U|g|CS User Manual

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**U|g|CS** stands for Universal Ground Control Software. The software is universal because it supports different vehicle and payload manufacturers and provides users with a unified environment for mission planning, execution monitoring, and the inventory and management of unmanned vehicles. Currently DJI Naza-M V2, A2, Wookong-M, Phantom 2 Visions+, Phantom 3 Advanced/Professional, Inspire 1, Microdrones, Mikrokopter, ArDrone, ArduPilot, Pixhawk, Micropilot, Kestrel and other MAVLink compatible UAVs are supported, with an option to add more, by a custom development performed by SPH Engineering or by the clients themselves through an included SDK for third-party developers.

The **U|g|CS** architecture consists of three separate layers:

- Human Control Interface (Client);
- Universal Control Server (Server);
- Vehicle Specific Modules (VSM).

The **Client** provides a graphical user interface for operations such as adjusting vehicle parameters, mission planning, monitoring telemetry and payload data, and replaying missions from an archive. The Client is designed to work on all main computer platforms (Windows, Mac OS X, Linux (Ubuntu)) and will soon be available for mobile platforms (iOS and Android).

**U|g|CS** has been tested to be stable on Windows, Mac OS X and Ubuntu 16.04 LTS (Xenial Xerus).

The **Server** is an intermediate layer. It contains the database, services for HCI and VSM, GIS and routing facilities.

Each **VSM** contains an adapter for a specific vehicle. It translates routes from our universal (vehicle-neutral) protocol to vehicle-specific protocols. It knows how to detect the vehicle and how to obtain and transfer it’s telemetry data to the Client and the Server.
Please Pay Attention!

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 acquainted with, and comply with location-specific legal regulations before using U|g|CS.

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

4. Also, make sure that a correct take-off point altitude is specified before flight. For doing this, please refer to page 43 (Take-off Altitude) of this manual. It is important to do this because the barometer readings can change between power-on, route upload and take-off.

5. In the case of strong wind, using automatic take-off and landing is not advised and could lead to a crash. In a scenario like this, it is safer to take off and land the vehicle in manual mode. Automatic mode should be switched on only when in mid-air.
## 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

<table>
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<th>OS</th>
<th>Windows</th>
<th>Mac OS</th>
<th>Linux</th>
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<tbody>
<tr>
<td>Operating system</td>
<td>Windows 7 with SP1 or later; Windows 8*</td>
<td>Mac OS X Maverick 10.9 or later*</td>
<td>Ubuntu 16.04 LTS (64 bit)</td>
</tr>
<tr>
<td>CPU</td>
<td>Core 2 Duo or Athlon X2 at 2.4 GHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory</td>
<td>Minimum: 2 GB of RAM, Recommended: 4 GB of RAM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hard drive</td>
<td>2 GB of free space</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphics hardware</td>
<td>Graphics card with DirectX 9 support (shader model 2.0). Any card made since 2004 should work.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Network</td>
<td>TCP/IPv4 network stack</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Screen resolution</td>
<td>Minimum supported screen resolution: 1024x768</td>
<td></td>
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</tbody>
</table>

* Please note that the software has not yet been tested on server versions of Windows and OS X. Windows Vista is not supported.
System Requirements for Advanced Installation

| Component       | U|g|CS client | UCS | VSM | Emulator |
|-----------------|------------|------|-----|-------|
| **Operating system** | Windows: Windows 7 with SP1 or later; Windows 8* | Mac OS: Mac OS X Maverick 10.9 or later* | 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** | 1 GB RAM minimum, 2 GB RAM recommended | | 512 Mb RAM | |
| **Hard drive** | 1 GB free space | | 256 Mb free space | |
| **Graphics hardware** | Graphics card with DirectX 9 support (shader model 2.0). Any card made since 2004 should work. | | VGA capable of 1024x768 screen resolution | |
| **Network** | | | TCP/IPv4 network stack | |
| **Screen resolution** | | | Minimum supported screen resolution: 1024x768 | |

* Please note that the software has not yet been tested on server versions of Windows and OS X. Windows Vista is not supported.

