SPHENGINEERING
SMART PLANES & HELICOPTERS

UgCS

DESKTOP APPLICATION version 3.3 (438)

USER MANUAL

Table of Contents

1 Safety considerations

Before flying with UgCS please consider the following statements:

1. It is the responsibility of the user to operate the system safely in order to avoid harming other people, animals, legal property or encountering other damages by taking unnecessary risks.

2. The user must be familiar with, and comply with location-specific legal regulations before using UgCS.

3. Make sure that the first waypoint is located close to the actual take-off point and there is no significant vertical drop.

4. Make sure to specify correct altitude of the take-off point before the flight. Please refer to "Take-off Altitude" paragraph of this manual. It is important to do this because the barometer readings can change between power-on, route upload and take-off.

5. The automatic take-off and landing is not recommended in case of strong wind, as it can lead to a crash. In a scenario like this, it is safer to take-off and land the vehicle in manual mode. Use Automatic mode only in mid-air.

2 Installation and System Requirements

There are two installation modes for all operating systems:

- "Simple deployment" installs all the components on a single computer and runs the components as processes inside a user session;

- Users with advanced requirements can choose the "Advanced deployment" option that allows the installation of different components on separate machines and/or the ability to run them as separate services.

System requirements for Simple installation

OS	Windows		macOS		Linux
Operating system	Windows 7 with SP1 or later; Windows 8; Windows 10*	64-bit	macOS 10.13 High Sierra or later*	64-bit	Ubuntu 16.04 LTS 64-bit**
CPU	Core 2 Duo or Athlon X2 at 2.4 GHz				
Memory	Recommended: 4 GB of RAM				
Hard drive	2 GB of free space				
Graphics hardware	Graphics card with DirectX 10 support (shader model 4.0). Any card made since 2009 should work.				
Network	TCP/IPv4 network stack				
Screen resolution	Minimum supported screen resolution: 1024x768				

*Note the software was not tested on server versions of Windows and OS X. Windows Vista is not supported.

**UgCS client requires support of OpenGL Core profile version 3.2 or higher to run on Linux. If this requirement is not met, UgCS client will fail to start. In that case Player.log file in" ~/.config/unity3d/SPH Engineering/UgCS [version_number]" will contain lines "Unable to find a supported OpenGL core profile" and "No supported renderers found, exiting".

System Requirements for Advanced Installation

OS	UgCS client	UCS	VSM	Emulator
Operating system	Windows: Windows 7 with SP1 or later; Windows 8; Windows 10* 64 bit			
	macOS: 10.13 High Sierra or later* 64 bit			
	Linux**: Ubuntu 16.04 LTS 64 bit			
CPU	Core 2 Duo or Athlon X2 at 2.4 GHz		1 GHz processor (Intel Celeron or better)	
Memory	2 GB RAM recommended		512 Mb RAM	
Hard drive	1 GB free space		256 Mb free space	
Graphics hardware	Graphics card with DirectX 10 support (shader model 4.0). Any card made since 2009 should work.	VGA capable of 1024x768 screen resolution		
Network	TCP/IPv4 network stack			
Screen resolution	Minimum supported screen resolution: 1024x768			

*Note the software was not tested on server versions of Windows and OS X. Windows Vista is not supported.

**UgCS client requires support of OpenGL Core profile version 3.2 or higher to run on Linux. If this requirement is not met, UgCS client will fail to start. In that case Player.log file in" ~/.config/unity3d/SPH Engineering/UgCS [version number]" will contain lines "Unable to find a supported OpenGL core profile" and "No supported renderers found, exiting".

2.1   Windows

For quick installation, follow these steps:

1. Run the installer ugcs-3.3.exe;

2. Follow the "Getting started" instructions in this manual;

3. Read the license agreement carefully (see End User License Agreement in a separate file).

2.2   Linux

For Linux, .deb packages are available on our website ugcs.com. For Linux installation instructions please go to http://apt.ugcs.com/doc.

NOTE: As of 3.0 UgCS requires OpenGL Core profile version 3.2 or higher.

2.3   mac OS

For quick installation, follow these steps:

1. Run the installer ugcs-3.3.dmg;

2. Follow the installation guide;

3. Read the license agreement carefully (see End User License Agreement in a separate file).

3   Useful links

Diverse basic instructions for setup and import

- https://wiki.ugcs.com/How_to

Detailed information on UgCS various application scenarios

- https://www.ugcs.com/photogrammetry-tool-for-land-surveying

Frequently asked question page with most common question

- https://wiki.ugcs.com/Faq

Visit UgCS YouTube channel with various tutorials, webinars and videos

- https://www.youtube.com/user/ugcstv

4   License activation

Initially installed UgCS software has limited functionality: the option to upload routes to vehicles is disabled, except the emulators. To activate the full functionality of UgCS a license code has to be activated.

The activation code of UgCS license will be sent via e-mail, after successful purchase at www.ugcs.com.

To activate UgCS license, select the License icon and enter/paste the activation code from e-mail. Click "Activate" – the license status will change to "Activated".

For assistance, please contact support@ugcs.com.

5   Overview

The typical operation with UgCS and UAV will consist of the following steps:

- connecting drone to UgCS;

- checking drone parameters;

- deciding where to fly and planning the route;

- performing actual flight;

- post-flight analysis, replaying telemetry, geocoding data.

UgCS user interface consists of three main windows:

1. *Mission editor.* Tools for route planning (left part of the screen) and drones management (right part of the screen), including route uploading, issuing commands and telemetry reception.
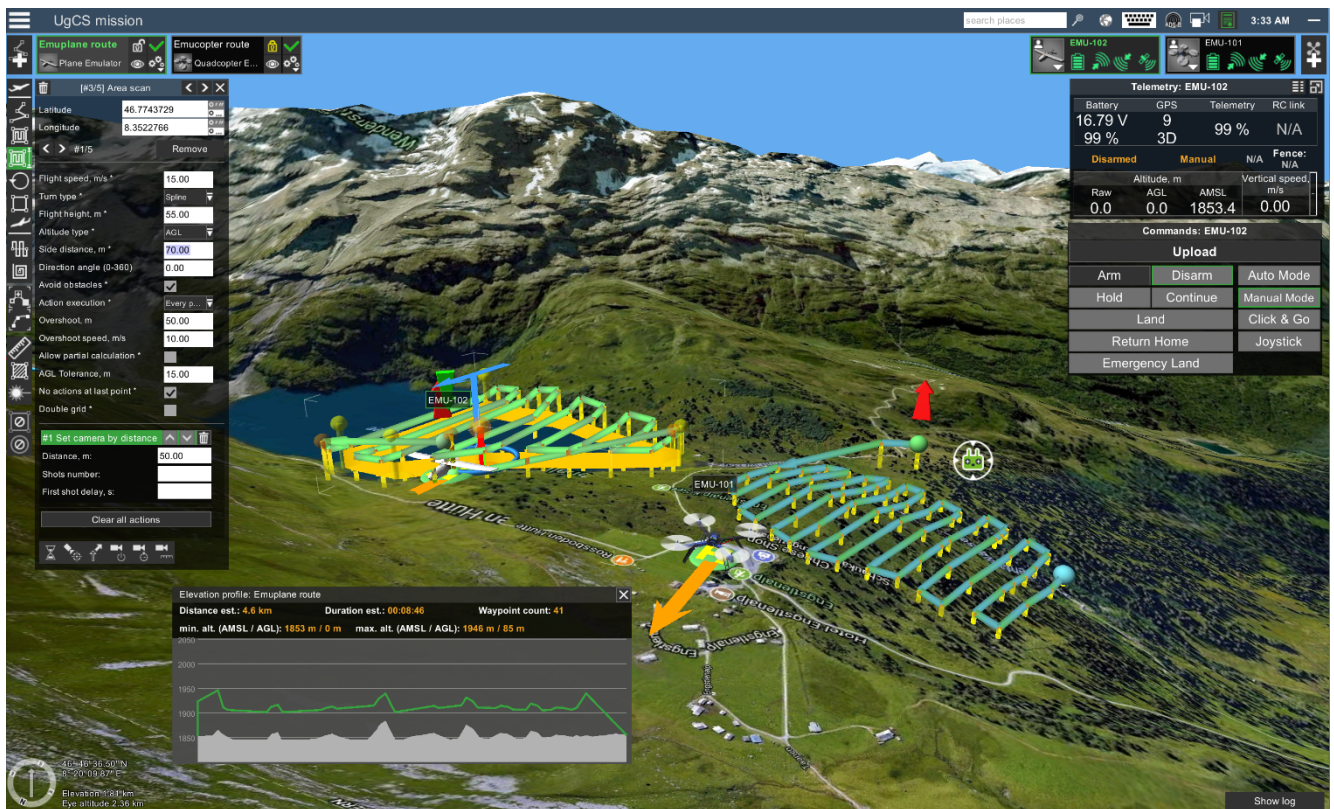
Figure 1 - Mission editor

Note: The RC position is only displayed when GPS module is turned on an Android device

2. **Telemetry player**. For post flight analysis, telemetry replaying for a selected vehicle and image geocoding.

Figure 2 - Telemetry player

3. **Main menu** - provides access to various configuration settings of the software.
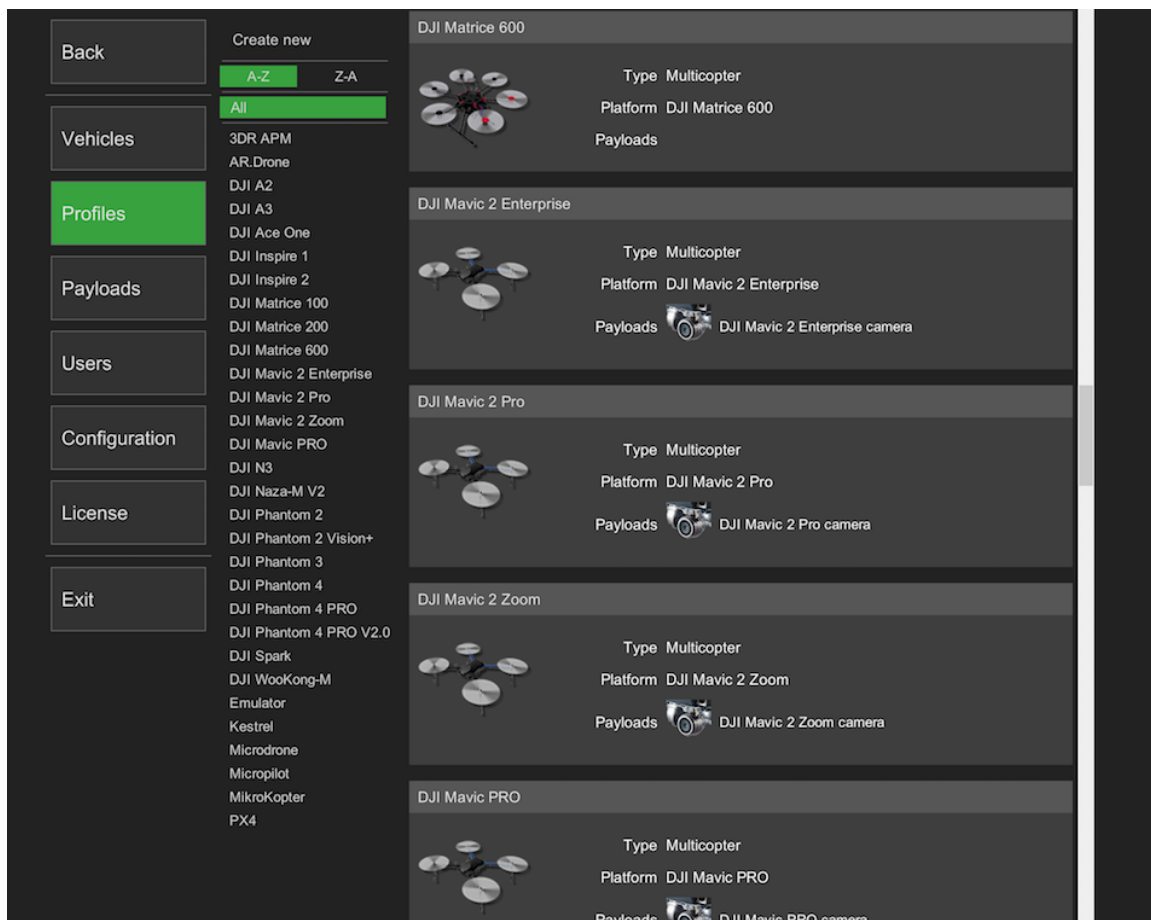
Figure 3 - Main menu

6 Standard operations

6.1 Mission editor: flight preparation

By default, mission editor is the first window that is displayed after application starts. UgCS version number of applications is displayed in the upper left corner. Please provide the UgCS version number when contacting UgCS support. Please see Figure 4 - Mission editor for more detailed explanation of main functionality.

Figure 4 - Mission editor

#UI block	Description
1	MENU button to access Main Menu settings, switches between Mission editor or Telemetry player screens, and Exits (Quits) software. Available functions for the Mission editor mode are to Create a new, Open existing, Stop editing, Remove, Import or Export a mission. Functions for the Telemetry player's mode: Import and Export telemetry.

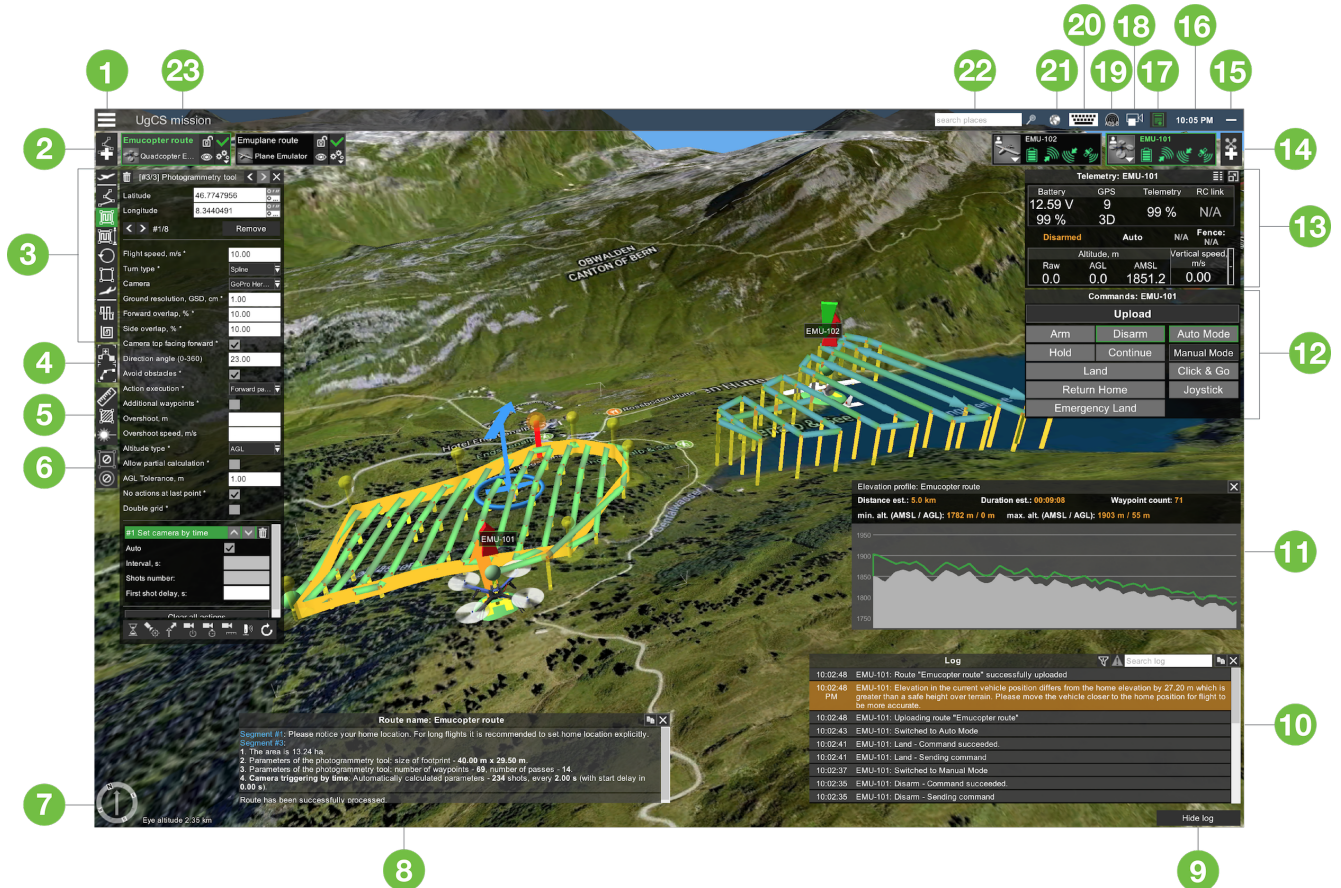|	
2	From left to right: Add new route button, following by the list of created Route cards.
	Each Route card indicates: Route's name, Assigned vehicle profile, Status of route's calculation, option to lock route for editing (route is automatically locked after uploading to vehicle), option to Hide/Show the route and Parameters setting button (right bottom corner of the Route card - the gears symbol).
	• Hovering cursor over Route card - displays short route status.
	• Click the calculation indicator of the Route to open / hide **Route's log**.
	• Double-click the Route's card will recenter point of view to appropriate route on the map.
	Route calculation indicators: ✔ Green check - the route is calculated and is ready to upload to the vehicle;
	● Yellow dot - the route is not calculated. If calculation doesn't start automatically, click the yellow dot to initiate calculation;
	❗ Red exclamation - route calculated with errors.
3	Route planning tools and associated tool's settings window - select a tool, draw route segment on the map, then configure parameters in route's tool setting window. Note: available Route planning tools can differ, depending on vehicle type. To draw a route, double-click (or SHIFT+click) on the map. To draw a freehanded curve, hold Alt+left click and draw by moving mouse on the map.
4	**Modifying** tools: the + Modifier tool allows to add a segment before a selected segment into a created route; the freehand Modifier tool allows to draw a freehand line, that will be automatically converted to waypoint route.
5	Measurement tools: Distance, Area and Visibility measurement tools.
6	No-Fly-Zone drawing tools: Polygon and Conical drawing tools.
7	**Compass, cursors coordinates on map** and **elevation** indicator. To return map to North-up view, click the compass icon.
8	**Route's log** - all route related notifications are displayed here. To open the log, click on route card's calculation status indicator.
9	Show / hide **route's log** button.
10	**Vehicle's log** - recent vehicle related notifications appear here, but will disappear after some time. To open full vehicle notification list, click Show log button.
11	**Elevation's profile** - displaying the AMSL or AGL elevation of the vehicle for the planned route. Also, displaying the estimated distance of the route, estimated duration of the flight, total count of waypoints and minimal and maximal altitude AMSL/AGL.
12	**Vehicle's command** buttons - these commands are never blocked to provide the pilot with ability to send any command to the vehicle at any time. **Note**: Vehicle command buttons can differ, depending on vehicle type. Button is dark grey - it is active and command can be sent to vehicle. If button is light-grey - based on telemetry data, it is not possible to send command to vehicle - the button is inactive. Button has green border - according to telemetry data, the vehicle is in current mode. (On the example screenshot, the vehicle is Disarmed in Auto mode.)

	Some commands may require confirmation to activate them; therefore, an additional window will be displayed.
13	**Telemetry's window** for selected vehicle.
14	From right to left: **Add vehicle** button (+) adds vehicle to the mission from a list. Usually all vehicles connected via datalink to the computer, are automatically added to the list. **Vehicle cards** are displayed to the left from **Add vehicle** button, indicating: Vehicle name, Battery status, Uplink level, Downlink level, GPS status (satellites count) and settings button (right bottom corner on Vehicle icon). • Hovering cursor over Vehicle card - basic information about the vehicle is being displayed (name, profile, serial number, connection port) • Double-click on the Vehicle card will recenter point of view to the appropriate vehicle position on the map.
15	**User interface minimize / restore** button - hides or displays all user interface (UI) elements.
16	**Clock** - displays clock with milliseconds, hover mouse cursor over the clock.
17	**License status indicator** - displays the license activation status of UgCS: green - the license is activated, yellow - not activated.
18	**Video recording indicator** - during video recording the square is red, otherwise - white.
19	**ADS-B indicator** - connection status of the ADS-B receiver: the indicator is green if connected, grey - if not.
20	**Input mapping** (keyboard symbol) - keyboard and joystick configuration to check mapping and calibration for connected devices.
21	**Map option** menu (globe symbol) - Layers: select map and overlay providers, elevation sources; add buildings, import placemarks and offline caching.
22	**Location search** field - enter address or latitude and longitude coordinates to navigate to the desired location. This function depends on internet connection!
23	**Mission's title** field - double-click change the title of the mission. The title saves automatically.

