace jeod.*

### 9.54.1 Detailed Description

Define the class responsible for reading the DE4xx ephemeris file.

## 9.55 de4xx\_file\_init.cc File Reference

Define De4xx initialization methods.

```
#include <cerrno>
#include <climits>
#include <cmath>
#include <cstddef>
#include <dlfcn.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
#include "environment/ephemerides/ephem_interface/include/ephem_messages.↵
hh"
#include "utils/memory/include/jeod_alloc.hh"
#include "utils/message/include/message_handler.hh"
#include "../include/de4xx_file.hh"
```

## Namespaces

- [jeod](#)

*Namespace jeod.*

## Functions

- static double [jeod::l1\\_point](#) (double b1b2\_mass\_ratio)

*Calculate the location of the L1 point as a ratio.*

### 9.55.1 Detailed Description

Define De4xx initialization methods.

## 9.56 de4xx\_file\_update.cc File Reference

Define De4xxFile::update.

```
#include <cstdint>
#include <stdint>
#include <dlfcn.h>
#include <limits>
#include <sstream>
#include "environment/ephemerides/ephem_interface/include/ephem_messages.↵
hh"
#include "utils/math/include/numerical.hh"
#include "utils/message/include/message_handler.hh"
#include "../include/de4xx_file.hh"
```

### Namespaces

- [jeod](#)  
*Namespace jeod.*

### 9.56.1 Detailed Description

Define De4xxFile::update.

## 9.57 ephem\_interface.hh File Reference

Define base class for all ephemeris interface models.

```
#include <string>
#include "utils/ref_frames/include/subscription.hh"
#include "utils/sim_interface/include/jeod_class.hh"
```

### Data Structures

- class [jeod::EphemerisInterface](#)  
*Interface class that specifies minimal functionality of an ephemeris model.*

### Namespaces

- [jeod](#)  
*Namespace jeod.*

### 9.57.1 Detailed Description

Define base class for all ephemeris interface models.

## 9.58 ephemer\_item.cc File Reference

Define member functions for the EphemerItem class and subclasses.

```
#include <cstdint>
#include "environment/ephemerides/ephem_interface/include/ephem_interface.↵
hh"
#include "environment/ephemerides/ephem_interface/include/ephem_messages.↵
hh"
#include "environment/ephemerides/ephem_manager/include/base_ephem_manager.↵
hh"
#include "environment/planet/include/base_planet.hh"
#include "utils/math/include/vector3.hh"
#include "utils/memory/include/jeod_alloc.hh"
#include "utils/message/include/message_handler.hh"
#include "utils/named_item/include/named_item.hh"
#include "../include/ephemer_item.hh"
```

### Namespaces

- [jeod](#)  
*Namespace jeod.*

#### 9.58.1 Detailed Description

Define member functions for the EphemerItem class and subclasses.

## 9.59 ephemer\_item.hh File Reference

Define classes for items represented in some ephemeris model.

```
#include "environment/ephemerides/ephem_interface/include/ephem_interface.↵
hh"
#include "environment/ephemerides/ephem_interface/include/ephem_ref_frame.↵
hh"
#include "utils/sim_interface/include/jeod_class.hh"
#include "class_declarations.hh"
#include "ephemer_item_inline.hh"
```

### Data Structures

- class [jeod::EphemerisItem](#)  
*The [EphemerisItem](#) class is the base class for representing an item that is modeled in an ephemeris model.*

### Namespaces

- [jeod](#)  
*Namespace jeod.*

### 9.59.1 Detailed Description

Define classes for items represented in some ephemeris model.

## 9.60 ephem\_item\_inline.hh File Reference

Define inline methods for the EphemerisItem class.

```
#include "ephem_item.hh"
```

### Namespaces

- [jeod](#)

*Namespace jeod.*

### 9.60.1 Detailed Description

Define inline methods for the EphemerisItem class.

## 9.61 ephem\_manager.cc File Reference

Define EphemeridesManager methods.

```
#include <algorithm>
#include <cstring>
#include "environment/ephemerides/ephem_interface/include/ephem_messages.↵
hh"
#include "environment/ephemerides/ephem_interface/include/ephem_ref_frame.↵
hh"
#include "environment/ephemerides/ephem_item/include/ephem_item.hh"
#include "environment/ephemerides/ephem_item/include/ephem_orient.hh"
#include "environment/ephemerides/ephem_item/include/ephem_point.hh"
#include "environment/planet/include/base_planet.hh"
#include "utils/memory/include/jeod_alloc.hh"
#include "utils/message/include/message_handler.hh"
#include "utils/ref_frames/include/ref_frame.hh"
#include "../include/ephem_manager.hh"
```

### Namespaces

- [jeod](#)

*Namespace jeod.*



### 9.61.1 Detailed Description

Define EphemeridesManager methods.