**Windows**
For quick installation follow these steps:

1. Run the installer ugcs-2.9.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).

**Linux**
For Linux, .deb packages are available on our website ugcs.com. For Linux installation instructions please go to http://apt.ugcs.com/doc.
Mac OS
For quick installation follow these steps:

1. Run the installer ugcs-2.9.dmg;
2. Follow the installation guide;
3. Read the license agreement carefully (see End User License Agreement in a separate file).

Checking the Components and Running the Application

Windows
U|g|CS will start automatically after the installation.

You can start U|g|CS Client by clicking the icon on desktop. U|g|CS Client is a GUI application which starts U|g|CS Service manager and all necessary processes. All processes will be closed after exiting from U|g|CS Client. Alternatively, you can run the service manager by clicking the icon on desktop.

U|g|CS Service manager will start the required background processes: universal control server (UCS), vehicle specific modules (VSM) and the emulator.

![UgCS Client and Service Manager shortcuts](image1.png)

Figure 1. U|g|CS Service manager and U|g|CS client shortcuts.

Provided that the service manager starts properly, it can be 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. Please note that “Administrator” privileges are required to run the services.

Provided that the U|g|CS components are installed as Windows Services, it is possible to open the “Windows Services” panel through the U|g|CS system tray icon.

![Windows Services panel](image2.png)

Figure 2. U|g|CS Service manager menu.
The desktop icon launches the U|g|CS Client. U|g|CS configuration is done automatically.

**Mac OS**
You can start U|g|CS by clicking the U|g|CS client icon in Launchpad.

After successful installation the Launchpad has folder UGCS with two shortcuts (U|g|CS Service manager and U|g|CS client). U|g|CS client will start GUI application and U|g|CS Service manager will all necessary processes.

![Figure 3. Shortcuts in the UGCS folder in the Launchpad.](image)

After starting the U|g|CS Service manager and U|g|CS client, the rest is done using the same method as in Windows. Please refer to the Windows section for more information.

**Linux**
For Linux installation instructions please go to http://apt.ugcs.com/doc.

The **U|g|CS 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.
Login
After the **UgCS client** starts it will auto-login. If you have more than one user account, a login page will be shown.

The default login - **admin** and password - **admin**.

Getting started
To create first flight mission in UgCS open up UgCS client application.

![Mission editor](image)

Figure 4. Mission editor.

Type the name of the desired place on map (country, city, street etc.) in “Search place” box (see Figure 16, g) to navigate there. You can choose location from drop-down menu or just by entering name end hitting Enter. Move mouse pointer to the desired location and zoom in by using mouse wheel or “+” and “-” buttons on numpad.

Next, if there is a vehicle connected, it will appear in the upper Vehicle menu, if there is not, one may choose from available emulators - plane and quadcopter emulators are available.

As soon as a vehicle is connected, one may start creating a new route by clicking “New route...” button in the top left corner of screen.

Next choose “Create from scratch” if no previously saved routes are available or “Import from file” option, if there are previously saved routes available.
Next choose a name for the route (“Sample route” in this case) and select the vehicle, which will be used for the route (usually the same vehicle that is connected).

Choose the appropriate settings for the route. All options are thoroughly explained in UgCS User Manual and if no specific settings are required may be left untouched for first flights.
Click “OK” and now it is time to place the first waypoints.

To begin a route, choose “Take-off” tool, then add the Take-off point on map by holding “Shift” key on keyboard and clicking the left mouse button. Note that “Take-off” is not mandatory. You may start route from any figure.
On the left side waypoint (also Take-off point) parameters may be edited and for ease of use a waypoint may be moved around by clicking and holding the left mouse button on the base circle of a waypoint. Also the altitude of a waypoint may be changed by clicking the left mouse button on top of the waypoint “pole” and dragging it up or down.