6.1.1 Basic operations with missions

Mission is like a workspace that combines routes and vehicles and covers following parts of the UAV operation life cycle:

• Planning routes;

• Controlling vehicles.

Mission editor can be divided in left and right parts. All route editing controls and tools reside to the left part of the window. All vehicle related controls reside to the right side.

It is important to understand concepts used in UgCS. It is important to understand what is vehicle platform, vehicle type, vehicle profile and real vehicle.

The vehicle platform is an autopilot type. E.g., DJI A3 is a platform as well as Micropilot. Vehicle type defines the frame type: multirotor, fixed-wing. Vehicle profile is a preset of parameters mapped to a vehicle platform and vehicle type. Vehicle – is a real vehicle instance identified by id, platform and type. Vehicle linked to one of the vehicle profiles.

For instance, flying DJI A2 multirotor. For different tasks, batteries of different capacity and different cameras are used. In this case, it makes sense to create two profiles for DJI A2 with different cameras and battery settings and use these profiles during route planning.

Another important thing to note is that during route creation, vehicle profile is selected and not a real vehicle instance, that allows a planned route to be uploaded to several vehicles of the same profile.

6.1.2 A simple scenario of planning a route and flying it:

1. To start planning the route click the Add new route button (see Figure 4 - Mission editor #2);

2. "New route creation" window will be displayed;

3. Leave "Create from scratch" marked and press "Next";

4. Name the route, select the vehicle profile and press "Next";

5. Leave the default parameters at the last step. More information about this window can be found in section "Route parameters and path finding". To create a route with provided settings click "Ok". A new route card will be displayed (see Figure 4 - Mission editor #2) with the specified name;

6. To create the route, select any of the Route planning tools (see Figure 4 - Mission editor #3) and add segments on a map by double clicking or "SHIFT+right click". Each Route's planning tool has associated inspector window enabling to adjust parameters like coordinates, altitude, speed that will be considered during the calculation process. Also, the turn type and camera actions settings can be adjusted;

7. The path-finding algorithm of UgCS will automatically start the calculation of the flight path in a few seconds when user stops editing the route. The status of the calculation will be displayed as the Route's calculation indicator on the Route's card (see Figure 4 - Mission editor #2);

8. When the route is successfully calculated (green checkmark) it can be Uploaded to the vehicle. To take off, Arm the vehicle and turn on Auto flight mode (see Figure 4 - Mission editor #2).

IMPORTANT! Operation procedures differ for each vehicle type. E.g. some of them may start from the ground, others require manual take-off to safe altitude. Please read carefully the vehicle operation guide and UgCS "How to connect…" manuals. Pilot MUST know how to act in emergency situations at all time.
Note: safety is always a responsibility of pilot!

6.1.3 Screen operations:

Operation	Keyboard or mouse combination
Draw segments	Double click left mouse button / SHIFT+left mouse button / Alt+hold left mouse button and draw free-handedly

Close polygonal objects	Draw polygon segments, set last segment near to first or drag last segment onto first segment to close polygon
Select segment	Left mouse-click on segment
Select multiple segments	(Win, Linux) CTRL+right mouse click on a figure / (macOS) cmd+right mouse click on a figure
Select all segments	(Win, Linux) CTRL+A / (macOS) cmd+A
Move selected segment(-s)	Hover figure basement, hold left mouse button and drag
Move map left, right, up, down	Hold left mouse button and drag / left, right, up, down keys
Zoom in	Mouse wheel / minus key / zoom in gesture
Zoom out	Mouse wheel / plus key / zoom out gesture
Rotate screen camera left, right, up and down	Hold right mouse button and move mouse / hold Shift + left, right, up, down keys.

6.1.4 Route's planning tools

Route planning tools are organized as a tool bar (see Figure 4 - Mission editor #3). Usage algorithm for each tool:

1. Select tool on the toolbar;

2. Draw figure on map. Figure may contain one or several base points;

3. Change parameters in tool inspector;

4. Optionally add actions in tool inspector.

Rule of thumb is that speed changes and actions take effect starting from the first calculated point of a figure in which changes are defined.

Note: On mouse hover over a selected waypoint, distance to the neighboring segments will display as hints on the corresponding paths. During the adjustments of any segment, distance to the neighboring segments will be displayed until the route is calculated.

Some parameters are common for almost all tools:

Flight speed - flight speed of the drone for this segment. The speed along the straight 3D line from current WP to next WP, it should not exceed the maximum speed specified in the vehicle profile settings. Must be a positive number.

Avoid obstacles – flag to be set if buildings have to be considered when planning the path. Do not uncheck, without specific need to do so.

Avoid terrain – flag to be set if the path has to maintain a minimum height over terrain relief (the corresponding value is one of vehicle parameters). Do not uncheck this flag, unless necessary.

Turn type – defines how vehicle passes segments. There are different ways of passing a waypoint for each autopilot. For Ardupilot these are Straight and Spline. For DJI autopilots, these are Stop and Turn (default), Bank and Adaptive bank. Please refer to vehicle's manual for information about the

supported turn types and functionality. Default turn types does not have an icon on the corresponding waypoints at route planning window, other turn types do.

Action execution parameters *(not available for Takeoff, Waypoint, Landing):*

- Every point – actions will be generated on all waypoints;

- At start – the algorithm will generate actions only at the first waypoint;

- Forward passes – actions generated at all points during passage, payload disabled at turns (available only for Photogrammetry and Area scan tools).

Take-off

Take-off tool is used to mark the target position after take-off. Vehicle is expected to launch from the ground level at the Takeoff position.

Availability of this tool depends on vehicle type.

Waypoint

Waypoint tool is the default tool. To create a new waypoint, press and hold "Shift" key while simultaneously dragging up from the ground to the desired height or just double-click on the map. Therefore, not only the location but also the required altitude of the waypoint is set in one motion. The waypoint's position can be adjusted more precisely later. To change latitude and longitude, the pin can be dragged by its base. Dragging the pin by its head changes the altitude of the waypoint. Alternatively, coordinates can be corrected in numerical form using the properties window of the waypoint. Multiple waypoints can be drawn in sequence. Each waypoint drawn, creates a new route segment connecting particular waypoints.

Photogrammetry

Route points placed at the same height relative to the ground. This height is calculated based on camera settings and set GSD value. Calculated parameters (number of passes, number of camera shots, etc.) are displayed in route log window (see Figure 4 - Mission editor). Photogrammetry tool is available for UgCS ONE, UgCS PRO and UgCS ENTERPRISE license.

Note: Photogrammetry tool requires selected camera as a payload. The camera must have properly specified (positive) values of focal distance, sensor size (width and height), and sensor resolution (horizontal and vertical).

Additionally, to all common options, these features are available for Photogrammetry tool:

Move / Rotate segment - select+hold the blue circle in center to drag-and-drop Area scan segment to other location. Select+hold circle's rim to rotate whole segment.

Camera – payload assigned to a profile. In case of multiple cameras assigned to profile it is possible to select which camera to use.

Ground resolution *(GSD, cm)* – approximate ground resolution for resulting images (in centimeters per pixel).

Forward overlap *(%)* – ratio of the overlap in neighboring frames (consecutive by motion vector, see the scheme below). Value is set in the range from 1% to 90%.

Side overlap *(%)* – ratio of the overlap in neighboring frames (placed in neighboring rows, see the scheme below). Value is set in the range from 1% to 90%.

Camera top facing forward – concerns the camera orientation to the motion vector. The flag assumes the camera is oriented so that the frames overlap over the upper frame boundary motion vector. If the flag removed, the frames overlap along the lateral frame boundary.

Direction angle - used to change the direction of the main scanning progress. By default, the algorithm calculates a route scan in a bounded polygon so that the main course of the scan performs in the direction of "South-North".

Additional waypoints – if the flag cleared, the algorithm generates only the turning points. If the flag is set, additional waypoints for camera shooting will be generated depending on overlap and camera settings.

Overshoot, m – adds extra segment to both ends of each survey line to allow extra space for turns.

Overshoot speed, m/s - option to decrease/increase vehicle speed for overshoot segment while passing turns.

Altitude type – *AMSL or AGL to set Flight height.*

Altitude AMSL - calculated from lowest point using GSD. However, the number of shots required to meet forward overlap and side overlap constraints are being calculated using altitude difference between calculated flight altitude AMSL and highest point of the area.

Allow partial calculation – option to allow route calculation in these cases:

- The part of route exceeds maximum AMSL of route

- Relief height is unavailable at some point(s) of route

- The part of route exceeds the maximum fence radius

- The part of route in No-fly zone (NFZ)

No action at last point – remove action for last waypoint.

Note: For those pilots who use autopilot that supports camera triggering by distance or time, there is automated algorithm that calculates and sets the correct parameters. It is not necessary to use this approach with Actions in every point parameter.
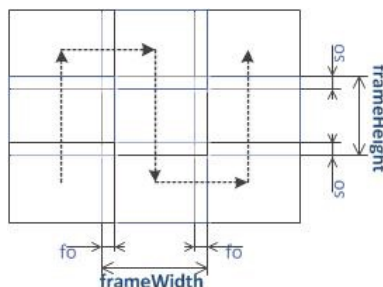

Figure 5 - Sample photogrammetry route

where "fo" - forward overlap, "so" – side overlap

Calculation:

1. Calculate the altitude required for camera recording:

- heightAgl = (f * GSD * sensorWidthPx) / sensorWidth;

- heightAgl = (f * GSD * sensorHeightPx) / sensorHeight;

- Selected minimum value calculated of heightAgl.

2. Calculate the frame size:

- frameWidth = (sensorWidth * heightAgl) / f;

- frameHeight = (sensorHeight * heightAgl) / f.

where "f" is True focal distance

The scanning area is partitioned into frames of calculated sizes with given overlaps. The direction of passage is selected using Direction angle. The route is is formed as "snake".

AGL Tolerance, m – allows to fly straight trajectories over slightly waved landscape, by specifying how precisely the UAV should follow required altitude above ground. To maintain specified height additional waypoints will be added if difference of height is larger than AGL tolerance. The smaller AGL tolerance value, the greater number of waypoints will be generated. If AGL tolerance is set 0 (zero) UAV's altitude will be constant throughout route, but many additional waypoints will be added.

No action at last point – removes action for last waypoint.

Double grid - if enabled, adds a second grid to the survey are in a 90-degree angle according to first grid.

Area scan

Area scan is similar to Photogrammetry tool, except for Area scan there is no need to set Ground resolution (GSD) and camera settings. This is a simpler way to plan flights over area. Parameters to specify: height, side distance and perimeter.

Additionally, to all common options, these features are available for Area scan tool:

Move / Rotate segment - select + hold the blue circle in the center to drag-and-drop Area scan segment to other location. Select + hold the circle's rim to rotate whole segment.

Flight height – altitude of flight along the area.

Altitude type – AMSL or AGL to set Flight height.

Side distance – size in meters between lengthwise route lanes.

Direction angle - used to change the direction of the main scanning progress. By default, the algorithm calculates a route scan in a bounded polygon so that the main course of the scan is performed in the direction of "South-North".

Overshoot, m – adds extra segment to both ends of each survey line to allow extra space for turns.

Overshoot speed, m/s - option to decrease/increase vehicle speed for overshoot segment while passing turns.

Allow partial calculation – option to allow route calculation in these cases:

- The part of route exceeds maximum AMSL of route

- Relief height is unavailable at some point(s) of route

- The part of route exceeds the maximum fence radius

- The part of route in No-fly zone (NFZ)

Calculation error may appear if trajectory fixed height is lower than safe height over terrain at some route point.

AGL Tolerance (m) - allows to fly straight trajectories over slightly waved landscape, by specifying how precisely the UAV should follow required altitude above ground. To maintain specified height additional waypoints will be added if difference of height is larger than AGL tolerance. The smaller AGL tolerance value, the more amount of waypoints will be generated. If AGL tolerance is set 0 (zero) UAV's altitude will be constant throughout route, but many additional waypoints will be added.

No action at last point – removes action for last waypoint.

Double grid - if enabled, adds a second grid to the survey are in a 90-degree angle according to first grid.

Search Pattern - Creeping Line

Search pattern tool allows to create a specific flight route over an area for search and rescue operations. Once the search&rescue area is marked and camera's profile and flight height (AGL) defined, a meander-like flight trajectory covering the whole search-area is automatically created without gaps of camera's footprint.

Search spacing is calculated according to the horizontal FOV of the selected camera's profile and set flight height (see Camera's parameters).

All transversal flight segments are parallel, all side segments are located on a convex perimeter of the area's shape (concave shape perimeter is not supported).
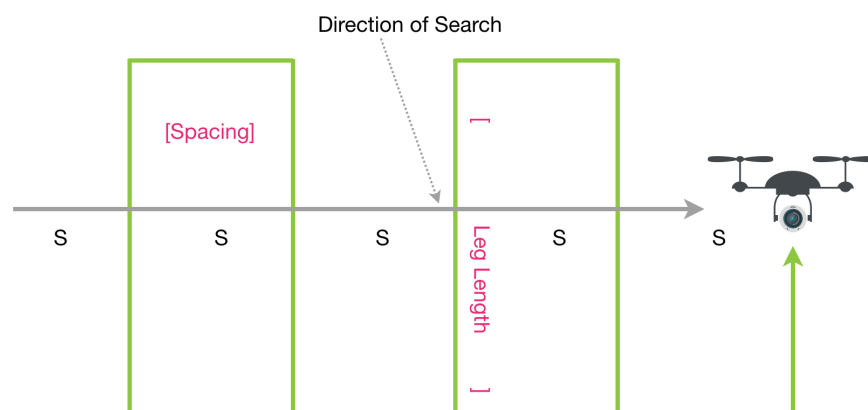

Figure 6 - Sample of the Creeping Line Search Pattern

Flight speed – flight speed of the drone for a segment.

Turn type – the way vehicle passes segments. Turn type is selected from the list of available turn types for particular vehicle profile.

Camera – a payload assigned to a vehicle profile. If multiple cameras are assigned to vehicle, it is possible to select which camera will be used to scan the area.

Camera's parameters - search spacing is derived based on the parameters of the selected camera profile:

d - sensor width

f - focal length

$fov = 2 * arctan(d / (2 * f))$

and thus:

$tan(fov / 2) = d / (2 * f)$ (eq. 1)

$spacing = (2 * height) * tan(fov / 2)$

using:

$spacing = (2 * height) * (d / (2 * f))$

The final equation for spacing is:

$spacing = (height * d) / f$

where height - AGL altitude (parameter), d - sensor width (camera profile), f - sensor focal length (camera profile).
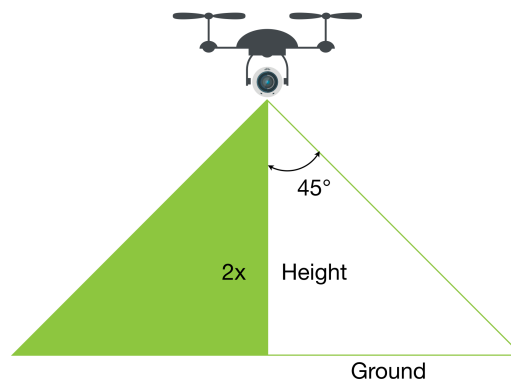
Figure 7 - The footprint of camera

Flight height – altitude of flight along the area.

AGL Tolerance, m – allows to fly straight trajectories over slightly waved landscape, by specifying how precisely the UAV should follow required altitude above ground. To maintain specified height additional waypoints will be added if difference of height is larger than AGL tolerance. The smaller the AGL tolerance value, the greater number of waypoints will be generated. If AGL tolerance is set to 0 (zero) UAV's altitude will be constant throughout the route, but a lot of additional waypoints will be added.

Direction angle - to change the direction of the main scanning progress. By default, the algorithm calculates a route in a bounded polygon so that the main course of the scan is performed in the direction of "South-North".

Side overlap (%) – the ratio of the overlap into neighboring frames (located in neighboring rows, see Figure 5 - Sample photogrammetry route). Value is set in the range from 1% to 90%.

Avoid obstacles – a flag to be set if buildings have to be considered when planning the path. Do not uncheck without specific need to do so.

Parameters for execution of actions:

- Every point – actions will be added for all waypoints;

- At start – the algorithm will add action only for the first waypoint;

- No action at last point – will remove action of the last waypoint.

Search Pattern - Expanding Square

Expanding square tool creates an area for search based on the search radius, selected camera's profile and flight height (AGL). A rectangle spiral-like flight trajectory that covers the specified area around the location will be calculated, having no gaps of the camera's footprint.

Search spacing derives from the selected camera's horizontal FOV and the flight height. (see parameters of the camera).

NOTE: Distance from location to the outer segment may exceed search radius to ensure that the search area is completely covered.
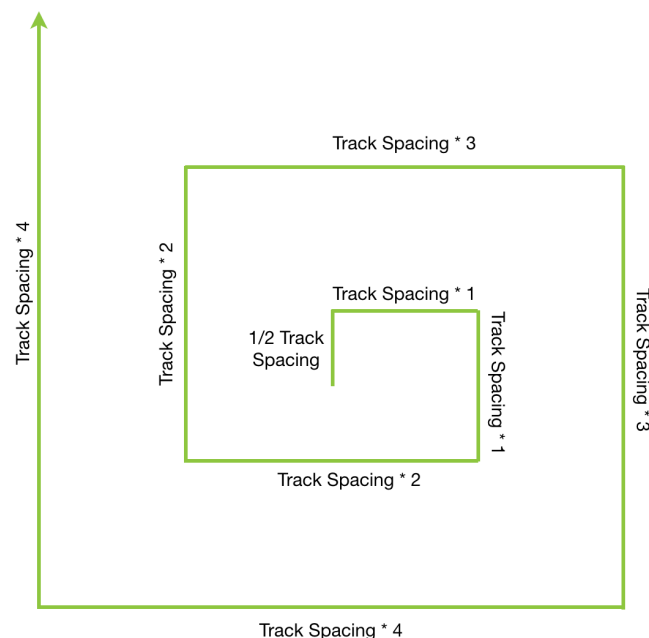

Figure 8 - Sample of the Expanding Square Search Pattern

Altitude AGL – altitude above ground.

Flight speed – flight speed of the drone for a segment.

Turn type – the way how vehicle will pass segments. Turn type can be selected from the list of available turn types for particular vehicle profile.

Camera – a payload assigned to a vehicle profile. If multiple cameras assigned to vehicle it is possible to select which camera will be used. (See more about Camera parameters in the Search Pattern - Creeping Line).

AGL Tolerance, m – allows to fly straight trajectories over slightly waved landscape, by specifying how precisely the UAV should follow required altitude above the ground. To maintain a specified height if difference of height is larger than AGL tolerance, additional waypoints will be added. The smaller AGL tolerance value, the greater number of waypoints will be generated. If AGL tolerance is set to 0 (zero) UAV's altitude will be constant throughout the route, but a lot of additional waypoints will be added.

Search radius - the radius that should be covered. Distance from a search center to the outer segment that should be covered by the payload's footprint.

Direction angle - to change the direction of the main scanning progress. By default, the algorithm calculates a route in a bounded polygon so that the main course of the scan is performed in the direction of "South-North".

Side overlap (%) – the ratio of the overlap into neighboring frames (placed in neighboring rows, see Figure 5 - Sample photogrammetry route). Value is set in the range from 1% to 90%.

Avoid obstacles – a flag to be set if buildings have to be considered when planning the path. Do not uncheck without specific need to do so.

Parameters for execution of actions:

- Every point – actions will be added for all waypoints;

- At start – the algorithm will add action only for the first waypoint;

- No action at last point – will remove action of the last waypoint.

Facade scanner

Facade scanner creates flight route to scan vertical objects. The calculation of the route is similar to Photogrammetry's tool only for vertical objects.