## 9.62 ephemer\_manager.hh File Reference

Define the EphemManager class, which manages the ephemeris models in a JEOD-based simulation.

```
#include "utils/container/include/pointer_vector.hh"
#include "utils/ref_frames/include/ref_frame_manager.hh"
#include "utils/sim_interface/include/jeod_class.hh"
#include "base_ephem_manager.hh"
```

### Data Structures

- class [jeod::EphemeridesManager](#)  
The *EphemeridesManager* class manages the ephemeris models in a simulation.

### Namespaces

- [jeod](#)  
Namespace *jeod*.

### 9.62.1 Detailed Description

Define the EphemManager class, which manages the ephemeris models in a JEOD-based simulation.

## 9.63 ephemer\_messages.cc File Reference

Implement the class EphemeridesMessages.

```
#include "utils/message/include/make_message_code.hh"
#include "../include/ephemer_messages.hh"
```

### Namespaces

- [jeod](#)  
Namespace *jeod*.

### Macros

- #define [MAKE\\_EPHEMERIDES\\_MESSAGE\\_CODE](#)(id) JEOD\_MAKE\_MESSAGE\_CODE(EphemeridesMessages, "environment/ephemerides/", id)

### 9.63.1 Detailed Description

Implement the class EphemeridesMessages.

### 9.63.2 Macro Definition Documentation

#### 9.63.2.1 MAKE\_EPHEMERIDES\_MESSAGE\_CODE

```
#define MAKE_EPHEMERIDES_MESSAGE_CODE(  
    id ) JEOD_MAKE_MESSAGE_CODE(EphemeridesMessages, "environment/ephemerides/", id)
```

Definition at line 39 of file ephem\_messages.cc.

## 9.64 ephem\_messages.hh File Reference

Define the class EphemeridesMessages, the class that specifies the message IDs used in the JEOD ephemerides model.

```
#include "utils/sim_interface/include/jeod_class.hh"
```

### Data Structures

- class [jeod::EphemeridesMessages](#)  
*Specifies the message IDs used in the Ephemerides model.*

### Namespaces

- [jeod](#)  
*Namespace jeod.*

### 9.64.1 Detailed Description

Define the class EphemeridesMessages, the class that specifies the message IDs used in the JEOD ephemerides model.

## 9.65 ephemeris.cc File Reference

Define member functions for the EphemerisItem class and subclasses.

```
#include <cstdint>
#include "environment/ephemerides/ephemeris_interface/include/ephemeris_interface.↵
hh"
#include "environment/ephemerides/ephemeris_interface/include/ephemeris_messages.↵
hh"
#include "environment/ephemerides/ephemeris_manager/include/ephemeris_manager.hh"
#include "environment/planet/include/base_planet.hh"
#include "utils/math/include/vector3.hh"
#include "utils/memory/include/jeod_alloc.hh"
#include "utils/message/include/message_handler.hh"
#include "utils/named_item/include/named_item.hh"
#include "../include/ephemeris.hh"
```

### Namespaces

- [jeod](#)  
*Namespace jeod.*

#### 9.65.1 Detailed Description

Define member functions for the EphemerisItem class and subclasses.

## 9.66 ephemeris.hh File Reference

Define class EphemerisOrientation.

```
#include "environment/ephemerides/ephemeris_interface/include/ephemeris_interface.↵
hh"
#include "environment/ephemerides/ephemeris_interface/include/ephemeris_ref_frame.↵
hh"
#include "utils/sim_interface/include/jeod_class.hh"
#include "class_declarations.hh"
#include "ephemeris_item.hh"
```

### Data Structures

- class [jeod::EphemerisOrientation](#)  
*An [EphemerisOrientation](#) object updates the rotational state of an ephemeris reference frame.*

### Namespaces

- [jeod](#)  
*Namespace jeod.*

### 9.66.1 Detailed Description

Define class EphemerisOrientation.