Next step is to add waypoints to the route. Choose “Waypoint” tool from the left pane and by holding “Shift” key on keyboard and clicking the left mouse button, one may add a waypoint on map. Double click of a left mouse button also works. The point will be added at the altitude of the previous figure.

Try to add a few waypoints and finish off by creating a Landing point. To do so select the Landing waypoint tool and place the point in same way as other waypoints. Only difference is that Landing waypoint does not have height parameter, descend rate parameter is taken from vehicle profile.

In the end route should contain takeoff waypoint, some regular waypoints and a landing point. If a autopilot does not support landing or take-off actions, then ofcourse there is no need to add these points to a route.

![Figure 9. Adding segments take-off and landing to route.](image)

One may choose to add waypoints by drawing a line with mouse. To do so, one must first choose Waypoint tool (Figure 10, a) and then hold Ctrl/Cmd key on the keyboard to draw a line on the map by additionally holding left mouse button and dragging the mouse cursor to the necessary position. Another way to do so is by choosing Waypoint tool and then selecting “Modifier: draw a curve with automatic points” tool (Figure 10, b) that will effectively replace holding keyboard button, so now one can just draw a line by holding left mouse button and moving the cursor around.
When a route is finished, it is time to do the actual flight path calculation. It is done by clicking the “Calculate path” button that is located on top of the screen in-between Route name and connected vehicle menu.

**Note:** almost every button in UgCS displays state as follows. While command is in progress you see progress indicator. If command succeeds buttons blinks in green. Otherwise blinks in red.

After successful calculation the “Calculate path” button changes to “Upload the route to vehicle” button and Elevation profile menu should appear on the lower part of screen.

If the calculation was not successful, “Calculate path” button will not change and an error message will appear in the status menu located in lower left corner of screen.
Next step is to send the route to the desired vehicle. To do so, one must click the “Upload the route to vehicle” button after which a warning message will appear. Click “OK” button if safe route execution can be ensured.

Note: If the mission will be executed using vehicle emulator, the emulator will move itself to the take-off point on the map as soon as a mission is uploaded.

Now one may set the vehicle in Auto mode and arm the motors using the command buttons on right side of screen (“Auto Mode” and “Arm”). If the vehicle does not support automated take-off, the steps will differ.

After clicking “Arm” the vehicle will start executing mission. In the end it will land in the specified location.

If one wants to repeat the flight with vehicle emulator, just repeat the sequence – engage auto mode and then arm the motors. One can also arm the motors in manual mode and then switch to auto mode.
Mission Workspace
When you start the application for the first time, a new mission workspace will be created automatically. The screen consists of several parts:

1. The route list (Figure 13, a) contains a drop-down list with prepared routes;
2. The vehicle list (Figure 13, b) contains a set of vehicles available for control.

![Mission workspace](image)

Figure 13. Mission workspace.

The Add vehicle (Figure 14, c) button opens the list of registered vehicles. To register a new vehicle connect your vehicle to U|g|CS, and ensure that the VSM for that vehicle type is running. U|g|CS should automatically detect the connected vehicle and assign an appropriate profile for it. For more information on specific vehicle workflows please refer to the “Adding a Vehicle to a Mission” section.

After adding a vehicle to the list and selecting it, its telemetry window (Figure 14, f), command history window (Figure 14, h) and command list (Figure 14, g) can be seen. Each vehicle provides its own set of commands.
Multiple vehicles can be added. To select more vehicles, click on the Add Vehicle button (Figure 14, c). The button to create a route is located below it (Figure 14, b). When the vehicle is selected, the telemetry window (Figure 14, f) and the vehicle event log (Figure 14, h) will appear on the screen. See more about it in the "Editing Mission" and "Log Window" paragraphs. The current coordinates of the cursor are displayed in the lower right corner (Figure 14, i). Buttons for measurement tools (Figure 14, e) and No-flight zones (Figure 14, j) are placed at the left border (refer par. "Measurement Tools and No-Fly Zones (NFZ)"). The menu bar is located at the top of the window (Figure 14, a). It contains a set of basic parameters and buttons (Figure 16).