It is implied, that the scanning zone is always rectangular, limited by vertical lines passing through A and B and horizontal lines on minimum and maximum height.
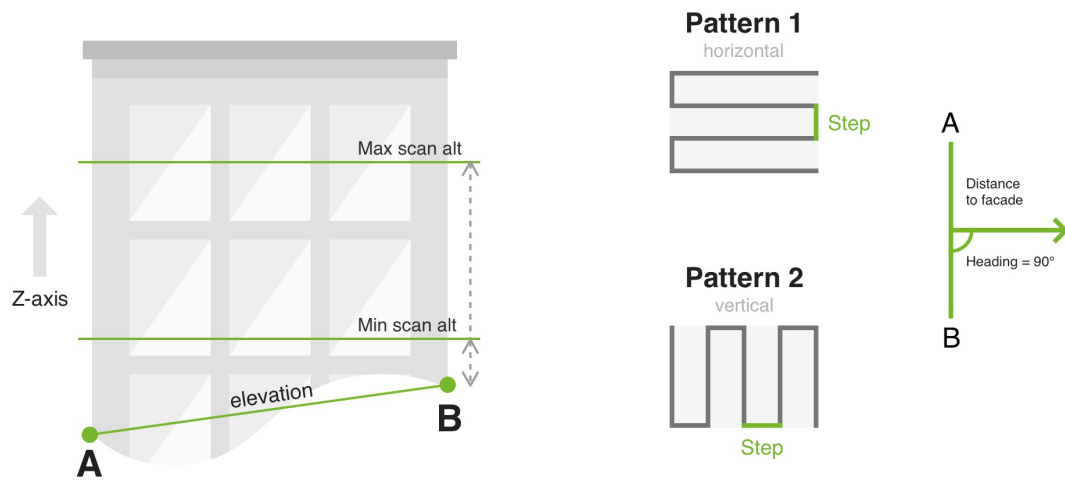
Figure 9 - Facade scan parameters explained

Parameter	Control	Description
Latitude	Latitude input with ability to point on map	Waypoint coordinates
Longitude	Latitude input with ability to point on map	Waypoint coordinates
Minimum height (AGL)	Input field allowing to specify minimum height	Specifies minimum height above highest point on A-B line AGL only irrespective to route settings Parameter is mandatory Must be in a range of allowed altitude for the vehicle profile: between "Safe height over terrain" and "Max altitude, AGL" Must not be greater than "Maximum height (AGL)"
Maximum height (AGL)	Input field allowing to specify maximum height	Specifies maximum height above highest point on A-B line AGL only irrespective to route settings. Parameter is mandatory Must be in a range of allowed altitude for the vehicle profile: between "Safe height over terrain" and "Max altitude, AGL" Must not be less than "Minimum height (AGL)"
Distance to facade	Input field allowing to specify distance to façade	Specifies drone distance to facade
Camera	Drop down list containing cameras attached to the vehicle profile	Parameter is mandatory

Forward overlap (%)	Input field allowing to specify overlap in percentage	Specifies overlap percentage between subsequent shots on a single forward pass Default 60% Parameter is mandatory Must not exceed 90%
Side overlap (%)	Input field allowing to specify overlap in percentage	Specifies overlap percentage between shots on parallel forward passes Default 60% Parameter is mandatory Must not exceed 90%
Pattern	Drop down with two values: Horizontal Vertical	Specifies scan pattern type Default is vertical Parameter is mandatory
Vertical speed	Input field allowing to specify vertical speed	Specifies required vertical speed Default maximum vertical speed from profile Parameter is mandatory Must not exceed maximum allowed vertical speed from profile
Horizontal speed	Input field allowing to specify horizontal speed	Specifies required horizontal speed Default maximum horizontal speed from profile divided by 2 Parameter is mandatory Must not exceed maximum allowed horizontal speed from profile

Facade scan scanning zone is always a vertical rectangle with vertical (default) or horizontal flight pattern.

During flight, the vehicle will always face facade;

Turn type is Stop & turn

"Camera by time" automatic triggering is calculated based on distance to the façade, camera FOV, vehicle speed (depending on the selected pattern vertical or horizontal)

After route is calculated successfully, message will show:

- Facade scanning area, resulting GSD, step between forward passes

- Calculated number of camera shots and interval between shots

Scanning will start from the corner of the rectangle, that is closest to first waypoint or if no waypoint is set before Facade scan - from left bottom corner.

Facade scan supported actions:

- Camera control

- Camera trigger

- Camera by time

- Wait.

Circle

The Circle tool makes the route to go around the specified point at a required distance the vehicle facing to the center (if autopilot supports it). If it is not required for the vehicle to face center, set Yaw angle to 0° and the vehicle will fly facing the flight direction. Creating a circle is similar to creating a waypoint. To change the radius of the circle, drag the circular part of the pin. The radius can be specified in the properties of the circle in numerical format. Like with waypoints, circles can be added to the route in sequence.

All common options available for this tool plus:

Number of laps – number of full turns the drone has to make around the circle.

Fly clockwise – flag indicates whether the drone will fly clockwise (checked) or counter clockwise (unchecked).

Number of approximating points – number of underlined basic waypoints generated. If left blank, this parameter will be automatically determined from the radius of the circle.

Follow terrain – if enabled, all generated waypoints have the same altitude from ground (AGL altitudes are equal). If disabled, all the points will have equal AMSL altitude.

Perimeter

All common options available for this tool, plus:

Flight height – flight altitude along the perimeter. The altitude type chosen does not affected flight height set for the route.

Number of laps – number of times the drone flies along the perimeter.

Landing

Landing tool marks the landing position and parameters. Availability of this tool relates to vehicle type.

Landing waypoints are associated with descent rate parameter that is found in vehicle profile.

Note: The landing algorithm for planes in UgCS has two basic points – the waypoint at which the landing sequence starts and the landing point. The landing trajectory is a straight line between both of these points, provided there are no obstacles between them. The landing trajectory is calculated based on the glide slope parameter.

The glide slope parameter is set in the vehicle profile settings. It might be, for instance, 10%. This means that for each 100m the plane travels to the landing point it decreases its altitude by 10m.

The landing ground speed parameter is the speed set in vehicle profile. This speed should be set to a low value in case, if automatic flaps enabled for the plane, they are deployed.

Modifier: Insert new route segment before the current one

Click the insert new segment route icon ![icon] to add a new segment before the current segment.

Modifier: Draw a curve with automatic points

Activate «Curve points» by clicking the icon ![icon] + hold left mouse button and drag cursor to draw a line without holding Ctrl button. For macOS it is not required to hold any key, just click the left mouse button and draw.

Another option is to draw a line on the map and UgCS will automatically set planning algorithms (WPs, points of perimeters, etc.) along the trajectory. To do so, hold Ctrl button on the keyboard + left mouse button and draw a line on the map. For macOS, hold alt (option).

Measurement tools

Several tools are available to ease mission planning (Figure 4 - Mission editor #5):

The **Distance measurement** tool allows to draw a line, and displays its length.

Area measurement tool allows to draw a polygon, and shows the size of the area.

Visibility range tool allows to place a point and find the distances to all obstacles around that point. The tracing is performed on a horizontal plane.

To deselect current tool, click the tool icon.

6.1.5 Actions

Wait

Wait action – wait in the current waypoint for a certain time (seconds).

Set POI

Point of interest (POI) sets the point of interest for the vehicle to face towards during the flight. It is set, either by entering a latitude, longitude, and altitude in a numerical form or by clicking the Crosshair button in the action properties and drawing the POI in the same way that waypoints are drawn (holding the Shift button and clicking on the map). After inserting the POI, click the crosshair icon again to exit POI mode.

Set yaw

Yaw action specifies the nose angle relative to the movement direction or to North direction. Choose option "Next WP" or "North". The value must be in range from 0° to 360°.

Camera mode

Camera mode allows choosing one of the following modes: "Start recording" for continuous video recording, "Stop recording" to stop recording and "Shot" for taking a photo.

Camera by time

Camera mode by time allows shooting a series of images with a time delay between them. Adding a delay is possible before the shot series is started. The series will consist of an automatically calculated number of shots with an interval between them.

Camera by distance

Camera mode by distance allows shooting a series of images with a specified distance between shots. Delay parameter can be added before the series of image taking is started. The series will consist of an automatically calculated number of shots with a distance between each.

Note: For DJI drones UgCS does not support "Camera by distance", for now.

Note: For both, Camera mode by time and Camera mode by distance, there is Auto option available if used with Photogrammetry tool. If enabled (by default), it sets the action parameters according to provided Photogrammetry parameters and will take a distinct number of camera shots. The calculated parameters displayed in log window after route calculation (#13, Figure 4 - Mission editor).

Auto parameter can be disabled and the parameters can be set manually.

Set camera attitude / zoom

The Set camera attitude / zoom action allows to change the angle for camera roll, tilt and yaw and to set the required camera zoom level. Angle can be set from 0° (inclusively) through 360° (exclusively). Zoom levels are integral positive values.

In UgCS for DJI the value of zoom level is displayed between zoom buttons. This value varies for different DJI cameras according to camera value range. Therefore, before defining the Set camera attitude action value, check the border zoom values of the camera.

The Zoom settings of UgCS are limited by optical zoom range of particular camera.

Note: Due to the different technical approach of Z30, it is not possible to see the correct zoom values in UgCS for DJI - for now the workaround to use this functionality is to find the desired zoom value empirically.

Note: Some vehicles are not supporting this action.

Panorama

Panorama action – allows the vehicle to slowly rotate in the specified waypoint to take a video panorama or shoot a series of photos while rotating

Note: The *Point of interest* action does not affect connection between the route segments for which it is set.

Set Servo

Action to control PWM controllable peripherals, e.g. retracting/extending a landing gear, LED control, etc. Selected segment and set Servo ID and value of impulse-width in microseconds.

Repeat Servo

The same action as *Set Servo* with two additional parameters: to delay the action - Servo Delay in seconds and Servo Cycle Count to set number of repetitions.

Note: Set Servo is supported by Ardupilot; DJI: A2, WooKong-M, Naza-M V2. Repeat Servo is supported only by Ardupilot.

6.1.6 Change route's start point (e.g. after battery change)

By default, vehicle starts mission from first waypoint. It is possible to manually set from which route's waypoint vehicle should start (continue) the flight. This functionality is used for battery change, large area scanning, etc.

To change start point click "Parameters" button on route card, click "Change start point" (Figure 10 - Change start point) select the waypoint on the map from which route should start. New starting point will be marked with a Flag icon next to it, also Route's card will be marked with the Flag icon.
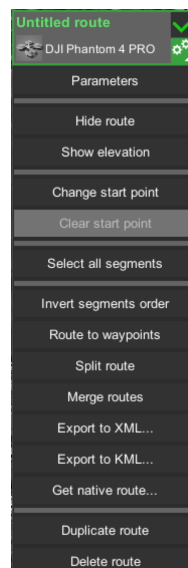

Figure 10 - Change start point

The route will recalculate automatically. Upload route to vehicle.

If the start point of the route is changed, a check box at the Upload confirmation window is added to choose whether the vehicle should fly directly to changed start point or through first waypoint.

To reset the selected start-point to first waypoint click "Clear start point" (see Figure 10 - Change start point) in Route's card drop-down parameters menu.

Every vehicle profile has maximum waypoint limit that can be uploaded at once, and maximum travel time. If planned mission has larger waypoint count or exceeds maximum allowed travel time a notification will display:

- Estimated flight time exceeds the maximum possible flight time specified for the vehicle profile.

- Route is longer than autopilot can accept at once (N waypoints allowed).

In this cases route will be uploaded partially, and a warning message will appear after pressing upload button (see sector Troubleshooting).

6.1.7 Add or edit common actions for multiple segments

While holding CTRL (cmd for macOS) select multiple segments to add or edit common actions. To select all segments, click CTRL+A for Windows or cmd+A for macOS.

When selecting multiple segments these functions will be available:

- add new action;

- delete action.

Note: Actions can be added/edited for segments if actions are in the same order and have same value.

6.1.8 Invert segment order

Allows to change direction of the flight to the opposite course i.e. invert.

6.1.9 Route to waypoints

Allows to convert Photogrammetry or Area scan to route of waypoints

6.1.10 Split route

Splits initial route into two or more parts.

There are several options to split a route:

- Manually - split a route at specific segment(s). In order to split into more than two parts, enter multiple segment numbers separated by a comma. The defined segment number will be the last segment of the first route part.

- Split by distance - split routes at a specific distance which is defined in Distance field.

- Tolerance - if existing waypoint is within the tolerance range of the split position, existing waypoint will be used. Otherwise, a new waypoint will be created.

- Limit - define allowed number of parts into which the route should split.

Overshoot defines section added before each split part except the first one.

6.1.11 Merge routes

Allows uniting two separate routes into one.

6.1.12 Route parameters and path finding

Route parameters
Third step is to review and set missing parameters of the route. In order to ensure a safe execution of the mission, it is crucial to understand and review all parameters before confirming the route's parameters.
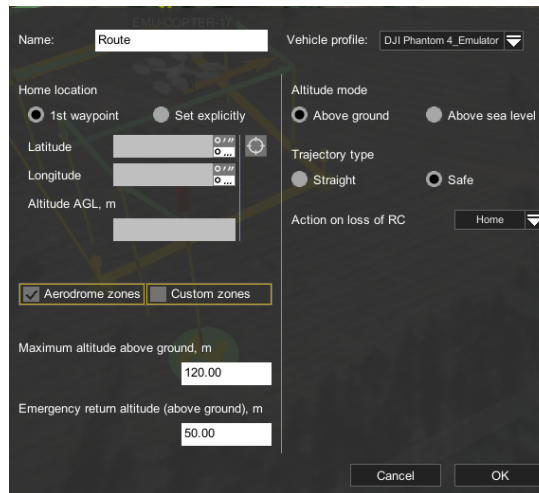
Figure 11 - Route parameters

Home location - is a point where the vehicle should return in the case of a failsafe condition. Triggered automatically or by the operator giving the command to return home. Failsafe execution conditions usually include emergencies such as loss of RC or low battery charge level.

Option "Do not modify" defines that autopilot actions for this setting remain default and not modified. Option is located in the drop-down list for each Failsafe action.

The home position can be set explicitly, or the first waypoint of the route can be set as the home location (Figure 11 - Route parameters). If it is set explicitly, the coordinates can be specified in numerical form; either decimal or degrees-minutes-seconds (DMS) formats can be used.

Note: To switch to the decimal degrees format, click on the °⁄ button. To switch back to the DMS format, click the °⁄ button.

An alternative and usually more convenient way to set the home position is to point it on the map. Click the button with the crosshair icon to use this option. As soon as the map is loaded, the location can be defined by dragging with left mouse button while holding the "Shift" key. A pin will appear allowing to change its height depending on the position of the mouse pointer (Figure 12 - On-the-map segment of home location). After choosing location, click the *OK* button to return to the wizard.
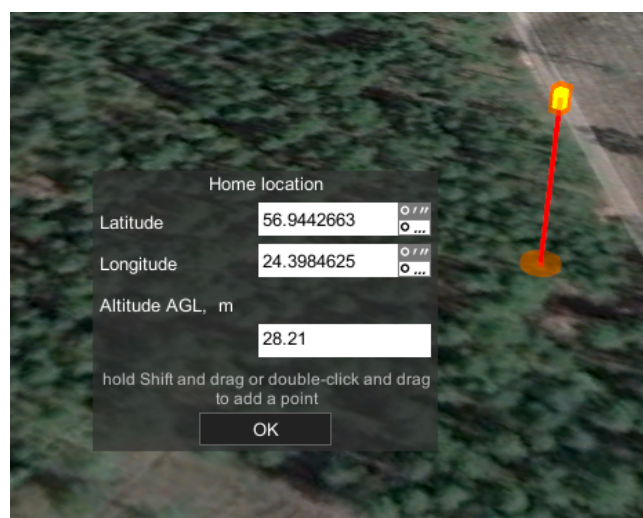

Figure 12 - On-the-map segment of home location

After uploading the corresponding mission, home location will be visible on map as a green circle with a yellow "H" within it. Additionally, if the home location altitude is above ground level, a vertical line similar to a waypoint will display above it.

Note: Every time the home location of a vehicle is changed, an informative message in the Log window will appear.

During mission execution, or manual flight, an indicator to the direction of home location will always be displayed as a red triangle with "H" within it. Above that, the angle to home location is displayed and if home location is not set, it displays "N/A".

To view additional data about the home location, move the mouse cursor on it. The available information consists of corresponding vehicle, current distance to the vehicle, coordinates and altitude of the home location and ground elevation at that point.

For ease of use, it is possible to view home location of the vehicle by clicking on "Focus on home location" command in the corresponding vehicle context.

Note: Every autopilot and thus vehicle might handle Home Location functionality differently. For safe use, please read the corresponding section in the vehicle's VSM User guide.
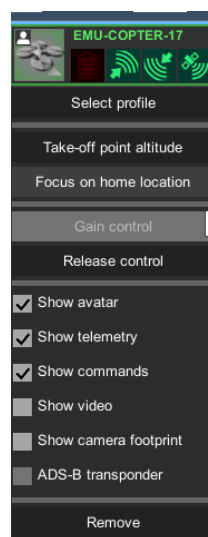
Figure 13 - Vehicle context menu

Maximum altitude is the altitude limitation for the route. Note that maximum altitude will change type (above mean sea level or above ground) if the altitude type for the route will be changed (see below).

Emergency return altitude is the altitude used by the vehicle to return to the home position in emergency cases or when the operator recalls it during the mission. This altitude is default when setting new waypoint by double-click on the map.

Altitude origin specifies whether altitudes are calculated from the mean sea level or from the level of terrain. Usually it is more convenient to specify altitudes relative to the ground level. Please note that once the choice is made, all the altitudes specified in the created route are interpreted in the chosen type. There is the option to change the altitude origin afterwards via the route options window.

Trajectory type is the parameter for defining the pattern of the route between two waypoints. Choosing the *Straight* option results in a direct line segment between the points whilst the *Safe*

option generally produces two segments, one vertical and one horizontal, as schematically shown below.

The behavior of vehicles in different types of trajectories, and applicability of failsafe conditions, depend on the autopilot's capabilities. For more information, check the manual and specifications of the device.
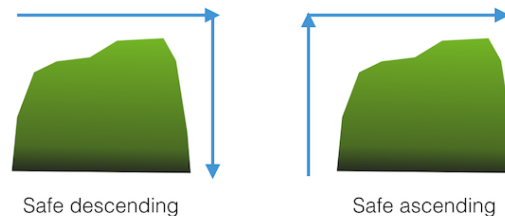

Safe descending   Safe ascending

Figure 14 - Safe trajectories

Action on GPS loss, action on RC loss, action on battery discharge and datalink loss are the pre-defined emergency actions. In all cases the option to wait or to land the vehicle can be chosen. Options to return to home position and to continue flight along the route are also available, provided GPS is operational.

Usually it is only required to specify the home position and safe altitude; other parameters have reasonable default values based on known vehicle properties. Still, it should be ensured that defaults are correct. The software will perform checks and will cancel route creation if incorrectly defined or conflicting values of parameters are present. Notifications about errors in values will display at the bottom of the window, and the particular parameter is highlighted.

Mission Calculation

After the route is formed with all segments in place and their parameters are double-checked, the mission is ready for processing.

The calculation process starts automatically. The mission saves automatically when the route calculates. Calculation might take some time.

During the calculation process, the route is checked for feasibility according to predefined rules. First, it checks whether figures and parameters are specified correctly. All polygons must be connected and all parameters must be correctly specified before proceeding. Correct parameters must also be specified for actions attached to the route segments.

Calculated route build around NFZ and (refer par. "No Fly Zones") and buildings.

To ease error correction for a route, a message will be displayed pointing to incorrect values before route calculation proceeds. The first route segment with an invalid parameter is automatically selected. After the problem is fixed, UgCS automatically start route re-calculation. If there are no more errors, the calculation process will be launched.

The route card displays the status of the calculation (in the upper right corner).

- green check mark - the route is calculated; no errors are detected;

- yellow circle - there is a route calculation;

- red triangle with an exclamation point - in the itinerary there is an error, change the parameters of points in the route.

To access log file saved on disk, see Troubleshooting section for default log paths.

6.1.13 Saving map for offline usage

To save the map with elevation information around the camera's view point for offline usage, click Map Options icon (or click the mouse right-button) and click on *Offline map* - the map caching progress will be initiated.
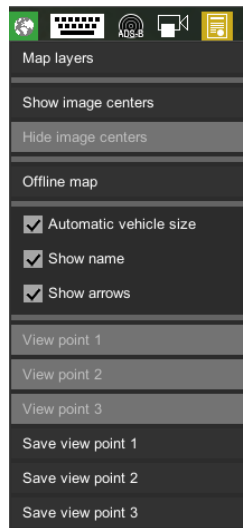
Figure 15 - Map options menu

Cache file with 1 km radius will be saved for current map provider. Wait until the animated progress bar at the bottom of UgCS window will disappear. Do not forget to press Offline map button after any camera view point changing for getting proper data.