## 9.67 `ephem_orient_zxz.cc` File Reference

Define member functions for the EphemItem class and subclasses.

```
#include <cmath>
#include <cstdlib>
#include "environment/ephemerides/ephem_interface/include/ephem_interface.↵
hh"
#include "environment/ephemerides/ephem_interface/include/ephem_messages.↵
hh"
#include "environment/ephemerides/ephem_manager/include/ephem_manager.hh"
#include "environment/planet/include/base_planet.hh"
#include "utils/math/include/vector3.hh"
#include "utils/memory/include/jeod_alloc.hh"
#include "utils/message/include/message_handler.hh"
#include "utils/named_item/include/named_item.hh"
#include "utils/quaternion/include/quat.hh"
#include "../include/ephem_orient_zxz.hh"
```

### Namespaces

- [jeod](#)  
*Namespace jeod.*

### Macros

- `#define EPSILON_TIME` 1e-12
- `#define TAYLOR_CUTOFF` 0.00786

### 9.67.1 Detailed Description

Define member functions for the EphemItem class and subclasses.

## 9.68 `ephem_orient_zxz.hh` File Reference

Define classes for items represented in some ephemeris model.

```
#include "environment/ephemerides/ephem_interface/include/ephem_interface.↵
hh"
#include "environment/ephemerides/ephem_interface/include/ephem_ref_frame.↵
hh"
#include "utils/sim_interface/include/jeod_class.hh"
#include "class_declarations.hh"
#include "ephem_orient.hh"
```

## Data Structures

- class [jeod::EphemerisZXZOrientation](#)

The [EphemerisZXZOrientation](#) is an [EphemerisOrientation](#) subclass that updates orientation based on an Z-X-Z Euler sequence and the time derivatives of this sequence.

## Namespaces

- [jeod](#)

Namespace [jeod](#).

### 9.68.1 Detailed Description

Define classes for items represented in some ephemeris model.

## 9.69 ephem\_point.cc File Reference

Define member functions for the EphemPoint class.

```
#include <cstdint>
#include "environment/ephemerides/ephem_interface/include/ephem_interface.↵
hh"
#include "environment/ephemerides/ephem_interface/include/ephem_messages.↵
hh"
#include "environment/ephemerides/ephem_manager/include/ephem_manager.hh"
#include "environment/planet/include/base_planet.hh"
#include "utils/math/include/vector3.hh"
#include "utils/memory/include/jeod_alloc.hh"
#include "utils/message/include/message_handler.hh"
#include "utils/named_item/include/named_item.hh"
#include "../include/ephem_point.hh"
```

## Namespaces

- [jeod](#)

Namespace [jeod](#).

### 9.69.1 Detailed Description

Define member functions for the EphemPoint class.

## 9.70 ephem\_point.hh File Reference

Define class EphemerisPoint.

```
#include "utils/sim_interface/include/jeod_class.hh"
#include "class_declarations.hh"
#include "ephem_item.hh"
```

## Data Structures

- class [jeod::EphemerisPoint](#)

An [EphemerisPoint](#) object updates the translational state of an ephemeris reference frame.

## Namespaces

- [jeod](#)

Namespace *jeod*.

### 9.70.1 Detailed Description

Define class EphemerisPoint.

## 9.71 `ephem_ref_frame.cc` File Reference

Define non-inlined member functions for the EphemRefFrame class.

```
#include <cstdint>
#include "environment/ephemerides/ephem_manager/include/base_ephem_manager.↵
hh"
#include "utils/message/include/message_handler.hh"
#include "../include/ephem_interface.hh"
#include "../include/ephem_messages.hh"
#include "../include/ephem_ref_frame.hh"
```

## Namespaces

- [jeod](#)

Namespace *jeod*.

### 9.71.1 Detailed Description

Define non-inlined member functions for the EphemRefFrame class.

## 9.72 `ephem_ref_frame.hh` File Reference

Define the class EphemerisRefFrame.

```
#include <cstdint>
#include "utils/ref_frames/include/ref_frame.hh"
#include "utils/ref_frames/include/ref_frame_interface.hh"
#include "utils/sim_interface/include/jeod_class.hh"
```

## Data Structures

- class [jeod::EphemerisRefFrame](#)

An [EphemerisRefFrame](#) is a [RefFrame](#) whose state is set by an ephemeris model.

## Namespaces

- [jeod](#)

Namespace [jeod](#).

### 9.72.1 Detailed Description

Define the class [EphemerisRefFrame](#).