You can find an additional menu with Offline map and ADS-B indicator at the top-right corner (Figure 14, a). To save elevation information with current camera view press Offline map button (refer par. "Offline map"). More information about ADS-B refer to ADS-B section.
The **Menu** button (Figure 16, a) allows you to exit to the main menu. The **Mission** and **Player** buttons (Figure 16, b and c) allow you to switch between the **Mission** and **Telemetry player** windows (refer par. “**Telemetry Window**”). The mission name is assigned according to their date and time of the creation of the mission (Figure 16, d). Next to the mission name, the release control icon (Figure 16, e) is displayed. Move the cursor to it to display the name of the user who has control, if you are working with a mission on two clients. Click the icon, if you want lock/unlock the mission. Enter the name of a location in the **Searching for...** bar (Figure 16, g) to quickly navigate to the specified position (internet connection required). **Video recording** indicator will show you recording status (Figure 16, i).

“**Keyboard**” button (Figure 16, m) opens Inputs mapping settings where you can choose suitable input device for map, device and camera(s).

For more information about “**ADS-B**” button (Figure 16, n) please, refer to ADS-B **section**.

“**Layers**” button (Figure 16, h) opens window with map layers’ configuration menu. Two map providers can be used at the same time, meaning that one of them is used as **Base map tile provider** (Google Hybrid, for example) (Figure 17, a) and another is used as an **Overlay tile provider** (OpenWeatherMap, for example) (Figure 17, b), which, for example, can add street names or show weather (refer. par “**Map providers**”). You can check map for terrain absence by toggling “**Show terrain absence**” checkbox (Figure 17, c). Area without terrain would be shown with red colour.

Click on **Buildings** (refer par. “**Building**”) and **Placemarks** (refer par. “**Placemark**”) checkboxes to display it on map (Figure 17, d). Also you can enable any single **Terrain source** (refer par. “**Elevation z-order**”) as a layer on the map by selecting it from list (Figure 17, e) and focus camera on it by pressing **Focus** button. The same is for **Building sources** list on the right side of the **Layers** window (Figure 17, f). To highlight a imported source (elevation or buildings) on the map with green colour you should select if from the list. To display **No fly zones** (refer par. “**NFZ**”) on map toggle checkboxes **Aerodrome zones** and **Custom zones** (Figure 17, g).
“Key” (Figure 16, j) icon is displayed when you are using the “Open” version. After activating the license the icon will disappear. Current local time is displayed in the right upper corner of the screen (Figure 16, k).

To minimize the interface, click the Minimize button (Figure 16, l). You can also access the mission menu (Figure 16, f and Figure 18).

![Mission of 2014/10/21 19:07](image)

Figure 18. Mission menu.

Create new mission (Figure 18, a) starts the creation of a new mission.

Start/Stop editing (Figure 18, b) allows the current user to gain/release control over the mission. This means that in a multiuser environment another operator will not be able to edit this mission until control is released. But if the current user releases control, another user can edit it.

Open (Figure 18, c) allows you to switch between missions.

Remove (Figure 18, d) deletes the current mission.

Import mission (Figure 18, e) allows you to load a mission from a file.

Export mission (Figure 18, f) allows you to save a mission to a file.

Adding a New Route
To create a route - select the “New route…” (Figure 14, c) icon. There can be more than one route in a mission. Route creation consists of three steps.

Route Name and Vehicle Profile
The first step is to choose whether to draw the route manually or to import the route from a file. Select Create from scratch and move to next step to create a new route. Select Import from file to import existing route. Click Browse in appeared string and specify the path to the .xml file with route. (Note: If imported route include different vehicle profile it leads to route convert procedure which can cause errors in some cases. If occurs, you would be notified with message and can choose “accept” or “cancel” changes.)
The second step is to name the route and specify the vehicle profile for the route. The vehicle profile defines common parameters for a vehicle class. For more information about vehicle profiles refer to the “Vehicle Profile” section. Route planning uses the vehicle profile instead of the vehicle instance. Thus one route can be uploaded to several vehicles sharing one profile. Profile will be checked for unavailable fail-safe operations, actions and algorithms (see Appendix). If found, warning message appears and you will be able to accept removing unavailable operations.
**Route Parameters**

The 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 of the parameters before the route is confirmed.