Parameter "cacheRadius" in map.xml configuration file allows to control radius of map caching area.

To save several viewpoints on the map - select 'Save view point' to save current location on the map with set camera tilt.

To return to the saved map location and route view, select saved viewpoint.

6.1.14 Map layers

"Layers" button (Figure 15 - Map options menu) opens window with map layers' configuration menu.
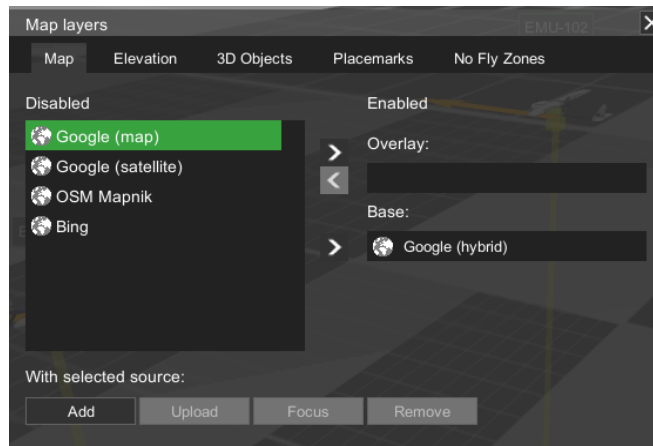
Figure 16 - Map layers window

In the Map layers window, it is possible to choose overlays to display on the map.
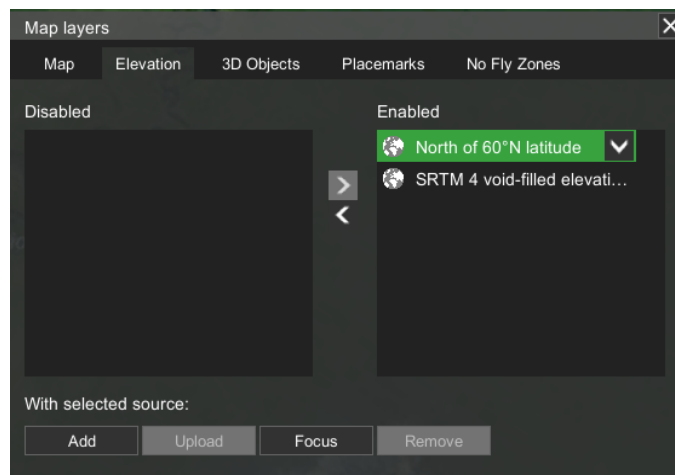
Figure 17 - Elevation source

It is possible to check, add and prioritize elevation sources that will be used on main map.

Figure 18 - 3D objects

To upload/remove 3D objects and Placemarks select the appropriate tab in the Map layers window. To display the No-fly zones (refer par. "No Fly Zones") on the map, toggle the checkboxes Aerodrome zones and Custom zones.

6.2 Mission editor: flight execution

6.2.1 Commands explained

Figure 19 - Command menu

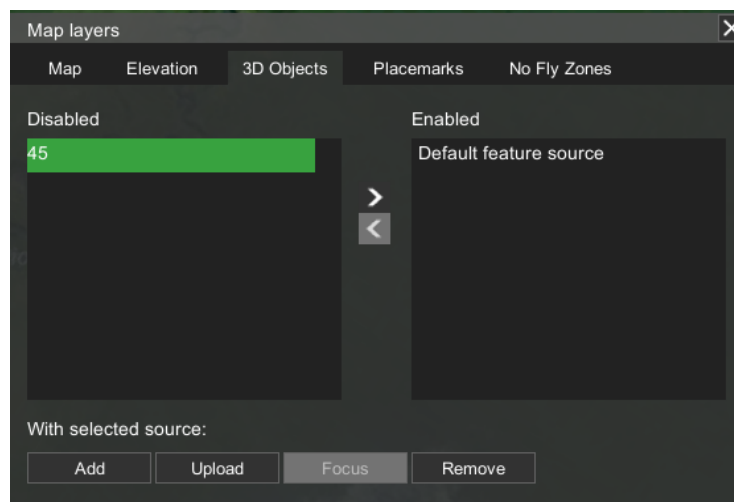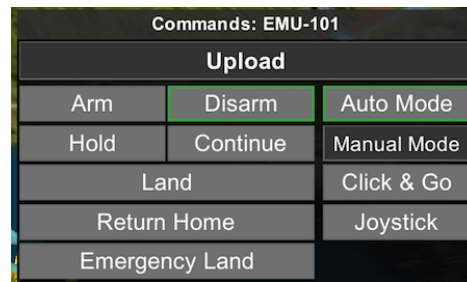| Command	Description
Upload	Upload current mission to vehicle. See command result at log window.
Arm \ Disarm	Activates \ deactivates all systems and makes the vehicle ready for flight. See command result at log window.
Auto \ Manual Mode	Setting selected vehicle to Auto or Manual mode. When in Auto, vehicle start execution of uploaded mission (if Armed).
Click & Go	When pressing "Click & Go" button, double click or SHIFT+click on the map to define target waypoint. If command sent successfully vehicle will move towards the specified point (if Armed). The dashed line, connecting vehicle and target point will be displayed. Hovering the point head, will show distance to approach and estimated time.
Joystick	Enable joystick control mode. See Joystick section for more information.
Hold	Suspends current operation. In case of execution mission (Auto mode) puts it on hold. In case of Click & Go - flight stops the vehicle (loiter around current position in case of plane) and clears current target point. In case of Landing holds landing.
Continue	Continues mission execution from point where mission put on hold.
Land	Lands the vehicle at the current point.
Return Home	Returns the vehicle to the Home Point. IMPORTANT! If the vehicle is within 30m from Home position it will land immediately.
Emergency land	Sending command to make emergency land.

6.2.2 Take-off point altitude

Take-off altitude – is the altitude above mean sea level that used by autopilot to calculate altitude. For Ardupilot it sets automatically after Home Point selection. For others it sets to altitude below Home Point when mission uploads to disarmed vehicle. In other cases, it can be set manually (see Figure 20 - Setting take-off altitude).
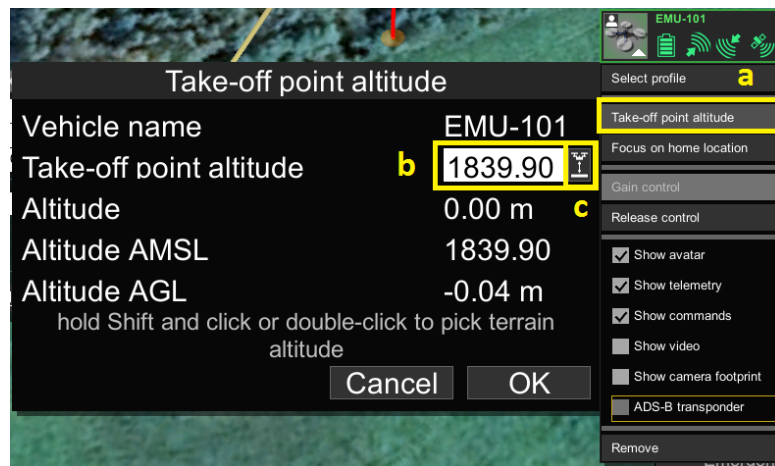
Figure 20 - Setting take-off altitude

Note: it is highly recommended to always check altitude values. Altitude drift problems cannot be solved by software only and require operator attention. Always check, after power cycling a vehicle or mission upload, whether the altitude is reported correctly. UgCS tries to detect such conditions and issues a warning "It looks as if you have to power on/off your drone in order to reset barometer..." if RAW altitude reported by the vehicle is very different from 0 at the time of mission upload.

After setting take-off altitude, it displays in the vehicle card.

6.2.3 Click & Go

Click & Go mode allows to interactively command vehicle to fly to a target location by clicking on the map. Once the location is reached, copter will hover at reached location, waiting for next command. This behavior is implemented as a mini mission containing two waypoints: current drone position and target point.

In order to start Click & Go mission, set a target point on the map to which the copter has to fly and confirm it.

Steps:

- Press the Click & Go command;
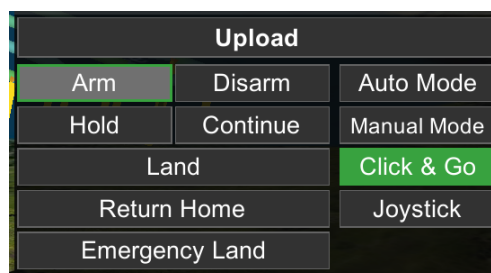
Figure 21 - Click & Go

- Click on the map to set the target point;

- Adjust additional parameters "AGL alt", "Speed" and "Heading" if needed and confirm to send the command to the drone;

Figure 22 - Click & Go parameters

- Press the green check button or the Enter key to confirm.

Heading is the angle between north direction and the vehicle bow. By default, "Heading" is set collinearly according to flight direction. The drone will fly to new target point all the way in set "Heading" angle after the command is sent to the vehicle. If the "Heading" field is left blank (not 0, but empty) - the vehicle will fly using current heading. It is also possible to adjust the heading by moving the arrow of the target waypoint.

When performing Click & Go mode for drone on the ground it firstly flies up to "Minimal safe altitude" (default – 5m, can be changed at Settings – Drone Specific Settings) and then proceed to selected point.

It may be necessary set Take-off point altitude (Take-off point altitude).

If an action trigger (Camera by time, Camera by distance and etc.) is interrupted with Click & Go command, this action will not be performed after clicking Continue button. Actions at next waypoints will work as usual.

Continue button will be inactive if Click & Go action is interrupted i.e. by pressing Hold button.

6.2.4 Vehicle notifications and log

Events related to command execution and related to UAV appears at the bottom right corner. Later system cleans up these messages from log window. All messages are located in the log file of the selected vehicle (press the button "Show log" button).
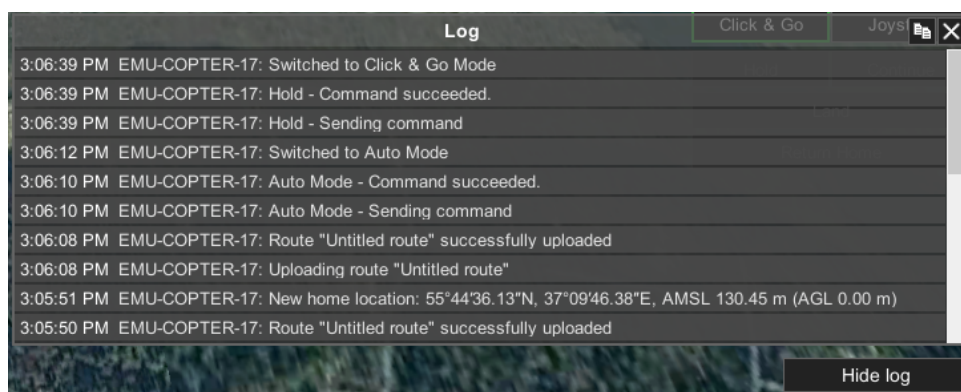
Figure 23 - Vehicle notifications and log

6.2.5 Telemetry window
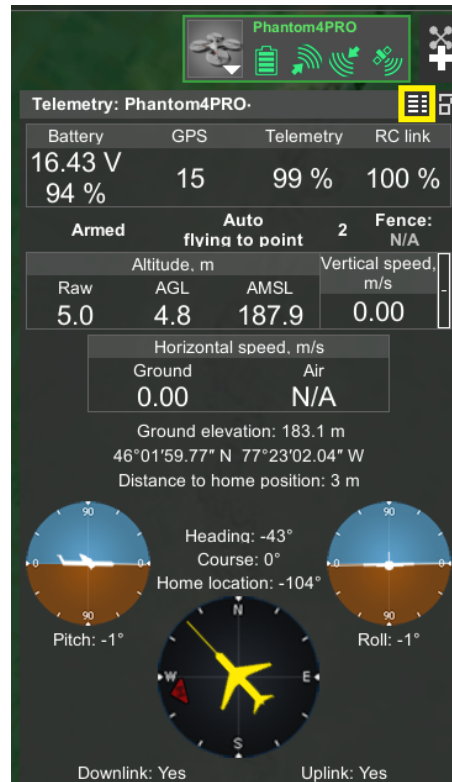
Figure 24 - Telemetry window

When the mission is in progress the telemetry window (Figure 24 - Telemetry window) is shown. Four gauges at the top of the window show the battery charge level, number of GPS satellites visible, the quality of the downlink channel and state of connection to remote controller. These gauges will have a white, orange or red color depending on the charge or the quality of the signal.

Next line represents state of vehicle – Armed (all systems are activated and the vehicle is ready for flight) or Disarmed (all systems are deactivated and the vehicle is not ready for flight) and control - automatic flight mode or manual mode.

Altitude Raw – altitude data sent from the vehicle (without any additional interpretation). This value based on GPS and/or barometer data

Altitude AGL - shows current vehicle altitude above ground level. Accuracy of this value depends on the digital elevation model of the map for the particular region. The value is calculated thusly: Altitude AGL = Altitude AMSL - Elevation.

Altitude AMSL - shows the current altitude of the vehicle above mean sea level. This value is based on Raw altitude data. The value is calculated thusly: Altitude AMSL = Take-off point altitude + Raw altitude.

Vertical speed - indication of how fast a vehicle is ascending or descending. A positive value means an increase of AMSL altitude, and negative means descending.

Horizontal speed - horizontal component of the vehicle speed or Ground Speed.

Air speed - shows the speed of the vehicle through the air. This value is available only if vehicle is equipped with an airspeed sensor.

Elevation - AMSL of landscape under the current location of the vehicle. Depends on the digital elevation model for the region. Landscape elevation shown in meters above the mean sea level.

Latitude and longitude - current latitude and longitude (WGS-84 coordinates) of the vehicle, calculated according to GPS coordinates.

Distance to home – distance from vehicle to home position.

Four more elements, below the list of values, display the current attitude of the vehicle: pitch, roll, heading, course and angle to home location.

Note: In the heading indicator, direction to home location displayed as a red triangle with "H" within it. Above that, the angle to home location is displayed and if home location is not set, it displays "N/A".

Downlink / Uplink – connection status.

Telemetry is recorded and values are saved to the database. Usually a vehicle reports its state multiple times per second. All reported data is saved to disk. The telemetry data can take up a large amount of available space.

6.3 Telemetry player

Figure 25 - Workspace of the Telemetry's player

Telemetry values recorded during the flight can be re-played to closely resemble actions that happened during the actual mission execution. To open the player, click Menu and choose Telemetry Player. Click Menu and choose Mission editor to return to mission view.

Select the vehicle, which telemetry was recorded. It is done the same way as in the Mission view. Check out the "Adding a Vehicle" section for further information. Telemetry displayed for all added vehicles.

6.3.1 Navigating timeline

If the telemetry data was recorded, it is displayed on a timeline (Figure 26 - Telemetry player). It might take some time to load the mission player and the recorded data.
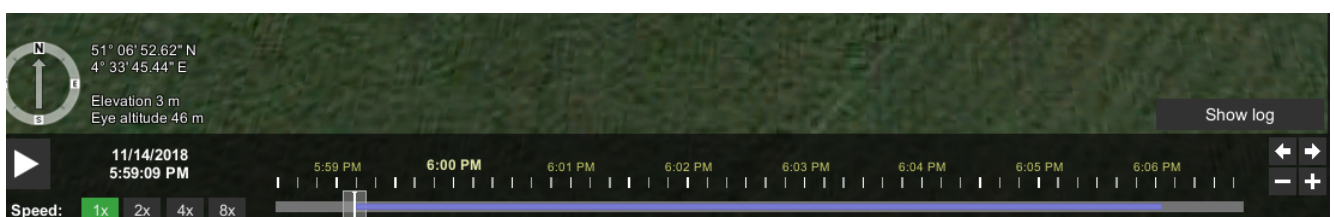
Figure 26 - Telemetry player

Under the section with the recorded telemetry, indication icons are displayed. Icons are schematic representations of commands sent to the vehicle at the time.

Note: For the emulator, the telemetry isn't stored by default - only the icons will be displayed, without any recorded data.

Icons correspond to the following commands:

Icon	Description
⬆	Upload
◆	Arm
◆	Disarm
▣	Auto Mode
▣	Manual Mode
▣	Joystick Mode
▣	Click & Go
❚❚	Hold
▶	Continue
⊞	Return Home
▼	Land

Table 1. Telemetry player workspace

Move the slider (Figure 26 - Telemetry player) to a time when telemetry has been recorded. To start playback, use Play ▶ button (Figure 26 - Telemetry player). At any moment playback can be paused using Pause ❚❚ button.

Navigation through the timeline is done by using mouse and click and drag in the desired direction or use the buttons to the right of the timeline. Zoom in or out with mouse wheel or the "+" or "−" buttons next to the timeline.

Playback speed can be adjusted using the speed buttons (Figure 26 - Telemetry player). Button "1x" is for real-time speed. Speed can be increased up to eight times (button "8x").

On the right side, a List of all telemetries tracks will be displayed.
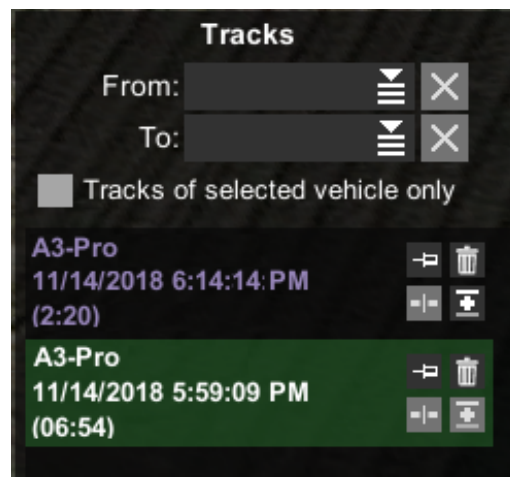
Figure 27 - List of telemetry tracks

To delete an event from the telemetries List, click the bin icon of the telemetries record. To display a record on the map - click the pin icon of the record. To split a telemetry record at a current playback time, click the -|- icon. To merge two records of one vehicle located next to each other, click the + icon.

To differentiate imported telemetry for several vehicles, select the 'Tracks of selected vehicles only'.

6.3.2 Exporting / Importing telemetry

To import the telemetry data, click "Import"; to export click "Export", select the format of the telemetry file and set its location. Telemetry records are saved in binary format.

Note: existing timeline frame defines start and end positions for export procedure.
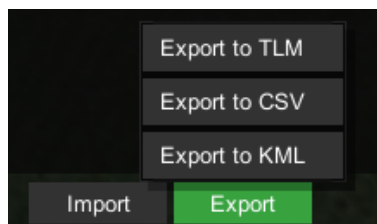
Figure 28 - Import / Export telemetry

6.3.3 Geotagging

UgCS allows tagging images taken by the drone with coordinates from recorded telemetry. Important note, remember the difference between camera clock and clock on computer that recorded the telemetry.

HINT: the easiest way to remember the time difference is to take a picture of computer's clock with the drone camera. Then compare time on the image with "modified" attribute of the picture. Hovering the mouse over the clock placed in top right corner of UgCS will provide a hint with current time detailed up to milliseconds.

Geotagging tool is available from context menu of vehicle in telemetry player (Figure 26 - Telemetry player).

After pressing "Geotagging" the following window is being displayed (Figure 29 - Geotagging window).
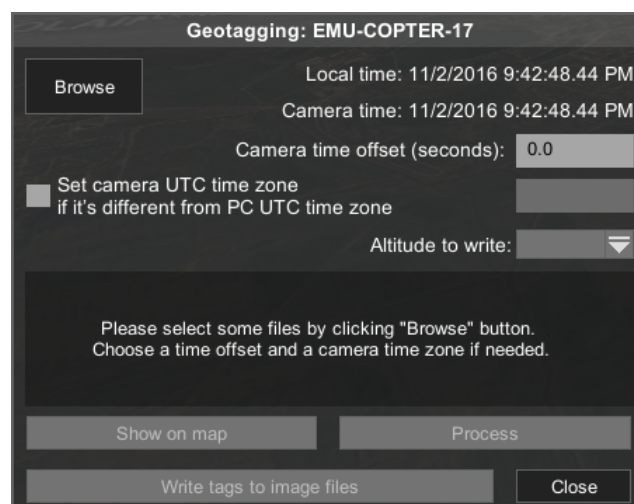
Figure 29 - Geotagging window

Click "Browse" to select images. Only JPEG is supported for now.

Number of images will be shown, time from the first and last image as start and end time.