## 9.73 find\_planet.cc File Reference

Define [EphemeridesManager::find\\_planet](#).

```
#include <cstdint>
#include "environment/ephemerides/ephem_interface/include/ephem_messages.h"
#include "environment/planet/include/base_planet.hh"
#include "environment/planet/include/planet.hh"
#include "utils/message/include/message_handler.hh"
#include "../include/ephem_manager.hh"
```

## Namespaces

- [jeod](#)

Namespace [jeod](#).

### 9.73.1 Detailed Description

Define [EphemeridesManager::find\\_planet](#).

This method is isolated from the other [EphemeridesManager](#) methods because the object file drags in a whole lot of stuff.

## 9.74 propagated\_planet.cc File Reference

Define the methods of the classes defined in [propagated\\_planet.hh](#).

```
#include <climits>
#include <cstdint>
#include <cstdio>
#include "dynamics/dyn_manager/include/dyn_manager.hh"
#include "environment/ephemerides/ephem_interface/include/ephem_messages.↵
hh"
#include "environment/ephemerides/ephem_manager/include/ephem_manager.hh"
#include "environment/planet/include/base_planet.hh"
#include "environment/time/include/time_dyn.hh"
#include "environment/time/include/time_manager.hh"
#include "environment/time/include/time_tt.hh"
#include "utils/math/include/vector3.hh"
#include "utils/memory/include/jeod_alloc.hh"
#include "utils/message/include/message_handler.hh"
#include "utils/named_item/include/named_item.hh"
#include "../include/propagated_planet.hh"
```

### Namespaces

- [jeod](#)  
*Namespace jeod.*

### 9.74.1 Detailed Description

Define the methods of the classes defined in [propagated\\_planet.hh](#).

## 9.75 propagated\_planet.hh File Reference

Define the classes needed to propagate a planet.

```
#include "dynamics/dyn_body/include/dyn_body.hh"
#include "environment/ephemerides/ephem_interface/include/ephem_interface.↵
hh"
#include "environment/ephemerides/ephem_item/include/ephem_item.hh"
#include "environment/ephemerides/ephem_item/include/ephem_orient.hh"
#include "environment/ephemerides/ephem_item/include/ephem_point.hh"
#include "utils/sim_interface/include/jeod_class.hh"
```

### Data Structures

- class [jeod::PropagatedEphemerisPlanet](#)  
*A [PropagatedEphemerisPlanet](#) is an [EphemerisPoint](#) whose state is coupled with the translational state of a [DynBody](#) reference frame.*
- class [jeod::PropagatedEphemerisOrientation](#)  
*A [PropagatedEphemerisOrientation](#) is an [EphemerisOrientation](#) whose state is coupled with the rotational state of a [DynBody](#) reference frame.*
- class [jeod::PropagatedPlanet](#)  
*The [PropagatedPlanet](#) ephemeris model provides planetary state via a [DynBody](#) object whose state is propagated using the JEOD state integration techniques.*



## Namespaces

- [jeod](#)  
*Namespace jeod.*

### 9.75.1 Detailed Description

Define the classes needed to propagate a planet.

## 9.76 simple\_ephemerides.cc File Reference

Define member functions for the SinglePointEphemeris class and subclasses.

```
#include <cstddef>
#include "environment/ephemerides/ephem_manager/include/ephem_manager.hh"
#include "utils/memory/include/jeod_alloc.hh"
#include "utils/message/include/message_handler.hh"
#include "../include/ephem_messages.hh"
#include "../include/simple_ephemerides.hh"
```

## Namespaces

- [jeod](#)  
*Namespace jeod.*

### 9.76.1 Detailed Description

Define member functions for the SinglePointEphemeris class and subclasses.

## 9.77 simple\_ephemerides.hh File Reference

Define classes that define simple ephemeris models.

```
#include "environment/ephemerides/ephem_item/include/ephem_point.hh"
#include "utils/sim_interface/include/jeod_class.hh"
#include "ephem_interface.hh"
#include "ephem_ref_frame.hh"
```

## Data Structures

- class [jeod::SinglePointEphemeris](#)  
*A [SinglePointEphemeris](#) has one ephemeris point.*
- class [jeod::EmptySpaceEphemeris](#)  
*Empty space has one ephemeris point.*
- class [jeod::SinglePlanetEphemeris](#)  
*A space with one gravitation body has one ephemeris point.*

## Namespaces

- [jeod](#)

*Namespace jeod.*

### 9.77.1 Detailed Description

Define classes that define simple ephemeris models.

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