![Figure 21. The third step of the route creation wizard.](image)

*Home location* is a point to which the vehicle should return in the case of a failsafe condition being triggered automatically or the operator giving the command to return home. Failsafe execution conditions usually include emergency situations such as loss of RC or low battery charge level.

The home position can be set explicitly, or the first waypoint of the route can be set as the home location (Figure 21, a). 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 on 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 (Figure 21, b) 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 and one is able to change its height depending on the position of the mouse pointer (Figure 22). After the location has been chosen, clicking on the OK button takes you back to the wizard.
After uploading the corresponding mission, home location will be visible on map as a green circle with a yellow “H” within it (Figure 23, a). Additionally, if the home location altitude is above ground level, a vertical line similar to a waypoint will be displayed 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 in the heading indicator the direction to home location will always be displayed as a red triangle with “H” within it (Figure 23, c). Above that one can see the angle to home location and if home location is not set, it displays “N/A”.

Additionally, it is possible to view additional data about the home location by moving the mouse cursor on it (Figure 23, b). 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 menu (Figure 24).

Note: Every autopilot and thus vehicle might handle Home Location functionality different. For safe use, please read the corresponding section in Your vehicles VSM User guide.

Figure 24. “Focus on home location” command.

Maximum altitude is the altitude limitation for the route. Note that this altitude changes its type (above mean sea level or above ground) as one changes the altitude type for the route (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.

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 behaviour 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.
Action on GPS loss, action on RC loss, and action on battery discharge 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 are displayed at the bottom of the window, and the particular parameter is highlighted.

**List of Routes**

The List of routes can be opened by clicking the *Open list* button (Figure 26, a) located to the right beside the particular mission. Each item on the list shows the route name and the name of the assigned vehicle. The *Remove* button (Figure 26, b) lets you exclude a specific route from the mission. Be careful when removing routes as route removal cannot be undone.

Creating more routes is similar to the creation of the first one. First open the list of existing routes, and then choose the *New route...* option (Figure 26, c).

*Show on map* button ( ) allows you to show/hide calculated routes on the map.

*Elevation profile* button ( ) allows you to show/hide the elevation profile window for calculated routes.

Route selection is done using the abovementioned list of routes.
Editing Route Parameters

Route parameters can be modified by clicking the Route options button next to the name of the route (Figure 27, a).

Figure 27. Current route bar.

In the Route options dialogue (Figure 28) the Vehicle profile can be reassigned (Figure 28, a), and route parameter values can be changed. When you reassign profile route convert procedure will check the availability of using algorithms, turn types & fail-safe operations. If some of these operations are not available, you will be informed with system message and can choose between stopping this procedure or continue (all unavailable actions and operations will be removed).

Figure 28. Route options dialogue.

A useful option is the change of Altitude mode (Figure 28, b). It converts all the altitudes regarding the digital elevation model of the area. Locations of all the points are preserved.

You can make export your route to file. Export to .kml and .xml is available. Click Export to KML or Export to XML (Figure 28, c) in the Route options dialogue to start unloading.
Saving a Mission

Missions are not saved in a file. All missions are stored in a single database so there is no need to specify a file when saving a mission.

![Mission saving](image)

The mission is automatically saved every 5 seconds if a change has occurred (Figure 29, a) or on mission upload (Figure 29, b).

Missions are distinguished by their names, which can be changed by clicking on the mission name (Figure 29). By default, the name of a new mission consists of the date and time of the mission’s creation. To rename the mission, click the mission title and then supply the new name.

Editing a Mission

Routes in the mission are edited separately. The route currently open for editing is the one selected from the list of routes.