The process of geotagging is straightforward. Choose image and try to find the closest telemetry record in the database. For search to be as precise as possible it is important to know camera time offset – the difference between camera clock and computer (where telemetry was initially recorded) clock.

If data was processed on a computer with clock configured for another UTC time zone than the camera time zone, checkbox "Set camera UTC time zone if it's different from PC UTC time zone" needs to be set and camera's UTC time zone specified.

After everything is configured, press "Process". Algorithm will try to find coordinates for the pictures.

After processing is complete, the button "Show on map" will display camera position for each picture taken.

If everything is correct, select altitude type from dropdown list - AMSL, AGL, RAW or None and press "Write tags to image files" to save coordinates and selected altitude as EXIF tags into pictures.

6.3.3.1   How to prepare photo for geotagging processing

In order to synchronize time between the capturing device and UgCS desktop, take several pictures of UgCS desktop screen with open time toolbar.

- In UgCS navigate the mouse cursor over the time widget, located in the top right corner.

- The Time toolbar will appear.

- Make a picture of the computer screen with the camera.

Figure 30 - Time tooltip

- Connect the vehicle to the PC/notebook to import telemetry data from the drone.

- Execute mission in automatic or manual mode with camera working in periodic photo mode.

6.3.3.2   How to write geotags to photo files

- Copy photo files from camera and back it up.

- Open telemetry player. Add drone to the vehicle list. Check that telemetry data can be found for selected drone.

- Open geotagging window for selected drone.

- Calculate time offset value. For this calculation, compare camera time and photo time.

  • Take photo of UgCS desktop time by camera and select time from picture - this is photo time;

  • Open UgCS client -> telemetry player -> add vehicle -> open geotagging window;

- Click Browse and select photo from previous step;

- Camera time is displayed in geotagging window at string after words "start time";

- Calculate difference between two values in seconds.

- Add all photos from camera (exclude photo with screen).

- Set calculated camera offset. Set time zone of the camera if necessary.

- Process and save geotags to photo files.

7 Main menu

To access Main menu, click the list icon in the top, left corner and select the Main menu, to access sections displayed in Figure 31 - Main menu.
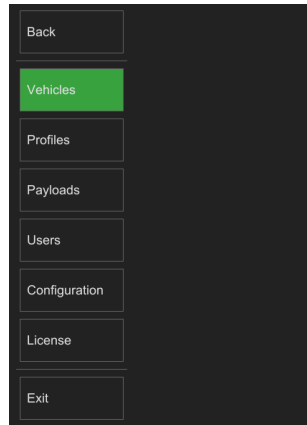
Figure 31 - Main menu

7.1 Vehicles

This section contains all the registered UgCS vehicles.

Filter can be set according to the platform type of the vehicle profile and sort vehicle by name (Figure 32 - Main menu – Vehicles #1).
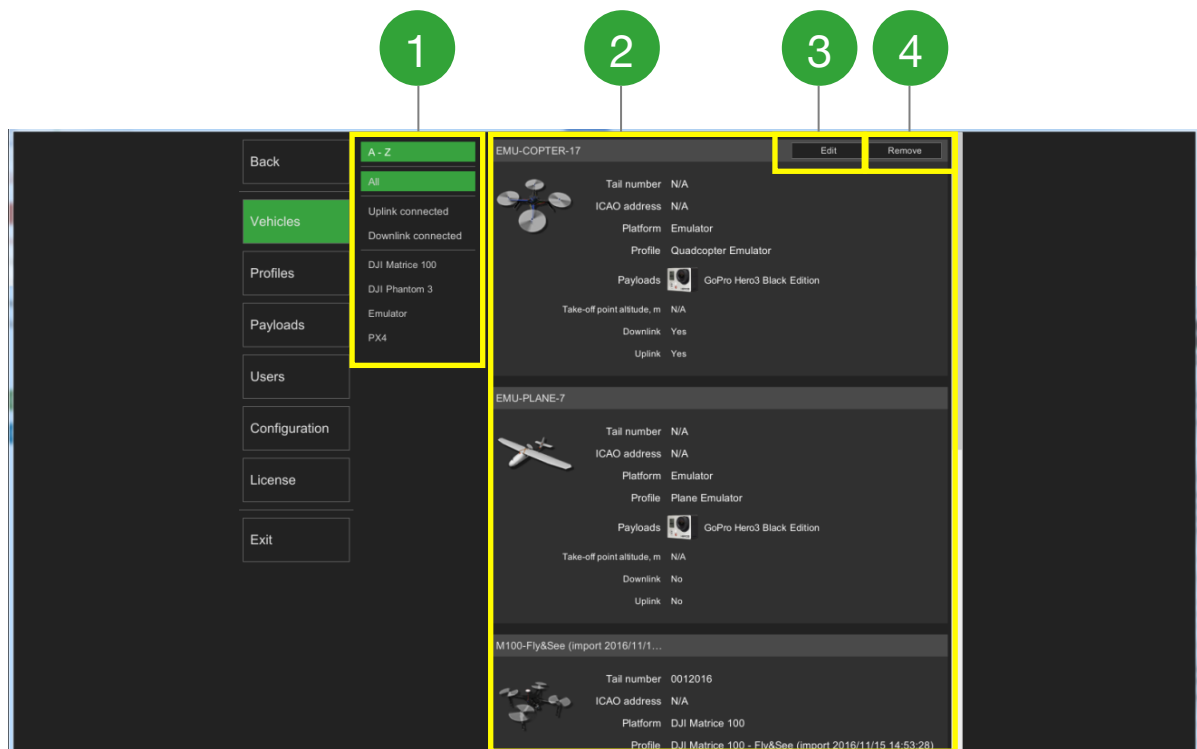
Figure 32 - Main menu – Vehicles

Table of parameters that should be filled for the vehicle.

Parameter	Description	Mandatory
Vehicle name	User defined vehicle name	Yes
Tail number	Former ID field. Tail number of the vehicle.	
ICAO address	ADS-B unique identification number.	
Platform	Vehicle platform. This field can be edited in the vehicle profile list.	
Profile	Choose an available vehicle profile or create a new vehicle profile	Yes
Payloads	View selected payload for the vehicle	
Altitude mode, m	Current take-off point altitude. For more information about this field please see the "take-off altitude" section	
Downlink connected	Downlink connection status	
Uplink connected	Uplink connection status	

7.1.1.1 Registering a New Vehicle

To register a new vehicle, connect the vehicle to UgCS and ensure that the VSM for that vehicle type is running. For more information on specific vehicle workflows please refer to our manuals.

Provided the vehicle is supported by UgCS, the VSM should detect a new connection and a new record in the vehicle list in the UgCS client should be created.

After automatic detection of vehicles in UgCS, the vehicle card displayed in the vehicle menu – vehicle list. UgCS will choose the most suitable vehicle profile for the vehicle.

7.1.1.2 Editing a Vehicle

If necessary, select a different profile for the device manually or edit the current profile. To select the profile for the vehicle, click "Edit" button (#3 - on the Figure 32 - Main menu – Vehicles). Then select a predefined vehicle profile.

Restart the VSM after configuration changes.

7.1.1.3 Removing a Vehicle

Remove a vehicle from the list manually by pressing the button "Remove" (#4 - on the Figure 32 - Main menu – Vehicles).

7.2 Vehicle profiles

This section contains all the base and custom vehicles profiles of UgCS.

In the left column (Figure 33 - Main menu - Profiles, 1) there is a list of all vehicle profiles and the button to "Create new" profile from scratch. On the right (Figure 33 - Main menu - Profiles, 2) all vehicle profile block-cards are listed.
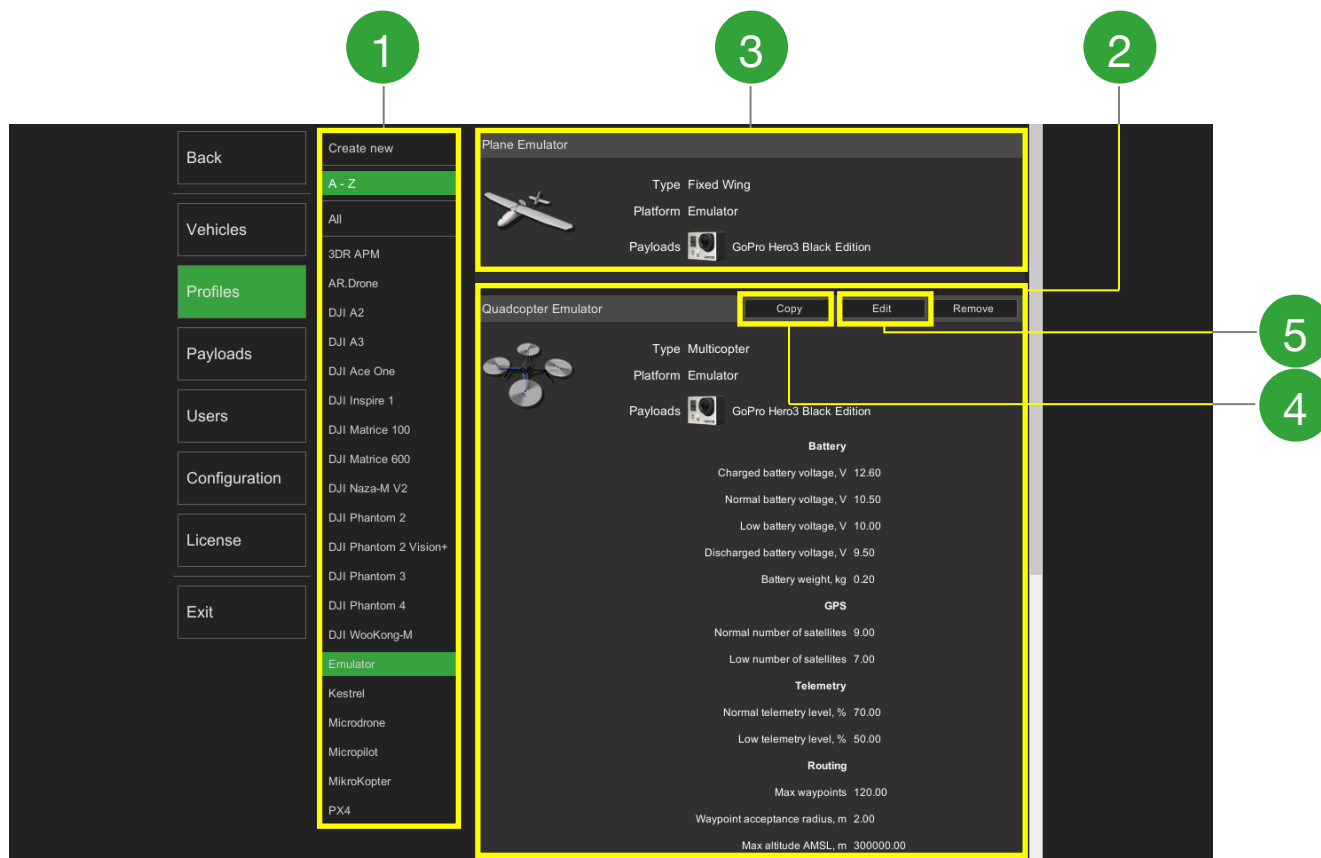
Figure 33 - Main menu - Profiles

Table of parameters for vehicle profiles

Parameter	Description	Mandatory
Main section		
Vehicle profile name	User defined vehicle profile name	Yes
Type	Vehicle type (helicopter, multicopter, fixed-wing).	Yes
Platform	Choose a vehicle platform from the available variables	Yes
Payloads	Edit available payloads for the vehicle profile	Yes
Battery section		
Charged battery voltage	Battery fully charged at voltage, V, shown as 100%. Voltage value shown in white color if between this voltage and normal voltage.	Yes

Normal battery voltage	Normal battery voltage V. Voltage value shown in white if at or above this voltage, shown in yellow if below this voltage.	Yes
Low battery voltage	Low, but sufficient voltage, V. Voltage value shown in yellow if at this voltage or between low and normal voltage. Voltage value shown in red if below this voltage.	Yes
Discharged battery voltage	Battery zero level, V, shown as 0%. Shown in red.	Yes
Normal battery power level[1], %	Normal battery level, percentage. Value in percent is shown yellow if below this value.	No
Low battery power level[2], %	Low battery level, percentage. Value in percent is shown red if below this value.	No
Battery weight	Battery weight, kg	Yes
GPS section		
Normal number of GPS satellites	Normal number of satellites to provide a good level of accuracy. Shown in white color if at or above this level. Number of satellites shown in yellow color if below this level and between normal and low level.	Yes
Low number of GPS satellites	Low number of GPS satellites while still being enough to launch the vehicle. Number of satellites shown in yellow color if at this level or between this and normal level. Number of satellites shown in red color if below this level.	Yes
Telemetry section		
Normal telemetry level	Normal telemetry level. Telemetry level value shown in white color if at or above this level. Telemetry level value shown in yellow color if below this level and between normal and low level.	Yes
Low telemetry level	Low telemetry level. Telemetry level value shown in yellow color if at this level or between this and normal level. Telemetry level value shown in red color if below this level.	Yes
Routing section		
Max. waypoints	Maximum supported WPs by flight controller	Yes
Waypoint acceptance radius	3D distance of the vehicle from approach waypoint sufficient to consider point as reached. Please refer to autopilot documentation to check applicability of this parameter.	Yes
Max altitude AMSL	Maximum allowed altitude AMSL, m	Yes
Max altitude AGL	Maximum allowed altitude AGL, m	Yes
Fence radius	Radio link range radius, m	Yes

Maximum travel time	Maximum flight time in seconds	Yes
Safe height over terrain	Minimal allowed distance to terrain for the vehicle, m. Small vehicles can fly very close to terrain but larger ones should fly higher	Yes
Safe distance to obstacle	Minimal allowed distance to obstacles for the vehicle, m	Yes
Max. climb rate	Maximum climb speed of copters for take-off waypoints, m/s	Yes
Max. descent rate	Maximum descent rate of copters for landing waypoints, m/s	Yes
Max. horizontal speed	Maximum horizontal speed, m/s	Yes
Default climb rate	Default climb speed of copters for take-off waypoints, m/s	Yes
Default descent rate	Default descent rate of copters for landing waypoints, m/s	Yes
Default horizontal speed	Default horizontal speed relative to ground, m/s Used as default speed for route segments and for Click & Go mode.	Yes
Fixed-wing section*		
Glide slope, %	Default glide slope, % Applicable for the planes	Yes
Airspeed during landing approach	Airspeed for fixed wing aircraft when approaching landing	No
Landing ground speed, m/s	Plane ground speed in last flight segment to landing point, m/s Applicable for planes and not used for multirotor.	Yes
Landing flare altitude	Altitude in meters at which Landing Flare will be engaged, this parameter is secondary to landing flare time parameter	No
Landing flare time	Time in which fixed wing aircraft should reach ground during landing, when landing flare will be engaged, motors stopped and heading locked	No
Minimum landing pitch	Minimum pitch in ° during final landing stage (after flare), the algorithm will control pitch above this value to achieve proper sink rate	No
Controller sink rate to pitch gain during flare	Sink rate gain for pitch demand during final landing stage, m/°	No
Weighting applied to speed control during landing	A value closer to 2 will result in plane ignoring height error during landing (will keep nose up), a value closer to 0 results in plane ignoring speed error (use with caution, could result in plane stall)	No

Maximum pitch in auto flight	Controls maximum pitch in ° during automatic mode, Rage: 0 to 45°, if set to zero, Maximum pitch parameters will be used	No
Maximum pitch	The maximum commanded pitch up angle, Range: 0 to 90°	No
Minimum throttle	Minimum throttle setting in % which Autopilot will apply. For final landing stage, this is ignored.	No
Landing sink rate (final stage)	The sink rate in meters/second for final landing stage. Range: 0.0 to 2.0	No
Enable rangefinder for landing	Enables the use of a rangefinder for automatic landing. The rangefinder will be used both on the landing approach and for final flare	No
Minimum rangefinder distance	Minimum distance in centimeters that rangefinder can reliably read	No
Basic section**		
Height**	Vehicle height, m	Yes
Width**	Vehicle width, m	Yes
Length**	Vehicle length, m	Yes
Wind resistance**	Maximum allowed wind speed, m/s	Yes
Dry take-off weight**	Dry take-off weight, kg	Yes
Maximum take-off weight**	Maximum allowed weight, kg	Yes

[1] Percentage displayed if supported by the vehicle. If the vehicle does not report the remaining charge as a percentage, the UgCS calculates the percentage based on the voltage values from the vehicle profile.

[2] Percentage displayed if supported by the vehicle. If the vehicle does not report the remaining charge as a percentage, the UgCS calculates the percentage based on the voltage values from the vehicle profile.

* Display section depends on the type of vehicle;

** Currently ignored and reserved for future versions.

7.2.1.1 Adding a New Vehicle Profile

Add a new vehicle profile by creating a new card and filling in the parameters.

7.2.1.2   Editing a Vehicle Profile

Edit a vehicle profile by clicking on the profile card and pressing the "Edit" button. There are variety of different (3D) avatars for vehicles. Vehicle profile parameters can be edited here as well.

Note: Profile changing leads to route convert procedure that can cause errors in some cases. If occurs, a message as notification will be displayed to choose accept or cancel the changes.

7.2.1.3   Copying a Vehicle Profile

Copy an existing vehicle profile by selecting the profile and clicking on "Copy" button. It will create a duplicate of the selected profile with a "- Copy" suffix. Works the same as "Edit" (see above), except it will save a new copy upon confirmation.

7.2.1.4   Delete a Vehicle Profile

To remove the vehicle profile, select the profile and click "Remove".

Basic profiles cannot be deleted. Basic profiles - are system profiles imbedded into software installation.

8   Configuration

8.1   Connections

The Core service section defines HCI and VSM connections to a UCS. By default, it points to the local instance. In case of a multi-node deployment network the address of the UCS can be specified.

UgCS uses systems default proxy settings. If custom proxy settings are required, settings can be applied in components configuration files: MENU -> Configuration -> Connections. Change of these settings can affect the loading of map.

8.2   VSM

Records for each of VSM servers. By default points to local instances. If using a dedicated VSM installation and want core services to connect to it, add a new record with the appropriate host and port fields.

8.3   Geoservers

Enable the option to add new geoservers or edit/remove the URL of existing geoservers.

8.4   Payloads

Choose a predefined payload card or create a new payload card defining payload's parameters. To add a new payload switch to Main Menu, select Payloads and click the Create new button - enter required parameters and confirm with "Save". To assign payload to a certain vehicle profile, in the Main Menu select Profiles, select the vehicle, and click the block-card, button "Edit" will be enabled. In the block-card after clicking "Edit" on the Payload section "Add" new button will be displayed - click it to add payloads from list.

Table of payload parameter description

Parameter	Description	Mandatory
Payload name	User defined payload name	Yes
Weight	Camera weight, kg	Yes
True focal length, mm	True focal length	Yes
Sensor width, mm	Physical sensor width in metric units	Yes
Sensor height, mm	Physical sensor height in metric units	Yes
Sensor horizontal resolution, px	Sensor horizontal resolution in pixels	Yes
Sensor vertical resolution, px	Sensor vertical resolution in pixels	Yes
Minimum triggering interval	Minimum time interval between two neighboring shots	Yes

9   Advanced topics

9.1   Screen Resolution

Option to adjust the resolution of user interface's window. Changes apply immediately.

9.2   Skin

Option to change from the available color schemes – Default, Classic, Khaki and Pony. Changes apply immediately.

9.3   Language

Select the language of the user interface.

9.4   Measurement

Option to choose the measurement system for the user interface.

9.5   Sound

Enable or disable the sound signals of UgCS. Sound signals are used to notify user about errors in the vehicle log.

9.6   Video

Allows to edit the location of the video server.

9.7   Performance

To decrease the performance of UgCS for battery saving, enable the "Battery saving mode" flag. For maximum performance the "Battery saving mode" flag should be disabled.

To increase the performance of UgCS, enable "Show buildings without textures" flag.

9.8   Appearance

Option to turn on or turn off 3D avatar smoothing.

9.9   3D map caching

Option to edit the size of cached map area or clear the map cache.

10 No Fly Zones

No-fly zones (NFZ) are areas on the map where flying is prohibited. NFZs are divided in two categories – Aerodrome zones, which are built into UgCS and Custom zones which can be created by the operator.

10.1 Creating a Custom NFZ

The operator can create a Custom NFZ of either two shapes:

- Prism

- Cone

NFZ can be created by clicking on one of the two bottom icons on the No-Fly-Zone drawing tools (Figure 4 - Mission editor #9) and shift-click on the map.