Navigation

This chapter describes map usage in order for the operator to be able to adjust the map view and create route elements.

Note: For full functionality of the map, an internet connection is required. Provided there is a proxy, its settings should be specified in the U|g|CS configuration.

Moving the map is done by holding the left mouse button and dragging, or by pressing the “arrow keys” or “WASD” keys on the keyboard. The map will follow mouse movements.

Zooming in and out is done by rotating the mouse wheel, or by pressing the “+/-” keys or “Page Up/Page Down” keys on the keyboard.

Map rotation is accomplished by dragging from left to right or from right to left while holding the right mouse button, or by pressing the “Ctrl + left/right arrow” keys or the “Ctrl + A/D” keys on the keyboard. To change the inclination, drag from up to down or down to up while holding the right mouse button, or press the “Ctrl + up/down arrow” keys or “Ctrl + W/S arrow” keys on the keyboard.

When using Mac OS you should use the ⌘ key on the keyboard instead of the “Ctrl” key for rotation and inclination of the map. For Windows/Linux OS use the “Ctrl” key.

The lower right corner of the map shows the current coordinates of the mouse pointer position. The displayed position corresponds to the point on the ground at which the mouse is currently pointing. This allows the operator to see the approximate landscape elevation (if eye altitude is less than 30 km) of a particular point on the map, as well as its latitude, longitude and eye altitude.

The compass component shows the direction the map is facing. To reset the direction to North, click the compass.

To navigate greater distances on the map, use the Search places bar in the upper right corner. Enter the location name to move to this location (Figure 30).
A source can be selected by clicking on the name of the current source (Figure 16, h) and choosing the required source. Available sources are specified in the configuration.

The telemetry component show/hide telemetry window, is switched on when the vehicle is selected (Figure 31). Telemetry can be displayed in edit and calculated route mode.
The telemetry window mode switcher (Figure 31, top right corner) makes the window full sized or collapses it to short mode, when only 10 parameters are shown. The default mode is short. It shows the battery level, GPS, telemetry level and Radio control link level values, which have a white, orange or red colour depending on the charge or reception level. Then there is State status which shows motor state, it can be armed or disarmed and Manual or Auto control state. And altitude values – Raw (altitude coming from the vehicle), AGL (above ground level) and AMSL – above mean sea level altitude. And a numerical vertical speed value as well as visual bar showing upwards or downwards vertical speed rate.

Once some geographical elements in a route have been created, one can quickly focus the view on the route by clicking the route name. The map will move to the last element of the route (or to the first calculated waypoint in case of a processed route).

The Tools and Basics of Drawing a Route
A route consists of a sequence of elements (route segments). Route segments allow for the setting of waypoints or the creation of more complex constructions like an area or a circle. For each segment a geographical object such as a point, a polygon or a building is set. The resulting path is shown after the route calculation process has completed. Tool selection is done from the toolbar at the left side of the window. Currently available tools are shown in Figure 32.

The Waypoint tool is the default tool. To create a new waypoint, press and hold the “Shift” key while simultaneously dragging up from the ground to the desired height. 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. The pin can be dragged by its base to change latitude and longitude. 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 you draw creates a new route segment connecting particular waypoints.
The *Circle* tool makes the route go around the specified point at a required distance the vehicle facing to the centre (if autopilot supports it). If one does not require the vehicle to face centre, just set Yaw angle at 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.

The *Perimeter*, *Photogrammetry* and *Area scan* tools are based on polygons and allow the vehicle to fly along a closed path or to cover an area with the required density of flight paths (e.g. for the purpose of scanning the area). To create a polygon, hold the “Shift” key and click on the map where you intend to have the corners of the polygon. Polygon corner pins can be moved by clicking and holding their bases. Latitude and longitude may also be adjusted by means of editing properties. To close the polygon, set the last pin close to the first one (or drag the last pin close to the first). A polygon must have at least three corners.

The *Take-off* tool is used to mark the take-off position and parameters.

The *Landing* tool is used to mark the landing position and parameters.