To create a prism formed NFZ, at least 3 points are necessary. The cone NFZ requires only one point. To finish creating an NFZ, click on the selected NFZ icon again. To edit the finished NFZ click it on the map. To delete an NFZ click on the trash can icon in the editing screen.

Following parameters for each of the NFZ can be changed:

- Name of NFZ

- No-fly zone starts from – altitude from which the NFZ begins. By default this parameter is set to 0 m AGL.

- Ground or sea level – change the altitude origin between AGL and AMSL

- Height – the altitude NFZ ends. By default, this parameter is set to infinity.

For the cone NFZ there are two additional parameters:

- Base radius – radius of the base of the flight zone. By default, this is set to 100 m.

- Top radius – radius of the top of the flight zone. This parameter can be used only if the height parameter for the cone NFZ is not infinity.

Note: If NFZ width is less than one meter it is not taken in account for route's calculation.

10.2 Disabling NFZ

The No Fly Zones can be disabled in parameter window of the route, by deselecting the Aerodrome zones or the Custom zones. The route's parameter window is displayed during the creation process of a new route, or it can be accessed selecting the Parameters button of the route's card Parameter setting dropdown.

Note: this feature is enabled only for UgCS with activated License (refer par. "License")!

10.3 NFZ visibility

To change the visibility of NFZ, click on the Map options (globe icon) button at the very top right-hand corner of the screen and click on the Layers button. In the new window, deselect Aerodrome zones or Custom zones so that they are no longer displayed on the map. Keep in mind, this operation does not disable the NFZ, it simply hides them. If disabling of NFZ needed, refer to the section "Disabling NFZ".

10.4 NFZ and route-creation algorithms

UgCS will not be able to calculate a mission with single waypoint in an NFZ. However, if a part of a circle or an Area scan mission intersects an NFZ, the flight path will be calculated around the NFZ automatically.

11 Importing 3ʳᵈ party mapping data

UgCS map contains following georeferenced data types:

- Georeferenced tiles, 3rd party WMS data.

- Elevation. Contains elevation data with reference to the coordinates (e.g., landscape). The altitudes in imported data are assumed to be based on WGS84 ellipsoid.

- 3D Models which consist of polygons and georeferenced tiles. These layers are managed by Geoserver. This layer is optional.

- Placemarks

11.1 Importing georeferenced images

To display the orthophoto in UgCS, import orthophoto images. To do this, create a new source with a unique name and download the photo in it. New source creation is available in the map source in one of the providers of Geoservers. Then save changes (press "Save" button). Go to the Mission Editor, click on the globe icon ("Map options") in the upper right pane. Select "Layers" in drop down list. "Map layers" window will appear. In the block "Overlay tile provider" in the drop-down list, choose name of the imported source. "Focus" button moves the map to the imported object.

11.2 Adding WMS sources

A Web Map Service (WMS) is a standard protocol developed by the Open Geospatial Consortium in 1999 for serving georeferenced map images over the Internet. These images are typically produced by a map server from data provided by a GIS database.

To add external WMS source:

- Navigate to "Map layers" window "Map"

- Choose "Add"

- Provide friendly name in field "Name"

- From "Type" dropdown, choose "External WMS"

- Enter WMS source URL into field "Remote Source"
  (example: http://ows.terrestris.de/osm/service)

- Choose WMS layer from dropdown "Layer name"

- Press "Create", user arrow to set layer as "Overlay" or "Base".
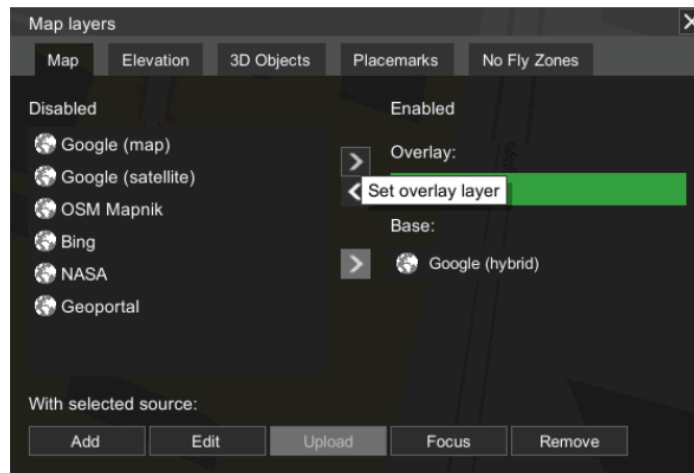
Figure 34 - Map layer window

11.3 Importing 3rd party elevation data from local file

Additional elevation data for particular area (besides default elevation sources) can be imported. It can be imported from local files or an external link can be pointed out. To import local elevation data, click the Map options (globe icon at the top right-hand corner of the screen) click on Map layers, and select Elevation. Click add and create a unique name for the object. Select the created object and click upload, than select the source of elevation data i.e. a resent ortophoto from local drive. The order of objects in the list to the right is important, because it determines the priority of Terrain elevation shown on the map. It is possible to change the source from enabled to disabled. "Focus" button displays the map of the imported object.

11.4 Importing 3rd party elevation data from External source.

To import elevation data from external source, click the Map options (globe icon at the top right-hand corner of the screen) click on Map layers, and select Elevation. Click add and create a unique name for the object. Select "type" and choose "external" Indicate link to the source and click "create". The order of objects in the list to the right is important, because it determines the priority of Terrain elevation shown on the map. It is possible to change the source from enabled to disabled. "Focus" button displays the map of the imported object.

The route on the particular area is calculated according to the priority of elevation source.

Note: UgCS supports ArcASCII, GeoTiff and SRTM formats, but all GDAL Raster Formats (more details https://gdal.org/) that feature Georeferencing should work. All altitudes in imported DEMs are assumed to be above WG84 ellipsoid. No other vertical datum is supported currently.

11.5 Importing buildings on a map

To display the 3D buildings on the map of UgCS and to take into consideration when route is calculated, import 3D models of buildings.

To import 3D building models, click the Map options (globe icon at the top right-hand corner of the screen) and click the Map layers button, select 3D objects tab. Add a unique name and upload 3D model via "upload" button. Browse for the uploaded models in KMZ format. It is possible to change

the models from enabled to disabled source list. «Focus» button will displays the region of the map of the imported object.

Note: UgCS supports the import of *.KMZ files.

*.KMZ file must be legacy (ZIP 2.0) compression compatible. The contents of a KMZ file are a single root KML document (notionally "doc.kml") and optionally any overlays, images, icons, and COLLADA 3D models referenced in the KML including network-linked KML files. The root KML document by convention is a file named "doc.kml" at the root directory level, which is the file loaded upon opening. By convention, the root KML document is at root level and referenced files are in subdirectories (e.g. images for overlay images).

11.6 Photo placemark creation during photoshoot (For DJI drones only)

Enabling "Placemark settings" in UgCS for DJI options menu, will allow taking photos, assigned to placemarks on the map. Using UgCS for DJI app, take a photo in the desired location. Placemark will appear on both UgCS for DJI and UgCS desktop.

List of compatible drones:

- Phantom 4, Phantom 4 Pro

- Phantom 3 Standard / 4K / Advanced / Professional

- Inspire 1, Inspire 1 Pro / Raw

- Inspire 2

- Matrice 100

- Matrice 200, Matrice210, Matrice210RTK

- Matrice 600, Matrice 600 Pro

- Mavic Pro

- A3

- N3

In UgCS desktop, hovering a mouse over the placemark will show small picture of the taken photo and latitude/longitude. Left click on the placemark will enlarge the photo to full screen, from where it can be exported as an image file (with written coordinates in the top left corner), using "Export" button in the right bottom corner. To exit out of full screen – press "Esc" or click white X in the right upper corner.

11.7 Adding layers

Adding layers helps to distinguish different routes and photo placemarks from each other. To do so, click the Map options (globe icon at the top right-hand corner of the screen) and click the Map layers button, select Placemarks, click "add" on the bottom left corner and provide friendly name for the layer on which all the desired placemarks should appear. Move the newly created layer to "enabled" section of the screen by selecting it and clicking right-pointing arrow in the middle. The layer with provided name, should now appear in "Placemark settings" section in UgCS for DJI options menu.

In case of using more than one layer, select the layer in UgCS for DJI to assign placemarks to.

To export all the placemarks at once as *.JPG or* .KMZ files, click the Map options (globe icon at the top right-hand corner of the screen) and click the Map layers button, select Placemarks. Select the layer, placemarks were assigned to. All the placemarks on the map will turn green. Select "Export placemark images" – to export as *.JPG files with coordinates or "Export Placemarks as KMZ" to export as Keyhole Markup language Zipped file.

To import the placemarks to the desired layer, click Upload and browse for previously exported data.

12 Working with placemarks

Placemarks are part of UgCS functionality that are used for informing user about possible dangers on the map. It is also possible to add custom markers and use them for individual purpose.

Placemarks are structured in categories. Currently there are three categories:

- HAZMAT – describes dangerous substances (solids, liquids or gases) that can be harmful

- Incidents – warns about dangers caused mainly by human activity

- Natural Events – warns about natural disasters or dangers

To place a placemark, right click on the desired area, select "Create placemark here" and chose from the available placemarks in the desired category.
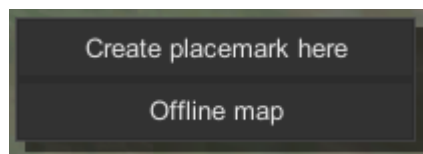

Figure 35 - Placemark menu

Adding description to placemark helps to inform about the purpose of placing it.
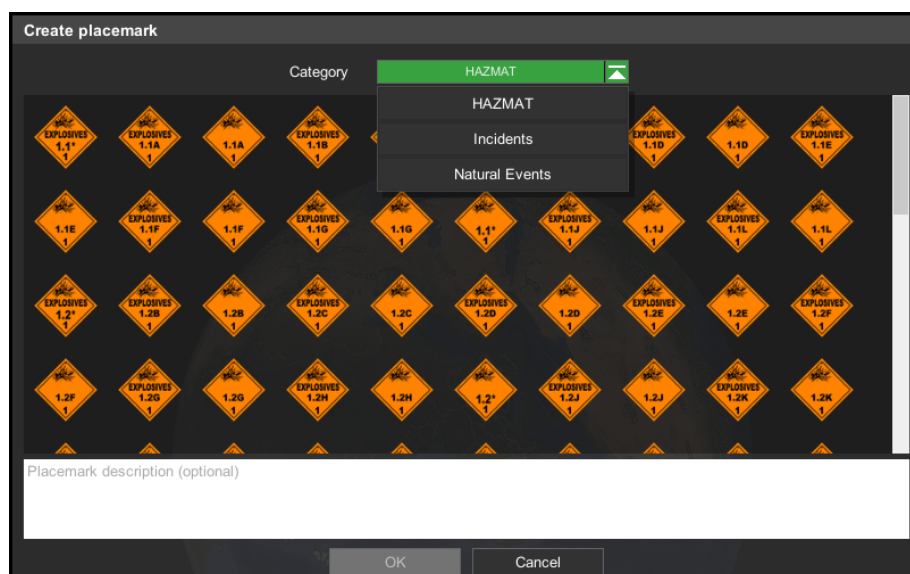
Figure 36 - Placemark creation window

To remove a placemark, right click on the placemark and chose "Delete placemark". To move a placemark, right click on a placemark, choosing "Move placemark" and then left click on the area the placemark needs to be moved to (Figure 37 - Window to edit Placemark).
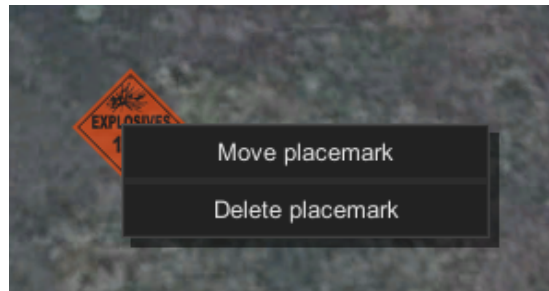
Figure 37 - Window to edit Placemark

It is possible to import custom markers in *.KML format using UgCS Client. To import placemarks, create a unique object for each source - click the Map options (globe icon at the top right-hand corner of the screen) and click on the Placemarks layers button. Add a new placemark source and upload them. Firstly add the necessary source to the list. The order of objects in the list is important because it determines the priority of objects in the map. It is possible to change the source from enabled to the disabled source list. «Focus» button displays the map to the imported object.

13 Orthomosaic

UgCS supports ortophotomosaic creation - a composed image from pictures taken during the flight. UgCS compose it using coordinates (from EXIF data) and overlap info. For UgCS OPEN and UgCS ONE licenses (available till April 2018) the number of images is limited to 20 items. For UgCS PRO and UgCS ENTERPRISE licenses it is unlimited.

14 Show camera position

UgCS can show camera's position where the camera shutter was set off. This option is enabled by clicking the globe icon (Map options) on the upper menu bars and selecting "Show image center" from the drop-down menu. Choose the photo or photos with georeferenced in the file browser and click "Select" or "Select all". After importing files on the map center of each frame will be display as mark. On the window "Image center" coordinates of marks can be export as *.CSV file ("Write report in CSV" button).

To hide image centers, click the globe icon (Map options) on the upper menu bars and selects "Hide image centers" from the drop-down menu.

15 Custom sectors

It's possible to create own custom sectors as aerial placemarks in layers, using third-party software. This is typically used for visual determination of the area or boundaries.

To do so, click the Map options (globe icon at the top right-hand corner of the screen) and click the Map layers button, select "Custom Sectors" and click "Add". Provide a friendly name for the desired sector and click "create". Using the "upload" button, browse for the previously created * .KML sector

and click "select". The chosen sector should now appear in UgCS for desktop. "Focus" button will place the point of view, right above it.

16 Proxy settings

Proxy settings are taken from OS settings. It is possible to set up proxy settings separately for each component. The proxy format is the following:

For the following components: (components and configuration file as follows)

vsm-ardupilot - vsm-ardupilot.conf

vsm-dji - vsm-dji.conf

vsm-emulator - vsm-emulator.conf

vsm-microadsb - vsm-microadsb.conf

vsm-microdrones - vsm-microdrones.conf

vsm-micropilot - vsm-micropilot.conf

vsm-mikrokopter - vsm-mikrokopter.conf

vsm-px4 - vsm-px4.conf

vsm-uavionix - vsm-uavionix.conf

vsm-xbee - vsm-xbee.conf

vstreamer – vstreamer.conf

geoserver.properties

#proxy settings

#http.proxy.host = Hostname address

#http.proxy.port = TCP/IP port number

#http.proxy.user = Username

#http.proxy.password = password

#https.proxy.host = Hostname address

#https.proxy.port = TCP/IP port number

#https.proxy.user = Username

#https.proxy.password = password

ucs.properties

java.net.useSystemProxies=true

#proxy.userName=login

#proxy.password=password

17 ADS-B

UgCS supports ADS-B (Automatic dependent surveillance-broadcast) receivers and transponders. When using an ADS-B receiver, UgCS will warn user about collision possibilities between vehicles. If using an ADS-B transponder, it is possible to configure and use it during flight with the help of UgCS.

17.1 Receiver

UgCS gives warnings about dangerous convergences concerning vehicles controlled by UgCS, and vehicles observed by UgCS, via the microADS-B receiver.

Figure 38 - ADS-B icon

To display the ADS-B monitor window, click on the ADS-B icon (Figure 38 - ADS-B icon) at the top right-hand corner of the screen.
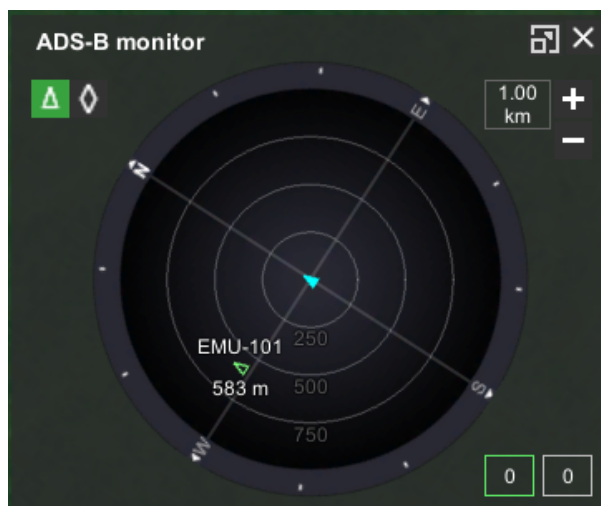
Figure 39 - ADS-B monitor window

The calculation of the collision possibility is based on three parameters:

- H – horizontal distance (meters)

- V – vertical distance (meters)

- T – warning time (seconds)

Values for the vehicles, controlled by UgCS:

- H = 20 m

- V = 15 m

- T = 60 sec.

Values for the vehicles, observed by UgCS:

- H = 9 260 m (5 NM)

- V = 300 m

- T = 60 sec.

Warnings about possible collisions appear in the log window if vehicles, during the minimal convergence, would, in the future, violate both boundaries (H / V) of any other vehicle in a time less than T. A warning is not displayed if the minimal convergence occurred in the past and the vehicles fly apart from one another.

A warning is cleared if one of the following events occurs:

- The minimal convergence persisted in the past and the spread angle between the trajectories is more than 20 degrees;

- The minimal convergence persisted in the past and spread angle between the trajectories is less, than 20 degrees and the areas of the vehicles are not violated.

Warnings created only for vehicles that were added to the vehicle list. When control is released, all current alerts for that vehicle are removed.

An indicator in the top right corner shows whether any ADS-B receivers are currently connected. It is displayed green if a connection with at least one such device is active, and grey otherwise.

17.2 Transponder

If the vehicle is equipped with an ADS-B Transponder or will be at some point, it is possible to configure and transmit ADS-B messages using UgCS. As of this moment, UgCS supports Sagetech XPS-TR Mode S transponders. The following main functions for ADS-B Transponder configuration and usage are available:

- To set ADS-B modes;

- To set parameters;

- To display annunciators;

The following list of parameters are available:

- SQUAWK: must contain of four octal digits. Allowed digits are: 0, 1, 2, 3, 4, 5, 6, 7.

- ICAO Address: must contain of six hexadecimal digits. Allowed symbols: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F.

- Aircraft registration (tail number): must contain of up to 8 symbols. Allowed are: 0-9, A-Z.

- Flight ID: must contain of up to 8 symbols. Allowed are: 0-9, A-Z.

- IDENT* flag: Yes (single direction button)

- External altitude: Yes/No

*http://aviation.stackexchange.com/questions/3049/how-does-ident-work
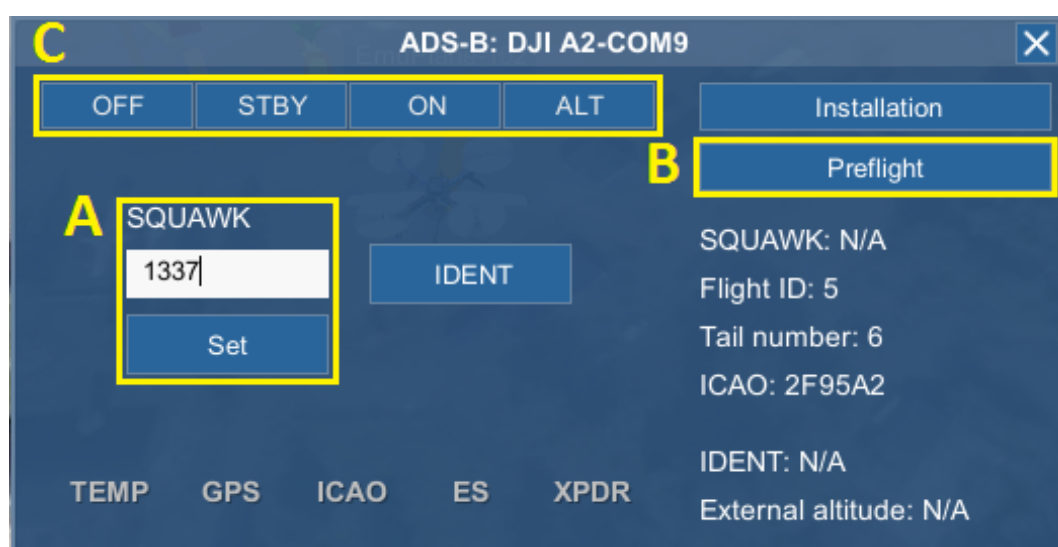
Figure 40 - ADS-B settings menu for reference

Transponder parameter usage:

- ICAO Address and Aircraft registration/Tail number will remain the same for a specific vehicle in most of the cases. These parameters can be set in Vehicle Parameters section Figure 40).