For complete information on how the tools work (how they produce commands that will be uploaded to vehicles) please see the Tool Parameters chapter.

Each tool has its own properties window. All the properties windows look similar. There are two buttons on the header row used to select the previous and next route segments. On the right side there is a *Remove segment* button. The properties window is divided into three sections. The first displays and allows the editing of the coordinates and general values of tools. The second contains parameters specific to the chosen tool. The last contains the list of attached actions and buttons used to create new actions.

Figure 33. Layout of tool inspector

(a – figure properties, b – tool parameters, c – list of actions).
Basic Waypoints

Tools, except for the Waypoint tool, are designed to automatically create sequences of waypoints in a more accurate and effective way than by defining them manually using the Waypoint tool. These automatically generated waypoints are further treated in U|g|CS as basic waypoints. Basic waypoints are locations that will be visited by the drone. Provided that safe calculation of route has been chosen, additional waypoints will be added automatically in-between the basic ones to avoid collisions with obstacles or violation of minimum altitude constraints. For example, see Figure 34 where additional waypoints were produced after setting two base waypoints.

![Figure 34. Additional waypoints inserted between the basic ones.](image)

The following table presents how each of the tools produces basic waypoints:

<table>
<thead>
<tr>
<th>Tool</th>
<th>Basic waypoints</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Take-off</strong></td>
<td>Take-off vehicle in the current position</td>
</tr>
<tr>
<td><strong>Waypoint</strong></td>
<td>Set explicitly by the user.</td>
</tr>
<tr>
<td><strong>Area scan &amp; Photogrammetry</strong></td>
<td>Generated in places where the camera has to take shots.</td>
</tr>
<tr>
<td><strong>Perimeter</strong></td>
<td>Correspon to vertices of the polygon elevated to the required height.</td>
</tr>
<tr>
<td><strong>Circle</strong></td>
<td>Set at equal distance from each other to give decent approximation of the circle. Number of basic points may be set by the user or are set automatically, a POI action is set by default in centre of it, but if You add any action to algorithm - POI disabled.</td>
</tr>
<tr>
<td><strong>Landing</strong></td>
<td>Vehicle landing in the selected position</td>
</tr>
</tbody>
</table>

Adding, Removing, and Editing Route Segments

By default, route segments are added in order of creation, the next one succeeding the last one created before. All new segments include arrows, which show direction of movement for vehicle. To insert a segment between two existing segments, select the segment, and then create the segment as described in the previous section. Each new segment of the route is created after the currently selected waypoint. To select a waypoint, click on its pin’s head. To select a circle, click on its head or on its circular part. A polygon is selected by clicking near its contour. To select a segment based on a building, click the marker located above the building. You can deselect current tool by clicking tool icon.
You can edit value in the segment’s properties window manually. To confirm the input value use button “Enter” on the keyboard.

**Note**: there are special cases when the inserted segment is created using the same tool as the one currently selected. E.g. if the next segment is required to be a polygon tool, the existing polygon has to be closed and finished beforehand. Until then, new polygon corners are added to the unfinished figure, not to the new one.

If using the building tool, click the *Choose next* button in the properties window to choose the next building; otherwise, clicking on a building will modify the current segment and will not produce a new one.

**Note**: Click the insert new segment route icon ( ) to add a new segment before the current segment.

When a route segment is selected, you can edit it as if it had just been created: move points, change the radius of circles, modify corner points of polygons or change the selected building for the building tool. You can see all available edit actions on the map as arrow icons near head and base of selected figure. You can select the next segment by clicking arrow button in the upper right corner of the segment’s properties or by click button “{” and “}” on the keyboard. The selected segment can be removed by clicking the *Remove segment* button in the upper left corner of the segment’s properties or click button “Del” on the keyboard.

You can draw a line on the map and UGCS will automatically set planning algorithms (WPs, points of perimeters, etc.) along the trajectory. For this action you must hold Ctrl/Cmd button on the keyboard + left mouse button and draw a line on the map. Another way is to activate «Curve points» by clicking the icon + hold left mouse button and drag cursor to draw a line without holding Ctrl/Cmd button.