- SQUAWK parameter can be defined when necessary any time during the flight (Figure 40 - ADS-B settings menu for reference, A).

- Flight ID should be set during preparation for take-off. That is done in the Preflight section (Figure 40 - ADS-B settings menu for reference, B).
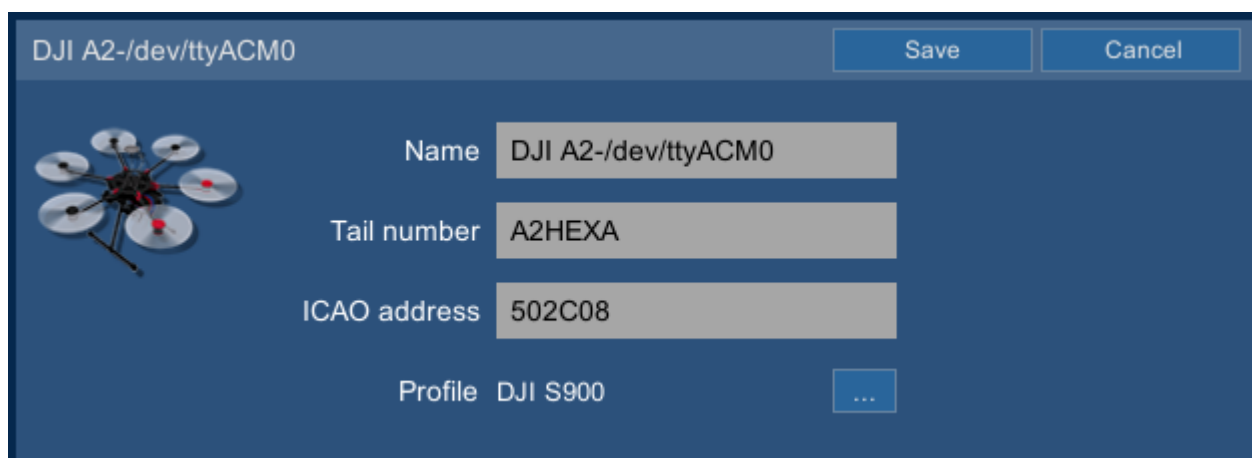
Figure 41 - Vehicle parameter window to set Tail number and ICAO address

Available transponder modes (Figure 40 - ADS-B settings menu for reference, C):

- OFF – Transponder is turned OFF

- STBY – Standby mode. Transmission does not happen, device is set to low power consumption, is ready for start-up with reduced warm-up time.

- ON – Transponder is transmitting and receiving data, but no altitude information is transmitted.

- ALT – Same as "ON" mode with the additional transmission of vehicle altitude.

The following error codes can be displayed:

- XPDR – General error code that is displayed if any of the following errors have occurred.

- TEMP – If transponder temperature sensor reports an error.

- GPS – Displayed if there is no GPS signal.

- ICAO – If there is no valid ICAO address set.

- ES – Displayed if the extended squitter has failed.

Figure 42 - ADS-B settings menu displaying XPDR and GPS error codes

18 Import route from KML

UgCS PRO and UgCS ENTERPRISE license able to import KML-files.

To import a route from a KML file, click "Add new route" button (plus sign). Select "Import from file", click "Browse" to locate, and confirm with "Select".

"LineString" segments of the KML file will be imported as simple Waypoint route.

"LinearRing" segments can be imported as "Area scan", "Photogrammetry" or "Perimeter" route type.
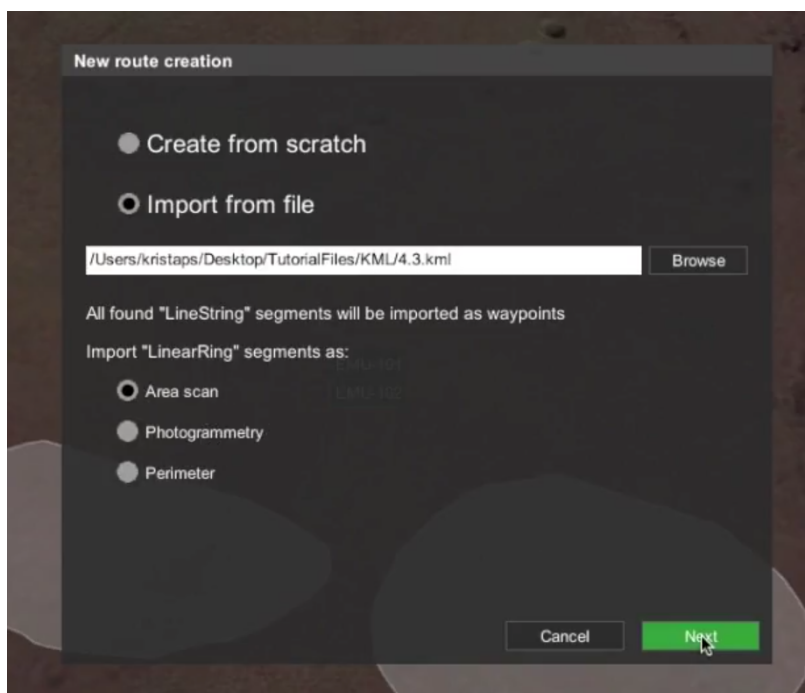
Figure 43 - Import KML file

A message with UgCS license upgrade option will be displayed, if current license has disabled KML import functionality:
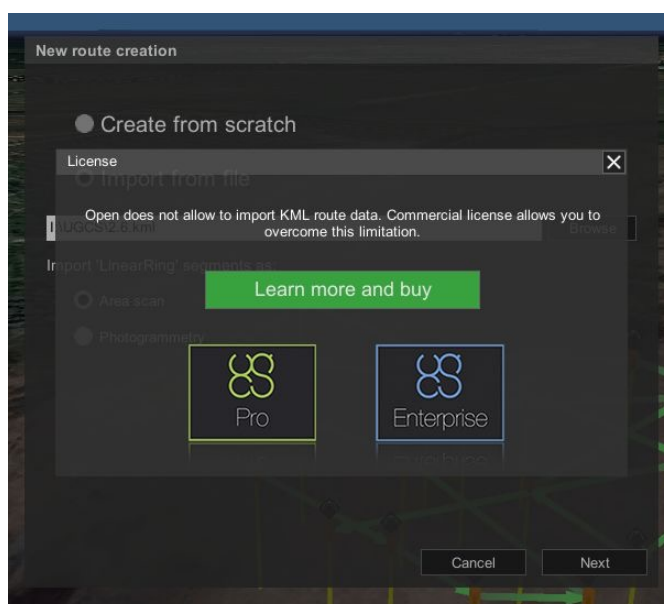
Figure 44 - License upgrade info message

19 Import route from CSV

UgCS is able to import CSV files. In order to import CSV files, click on the "Add new route" button (plus sign). Choose "Import from file", click "Browse", to locate the CSV file and confirm with "Select" and confirm with "Next".
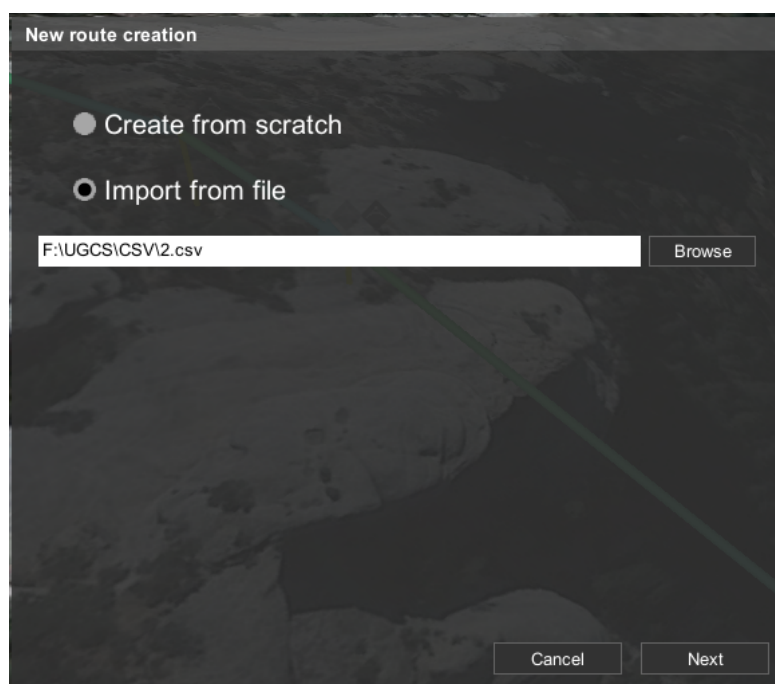
Figure 45 - Import CSV file

In the next screen, select the preferable vehicle profile.

CSV file must have 3 mandatory fields: "Latitude", "Longitude", "AltitudeAGL". Fourth field "Speed" is optional. Please note the header is ignored if it contains letters.

Measurement units used:

- WP - count of waypoints in the route. If not specified then the waypoints are ordered by row number

- Latitude - degrees

- Longitude - degrees

- AltitudeAGL - m (AGL)

- AltitudeAMSL - m (AMSL)

- Speed - m/s

- Picture - If "TRUE", then "Set camera mode" action with option "Shot" is created for the waypoint.

- UavYaw - If specified then "Change yaw" action with corresponding "Yaw" relative to the North is created for the waypoint.

- CameraTilt - If specified then "Set camera attitude" action with corresponding "Tilt" is created for the waypoint.

- WaitTime - If specified then "Wait" action with corresponding "Wait duration, s" is created for the waypoint.

Separator: , (comma)

Example:

> *Latitude,Longitude,AltitudeAMSL,Speed,Picture,ElevationMap,WP,CameraTilt,UavYaw,Distan ceFromFace*
> *1.331213958,103.7424341,130,1,FALSE,,1,,,*
> *1.331433271,103.7422533,131.7965138,1,TRUE,north,2,0,-145.4353298,5.5*
> *1.331479854,103.7421857,131.7965138,1,TRUE,north,3,0,-145.4353298,5.5*
> *1.331539018,103.7422265,131.7965138,1,FALSE,,4,,,*

20 Joystick

Joystick/Keyboard (Input control) is used to control vehicle or payload. Several input controls can be used simultaneously.

Control flow from input device should be sent to the vehicle only if:

- vehicle is under control of the operator;

- client window is active;

- vehicle is selected in UI.

"Keyboard" button allows to check connected devices, their mappings, calibration and to change settings (Figure 4 - Mission editor #5).

JOYSTICK mode control channel:

Joystick mode is inherently more fragile than direct manual control via RC transmitter as it involves many different data links and components:

Joystick device --> UgCS client --> server --> VSM --> Radio --> Radio --> Autopilot

If any of the above links fail, the joystick control is broken.

20.1 Fine-tuning axes via the GUI

Axis fine-tuning performed via interface. Click "Input mapping" button, located at the top right corner. Checkbox the desired controller and select the axis that requires tuning.
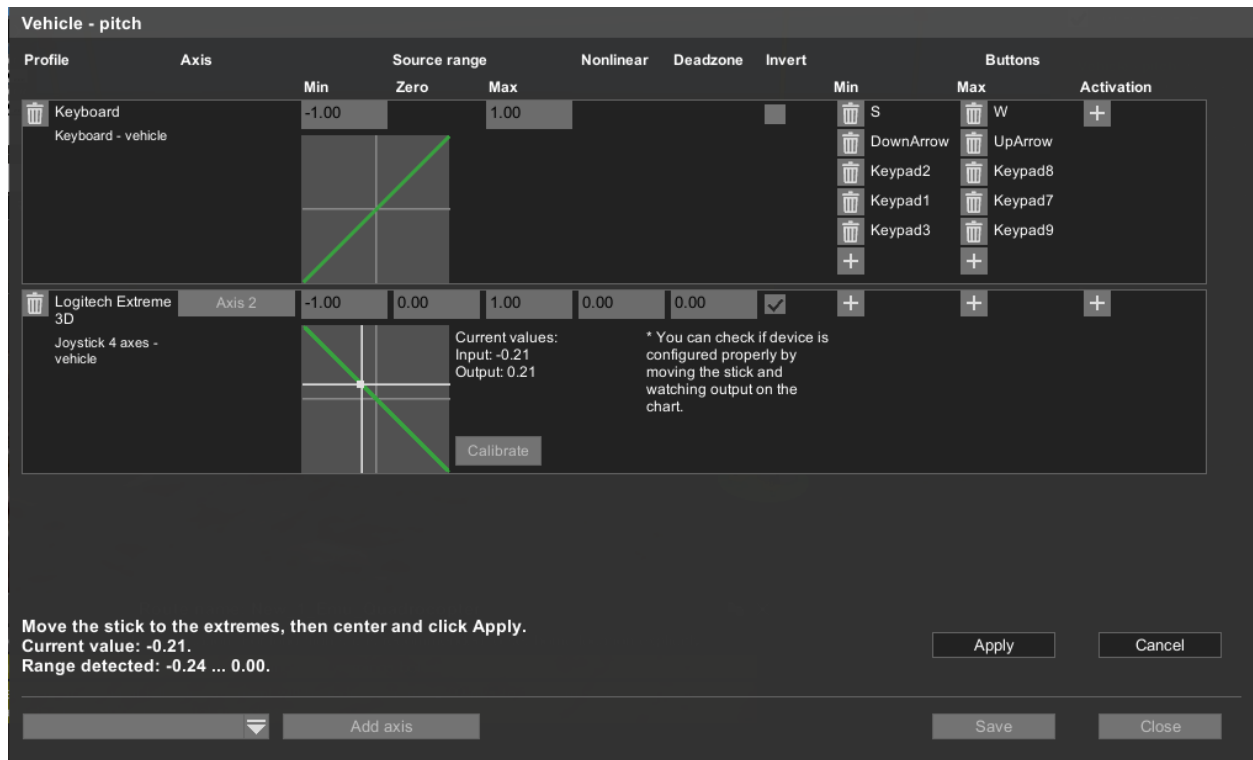
Figure 46 - Window fine-tuning single axis

The window shows a list of the settings of the axis. Input and output axis of the profiles and devices (Figure 46 - Window fine-tuning single axis). If the settings of axes more than fit the window to the right appears scroller.

Following actions can be performed:

- add configuration for the profile that does not yet have such an axis setting;

- add individual input button to configure axis;

- calibrate axis for the input device;

- delete added devices;

- configure boundaries and point zero, non-linearity and "deadband";

- check the results of device settings.

Add axis settings for a profile, which does not yet have such settings
In the "Input" window, select the function which has no button (axis) assigned. For example. "Payload 1 – zoom" In the next module window, select the controller from dropdown menu located at the bottom left, and click "add axis". Use the desired axis for the action on the controller. UgCS should detect it and notify operator with message "Currently detected: axis #" at the bottom. Click "Apply" and "Save".

Adding a single input button to configure axis

Single action button is being set up the same way as an axis. Select the single action function – Drop down menu, select controller – add axis and click "Cancel" instead the axis editing window, will appear single action editing window. Click "+" (plus) button, under "activation" sign at the top, right corner of modular window. Press the desired action button on the controller. UgCS will detect it and notify operator with the message "Currently detected #" at the bottom. Click "Apply" and "Save".

Calibration of input devices

Pressing the button "calibrate" (calibrate) enables the calibration mode. Movement along the axis of the device determines its minimum, maximum, and average values for the input. To accept or reject the changes will be prompted.

Remove individual buttons and axis

To remove entire axis or a single action button, use the trash bin pictogram located at the modular calibration window. (click the required action to open it). The button is located at the beginning of the line, next to the device name and profile for axis and at the end, for single action buttons. Until "Save" is pressed, all changes remain unsaved, window closes without saving.

Setting minimum, zero, peak, nonlinearity, the "dead zone"

These settings apply to the "input" signal from the control device in relation to the value of the main axis, and are displayed as numbers with two decimal places. It's possible to configure them manually. Minimum, zero, determine the maximum under what values on input, will -1, 0 and 1. Next, the output function is converted to a parameter with nonlinearity of the curve, and adjusted around the "deadband" to non-zero values started immediately behind the range (it is set to +-n around a given value of zero). Derived values are displayed at the bottom, in the form of graphics input to the output. A line chart displays both the function and the current i/o device on it. The side graphics these same data displayed in numeric form.

Note: Features work with the keyboard!

The keyboard has the following differences from other devices:

- Input axis search will not start when adding a keyboard;

- The current value is not displayed on the chart and calibration is not prompted.

- Input axis value zero, non-linearity and dead zone are not displayed.

21 UgCS ENTERPRISE configuration

21.1 Service manager

UgCS consists of many components to ensure maximum flexibility. Service manager is a utility for managing the components of UgCS.

21.2 Checking the Components and Running the Application

21.2.1 Windows

UgCS will start automatically after the installation.

Run UgCS client by clicking shortcut icon on desktop. UgCS client is a GUI application which starts UgCS service manager and all necessary processes. All processes will close after exiting from UgCS client. Alternatively, start service manager by clicking the icon on desktop.

UgCS service manager will start the required background processes: universal control server (UCS), vehicle specific modules (VSM) and the emulator.
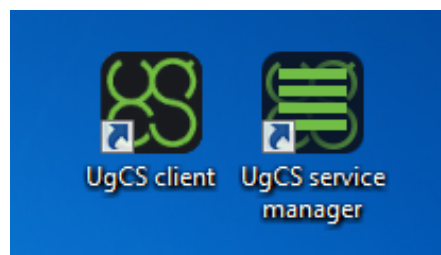
Figure 47 - UgCS Service manager and UgCS client shortcuts

If service manager starts properly, it is found in system tray. Please check that all services are running. If a service has stopped, it should be launched from the system manager's menu.

Note: "Administrator" privileges are required to run the services.

If UgCS components are installed as Windows Services, it is possible to open the "Windows Services" panel through the UgCS system tray icon.
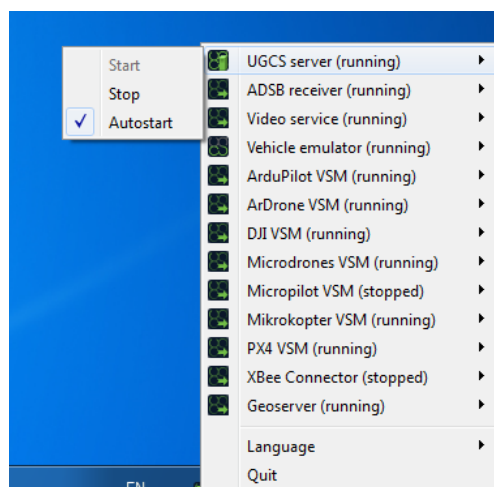
Figure 48 - UgCS Service manager menu on Windows OS

The desktop icon launches the UgCS client. UgCS configuration is done automatically.

UgCS components can be started or stopped, using the context menu of service manager. The automatic launch of the components is also managed in context menu (Figure 48 - UgCS Service manager menu on Windows OS).

21.2.2 mac OS

Start UgCS by clicking the UgCS client icon in Launchpad.

After successful installation, the Launchpad has folder UgCS with two shortcuts (UgCS Service manager and UgCS client). UgCS client will start GUI application, UgCS service manager will start all necessary processes (Figure 49 - UgCS Service manager menu on mac OS).

After starting the UgCS service manager and UgCS client, the rest is done using the same method as in Windows. Please refer to the Windows section for more information.
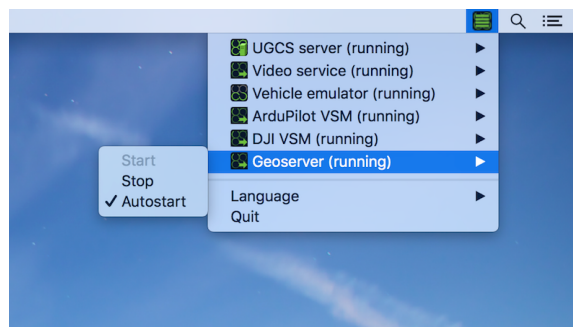
Figure 49 - UgCS Service manager menu on mac OS

21.2.3 Linux

For Linux installation instructions are published on http://apt.ugcs.com/doc.

The **UgCS Client** is started using the terminal command "$ ugcs-client" or from a desktop shortcut. All server applications on Linux will start as a service automatically.

21.3 Deploying UgCS components to separate computers

Any component of UgCS can be installed on a separate computer.

Installing prerequisites is carried out using the installer when selecting "Advanced deployment".

Choose the components that will be installed to the computer and components configuration (ports, ip addresses, etc.).

21.4 Configure connection from the client to the server USC

If using UgCS PRO or UgCS ENTERPRISE license, it is possible to connect additional clients from other computers to the USC server.

To establish connection, it is necessary to click "Choose another server" when the client starts up. Change the ip address to the address of the USC server and click "Retry".

21.4.1 Configure connection from the USC to the server VSM

When USC starts the server automatically contains all the VSM servers in the same network subnet, or WiFi.

To add VSM server from a different subnet, specify the address and port in the application settings (Main menu, Configuration, VSM-> add).

21.4.2 Configure connection from the USC to the other local UgCS Geoserver

To add or edit parameters of local UgCS, specify the address and port in the UgCS client settings (Main menu, Configuration, Geoservers -> add/edit).

22 Custom maps

22.1 Map providers

Tiles

UgCS supports providers that use the Google XYZ addressing system. The URL of the provider should be like this one in the example:

http://maps4.wien.gv.at/basemap/bmaporthofoto30cm/normal/google3857/{level}/{southing}/{easting}.jpeg
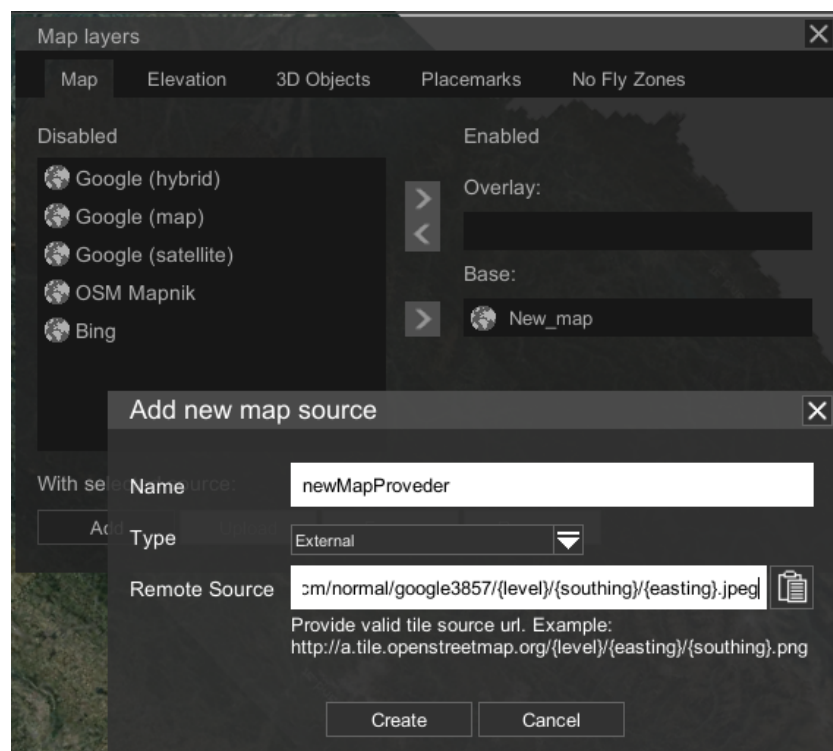
Figure 50 - Add new map source

22.2 UgCS Geoserver

This is map provider for sources which are provided by Local Geoserver and will be added automatically when new map overlay uploaded.

22.2.1 Geoservers

Geoserver is a UgCS component meant for custom map source, elevation source and 3D model import. It is installed together with UgCS and allows users to import custom DEM (Digital Elevation Model) data as elevation source for a specified region and upload georeferenced raster data to geoserver.
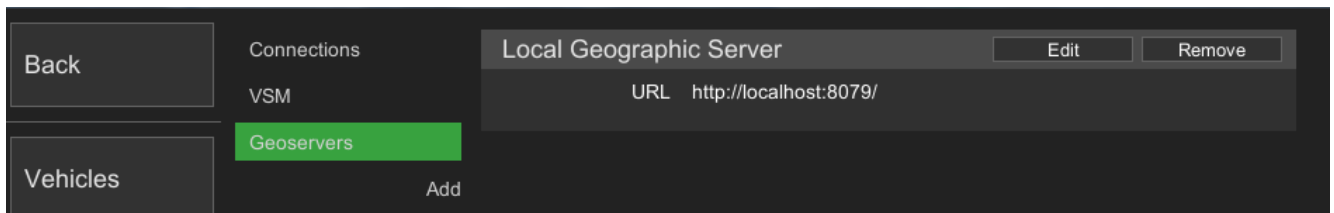
Figure 51 - Geoserver providers

22.2.2 Elevation z-order

Currently UgCS supports ArcASCII, GeoTiff and SRTM formats, but all GDAL Raster Formats[1] that feature Georeferencing should work.

To use an elevation source, it must be first added to "Elevation z-order" list. This list contains all elevation sources that may be currently used. First add the necessary source to the list. The list order is also important, because it determines the priority of a source – higher listed sources are of higher priority and lower listed accordingly are of lower priority.

Now the added elevation source is ready to use and the route will be calculated according to the elevation source of highest priority for the specific area.

22.2.3 Building sources

Currently UgCS supports the import of *.KMZ archives and *.KML files with external links.

To add new building source, create it in the "Geoservers" menu. The process is similar to elevation sources. Go to "Geoservers" menu, clicking on "Local Geographic Server", one can access "Manage elevation buildings" menu. Then create new one by pressing "New source" button.

Add created source to "Building sources" list. As for elevations sources that list contains all building sources that may be currently used. Press "Add" button and select created source.

23 Multioperator work

The UgCS allows operating a mission by different users from different computers.

This option is available only for UgCS PRO and UgCS ENTERPRISE licenses.

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1 http://www.gdal.org/formats_list.html

23.1 User list management

For the convenience and control, create a number of users who can have either "Admin" or "Operator" role.

To create a new user navigate to Main menu - > Users. Click on "Create new". Fulfil all the fields and specify the role. After that click "Save".

"Operator" role differs from the "Admin" role with only one function. Operator cannot create and edit the list of users.

23.2 Collaboration on a mission

Collaboration work on one mission from different computers is possible if UgCS clients are configured properly. See paragraph: **Configure connection from the client to the server USC**.

In this case, vehicles of all participants are available for all participants. The first user who opens the mission has the permission to edit it. Other users are allowed only to view the mission. To refuse edit permission of mission the current mission editor should click "Stop editing" in the menu "Menu". New mission editor should click "Edit" in the menu "Menu".

Use the same scheme to give vehicle control to another person. Click "Release control" in the vehicle drop down menu to do this. To take vehicle control click "Gain control" in the vehicle drop down menu. In the vehicle card, there is an icon with the man (top left corner). Hover cursor on the icon and the hint shows who locked the vehicle.

24 Drone specifics

24.1 Commands

Platform	Type	Arm	Dis-arm	Auto Mode	Manual Mode	Click & Go	Joystick Control	Return Home	Take-off	Land	Emergency Land	Hold	Continue
3DR APM	M	Y	Y	Y	Y	Y	Y	Y		Y		Y	Y
3DR APM	F	Y	Y	Y	Y	Y	Y	Y				Y	Y
DJI A2	M			Y		Y	Y	Y				Y	Y
DJI A3	M			Y	Y	Y	X	Y				Y	Y
DJI Inspire 1, 2	M			Y	Y	Y	X	Y				Y	Y
DJI Matrice 100	M			Y	Y	Y	X	Y				Y	Y
DJI Matrice 200	M			Y	Y	Y	X	Y				Y	Y
DJI Matrice 210	M			Y	Y	Y	X	Y				Y	Y
DJI Matrice 600	M			Y	Y	Y	X	Y				Y	Y
DJI Mavic Pro, Mavic 2 Pro/Zoom/ Enterprise	M			Y	Y	Y	X	Y				Y	Y
DJI Spark	M			Y	Y	Y		Y	Y	Y		Y	Y
DJI N3	M			Y	Y	Y	X	Y				Y	Y
DJI Naza-M V2	M			Y		Y	Y	Y				Y	Y
DJI Phantom 3	M			Y	Y	Y	X	Y				Y	Y
DJI Phantom 4	M			Y	Y	Y	X	Y				Y	Y
DJI Phantom 4 Pro	M			Y	Y	Y		Y	Y	Y		Y	Y
DJI WooKong-M	M			Y		Y	Y	Y				Y	Y
Emulator	M	Y	Y	Y	Y	Y	Y	Y		Y		Y	Y
Emulator	F	Y	Y	Y	Y	Y	Y	Y				Y	Y
Kestrel	M	Y	Y	Y	Y	Y	Y	Y		Y		Y	Y
Microdrone	M	Y	Y										
Micropilot	M	Y	Y	Y				Y		Y		Y	Y
Mikrokopter	M							Y					
PX4	M	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y

24.2 Actions

Platform	Type	Camera Mode	Camera trigger by Time	Camera trigger by Distance	Camera Attitude / zoom	POI	Panorama	Change Yaw	Wait
3DR APM	M/H	Y	Y	Y	Y	Y	Y	Y	Y
3DR APM	F	Y	Y	Y	Y	Y		Y	Y
DJI A2	M	Y	Y	Y				Y	Y
DJI A3	M	Y	Y	Y	Y	Y	Y	Y	Y
DJI Inspire 1	M	Y	Y		Y	Y	Y	Y	Y
DJI Inspire 2	M	Y	Y	Y	Y	Y	Y	Y	Y
DJI Matrice 100	M	Y	Y	Y	Y	Y	Y	Y	Y
DJI Matrice 200	M	Y	Y	Y	Y	Y	Y	Y	Y
DJI Matrice 210	M	Y	Y	Y	Y	Y	Y	Y	Y
DJI Matrice 600	M	Y	Y		Y	Y	Y	Y	Y
DJI Mavic Pro, Mavic 2 Pro/Zoom/ Enterprise	M	Y	Y	Y	Y	Y	Y	Y	Y
DJI Spark	M	Y	Y		Y	Y	Y	Y	Y
DJI N3	M	Y	Y	Y	Y	Y	Y	Y	Y
DJI Naza-M V2	M	Y	Y	Y				Y	Y
DJI Phantom 3	M	Y	Y		Y	Y	Y	Y	Y
DJI Phantom 4	M	Y	Y	Y	Y	Y	Y	Y	Y
DJI Phantom 4 Pro	M	Y	Y	Y	Y	Y	Y	Y	Y
DJI WooKong-M	M	Y	Y	Y				Y	Y
Emulator	M	Y	Y	Y		Y	Y	Y	Y
Kestrel	M						Y	Y	Y
Emulator	F	Y	Y	Y		Y	Y	Y	Y
Microdrone	M	Y	Y		Y	Y	Y	Y	Y
Micropilot	M				Y	Y			Y
Mikrokopter	M	Y	Y	Y	Y	Y	Y	Y	Y
PX4	M	Y	Y	Y	Y	Y		Y	Y

24.3 Fail-safe actions

Platform	Type	RC loss	Datalink loss	GPS loss	Low battery	Notes
3DR APM	M \ H	HLCN	-	L**WN**	HCN	Continue possible only while in AUTO mode
3DR APM	F	N	N	-	N	Currently not implemented in VSM
DJI A2	M	-	-	-	-	Configurable only via Assistant
DJI A3	M	**H**C	-	-	-	
DJI Inspire 1, 2	M	HC	-	-	-	
DJI Matrice 100	M	HC	-	-	-	Configurable only via Assistant
DJI Matrice 200	M	HC	-	-	-	Configurable only via Assistant
DJI Matrice 210	M	HC	-	-	-	Configurable only via Assistant
DJI Matrice 600	M	HC	-	-	-	Configurable only via Assistant
DJI Mavic Pro, Mavic 2 Pro/Zoom/ Enterprise	M	HC	-	-	-	
DJI Spark	M	HC	-	-	-	
DJI N3	M	HC	-	-	-	
DJI Naza-M V2	M	-	-	-	-	Configurable only via Assistant
DJI Phantom 3	M	HC	-	-	-	Configurable only via Assistant
DJI Phantom 4	M	HC	-	-	-	Configurable only via Assistant
DJI Phantom 4 Pro	M	HC	-	-	-	
DJI WooKong-M	M	-	-	-	-	Configurable only via Assistant
Emulator	M	HLCWN	HLCWN	HLC**W**N	H**L**CWN	
Emulator	F	HLCWN	HLCWN	HLC**W**N	H**L**CWN	
Kestrel	M	**HL**	-	-	**HL**	
Microdrone	M	HLCWN	-	L**W**N	H**L**CWN	
Micropilot	M	HLCWN	-	L**W**N	H**L**CWN	
Mikrokopter	M	-	-	-	-	Configurable only via Kopter Tool
PX4	M	HLCW**N**	-	-	HLC**N**	Datalink loss (HLCW) is supported by autopilot but not implemented in UgCS
PX4	F	-	-	-	-	Currently not implemented in VSM

Legend:

W: Wait   L: Land   H: Go home   C: Continue   Default value

24.4 Turn types

Platform	Type	Stop & turn	Straight	Spline	Banked turn	Adaptive banked turn
3DR APM \ Pixhawk	F		Y			
3DR APM \ Pixhawk	M \ H		Y	Y		
DJI A2	M	Y			Y	Y
DJI A3	M	Y				Y
DJI Inspire 1, 2	M	Y				Y
DJI Matrice 100	M	Y				Y
DJI Matrice 200	M	Y				Y
DJI Matrice 210	M	Y				Y
DJI Matrice 600	M	Y				Y
DJI Mavic Pro, Mavic 2 Pro/Zoom/Enterprise	M	Y				Y
DJI Spark	M	Y				Y
DJI N3	M	Y				Y
DJI Naza-M V2	M	Y			Y	Y
DJI Phantom 3	M	Y				Y
DJI Phantom 4	M	Y				Y
DJI Phantom 4 Pro	M	Y				Y
DJI WooKong-M	M	Y			Y	Y
Emulator	M	Y		Y		
Emulator	F			Y		
Kestrel	M	Y				
Microdrone	M	Y				
Micropilot	M \ H	Y				
Mikrokopter	M	Y				
PX4	M		Y			
PX4	F		Y			

25 License types and feature comparison

After the download and installation of UgCS it has limited functionality: the option to upload routes to vehicles is disabled, except the emulators. To activate full functionality of UgCS the license has to be activated (see chapter License activation).

To obtain an UgCS Activation code compare features and prices, visit UgCS online-store www.ugcs.com or send a request to ugcs@ugcs.com.

UgCS PRO	UgCS ENTERPRISE
For UAV professionals.	For companies operating a fleet of drones.
Fully functional multi-drone ground control software for professional UAV mission planning. Digital elevation model (DEM) and KML file import enabling map customization, ADS-B receiver support to ensure flight safety.	Suitable for companies operating a fleet of different manufacturer drones, requiring a unifying ground station solution. ADS-B transponder support, multi-node deployment, enabling operating a central server with unlimited connections to UgCS server.

FEATURES COMPARISON		
	PRO	ENTERPRISE
Mission planner I Drone control		
Aerial surveying tools:		
simple mission planning	Y	Y
Photogrammetry planner with GSD support	Y	Y
Flying long routes with battery exchange	Y	Y
Immersive 3D mission planning environment	Y	Y
Elevation profile	Y	Y
Telemetry display	Y	Y
Automatic flight mode (waypoints)	Y	Y
Manual mode	Y	Y
Click & Go	Y	Y
Joystick and keyboard control	Y	Y
Software emulator	Y	Y
Supported Drones and Autopilots		
DJI drones Inspire 1/1 PRO/Raw, Inspire 2, Matrice 600/PRO, Matrice 200/210/210RTK, Matrice 100, Mavic Pro, Mavic 2 Pro/Zoom/Enterprise, Phantom 4 PRO v2, Phantom 4 ADV, Phantom 4 PRO+, Phantom 4 PRO, Phantom 4, 3 and 2, , Spark, A3, N3	Y	Y
MavLink compatible Pixhawk/APM multicopter & helicopter APM Airplane	Y	Y
Mikrokopter Quadro XL, Octo XL, Hexa	Y	Y
Microdrones MD4 series	Y	Y

FEATURES COMPARISON		
	PRO	**ENTERPRISE**
MicroPilot Multicopter, Helicopter, Plane	Yes, experimental	Yes, experimental
Lockheed Martin Kestrel, Indago	Y	Y
Post-flight analysis and Image processing		
Geotagging	Y	Y
Telemetry player	Y	Y
UgCS Mapper (BETA)	Y	Y
Custom maps		
3D Buildings import	Unlimited	Unlimited
KML data import	Y	Y
DEM data import	Y	Y
Geo-referenced images import	Y	Y
No-Fly zones		
No-Fly zones - airport registry	Can be disabled	Can be disabled
No-Fly zones - custom zones	Y	Y
Fly zone limits for routes	No Limits	No Limits
ADS-B Support		
ADS-B Receiver microadsb; uAvionix pingRX and pingUSB	Y	Y
ADS-B Transponder Sagetech XP	X	Y
ADS-B Transmitter Skysense BCON[1]	X	Coming soon
Video **features**		
Video recording to the drone internal storage	Y	Y
Camera footprint	Y	Y
Multi-operator / Multi-drone support		
Multinode installation	Y	Y
SDK support	Limited	Unlimited
Multi-drone support	Unlimited	Unlimited
Support		
First year's support and update package	Y	Y
Annual Support & Update package (starting second year)	120 USD	400 USD
E-mail support	support@ugcs.com	support@ugcs.com
Phone support 5x8 (UTC+02:00)	Y	Y
Support 24x7	Request quote ugcs@ugcs.com	Request quote ugcs@ugcs.com

26 Troubleshooting

Answers to the most common questions are published on ugcs.com/faq.

26.1 Logs

To provide support for certain questions and issues UgCS logs would be required. Logs are store in the following locations:

General logs:
Windows

C:\Users\ [USER NAME]\AppData\Local\UGCS\logs

(%LOCALAPPDATA%\UGCS\logs)

macOS

~/Library/Logs/UGCS

(/Users/[User Name]/Library/Logs/UGCS)

Linux

/var/opt/ugcs/log

Installation\Uninstallation logs:
Windows

C:\Users\[USER NAME]\AppData\Local\Temp

macOS

/Users/[User Name]/Library/Logs/
~/Library/Logs/

Linux

Use system logs for debian packages

Configuration files:
Windows

C:\Users\[USER NAME]\AppData\Local\UGCS\
C:\Program Files (x86)\UgCS\

macOS

/Applications/UgCS
~/Library/Logs/UGCS/configuration
(/Users/[User Name]/Library/Application Support/UGCS/configuration)

Linux

/opt/ugcs
/etc/opt/ugcs/

Database:
Windows

C:\Users\[USER NAME]\AppData\Local\UGCS\db\sqlite
(%LOCALAPPDATA%\UGCS\logs\db\sqlite)

macOS

~/Library/Logs/UGCS
(/Users/[User Name]/Library/Application Support/UGCS)

Linux

/var/opt/ugcs/server/sqlite

Installation directory (by default):
Windows

C:\Program Files (x86)\UgCS

macOS

/Applications/UgCS

Linux

/opt/ugcs

26.2 Errors and warnings

Messages	Resolution
Only a part of the calculated route from point # to point # will be uploaded to the vehicle. Please control the battery during the flight to return the vehicle home before it reached point of NO-RETURN.	Count waypoint exceeds the maximum specified in the vehicle profile. Change the route or Change start point. Then the part of route will be cut before the first dot (if there is a point), and after a Max point specified vehicle profile. Note: When uploading mission to vehicle, actual number of loaded points may be different. Loading huge mission with a lot of waypoint please check log file to know how many waypoints really uploaded to vehicle. This log on Windows usually at C:\Users\USER_NAME\AppData\Local\UgCS\logs\VEHICLE_VSM_FOLDER\
Estimated time of flight by route () exceeds the maximum flight time specified for the vehicle profile (). Please control the battery during the flight to return the vehicle home before it reached point of NO-RETURN	Estimated flight time exceeds the maximum possible flight time specified for the vehicle profile.

	Change the route or Change start point**. Then the part of route will be cut before the first dot (if there is a point), and after a Max point specified vehicle profile.**
Display warning message in route calculation result Segment #: Warning: found more than one camera by time/distance actions on a segment. Used only first one for processing.	Please delete duplicate action.
For only DJI vehicle on the mobile app: After changing the camera settings, the image is not displayed or a black screen is displayed.	Check camera settings.
There is a known issue of Arducopter firmware below 3.5.3 - which can result the autopilot to crash when multiple WPs with "Turn Type"="Spline" and "Wait" action added are located at the same location.	In order to avoid this, please use the "Turn Type" = "Straight" or move the WPs apart.