**Tool Parameters**
Each tool requires the specification of additional parameters which customize the planned path of the drone. These parameters are listed in the segment properties window. Some of them have default values; others require manual specification of values. Please ensure you understand the meanings of these parameters and always review their values to avoid unexpected results. Parameters without correct values are highlighted. Parameters marked with an asterisk (*) are mandatory, the others are optional.

To edit the parameters of the existing route segment, select it as described in the previous section. Parameters can be specified before the actual segment of route is created. It is enough to select a tool.

The following table describes parameters for each of the tools.

<table>
<thead>
<tr>
<th>Tool</th>
<th>Parameters</th>
</tr>
</thead>
</table>
| All  | **Flight speed** — flight speed of the drone for this segment. The speed is along the straight 3D line from current WP to next WP. 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 taken into account when planning the path. Do not uncheck without specific need to do so. |
Avoid terrain – flag to be set if the path has to satisfy a minimum height over terrain condition (the corresponding value is one of vehicle parameters). Do not unset this flag unless necessary.

Turn type – the way how segments will be passed by vehicle. 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. You can find more information about the supported turn types and their descriptions for your vehicle in the vehicle Manuals (ex. DJI Manual). Default turn types doesn't have an icon on the corresponding waypoints at route planning window like other turn types do.

All except for Waypoint Action execution:

- Every point – actions will be generated on all waypoints;
- At start – the algorithm will generate actions only on the first waypoint;
- Forward passes – actions will be generated on all points during pass, payload disabled at turns (available only for Photogrammetry and Area scan tools).

Take-off

Take off waypoints are associated with climb rate parameter that can be found in vehicle profile.

Landing

Landing waypoints are associated with descent rate parameter that can be 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 100 m the plane travels to the landing point it decreases its altitude by 10 m.

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

Circle

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 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 altitudes.

Additionally, circle has set default POI in the middle of circle, so that vehicle will circle front facing to the centre (if POI is supported). To disable this, just set Yaw angle “0” in the waypoint parameters.

Route calculation is performed so that the route points are placed at the same height relative to the ground. This height is calculated based on the camera settings and set value GSD.

**Note:** this tool requires a camera to be selected 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). For more information about setting a camera for vehicle and camera parameters please see the Adding a Payload to a Vehicle Profile and Payload List sections.

All common options available for this tool plus:

- **Camera** – payload that is assigned to a profile. In case of multiple cameras attached to profile it is allowed to select which one to use for area scanning.

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

- **Forward overlap (%)** – ratio of the overlap in neighbouring 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 neighbouring frames (placed in neighbouring 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. If the flag is set, then it is assumed that the camera is oriented so that the frames overlap over the upper frame boundary motion vector. If the flag is removed, then 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 is performed in the direction of "South-North".

- **Additional waypoints** – if the flag is 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)** – additional space for turn. More proper route following. See Figure 36.

- **Altitude type** – AMSL or AGL to set Flight height.
Allow partial calculation – option to allow route calculation in these cases:

a. The part of route exceeds maximum AMSL of route  
b. Relief height is unavailable at some point(s) of route  
c. The part of route exceeds the maximum fence radius  
d. The part of route in No-fly zone (NFZ)

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

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

For more info, see section Types of Actions.

![Diagram](image)

Figure 35. Sample photogrammetry route (fo - forward overlap, so – side overlap).

**Calculation:**

1. Calculate the altitude required for camera recording:

   a. \( \text{heightAgl} = \frac{f \times \text{GSD} \times \text{sensorWidthPx}}{\text{sensorWidth}}; \)
   
   b. \( \text{heightAgl} = \frac{f \times \text{GSD} \times \text{sensorHeightPx}}{\text{sensorHeight}}; \)
   
   c. Selected minimum value calculated of \( \text{heightAgl} \).

2. Calculate the frame size:

   a. \( \text{frameWidth} = \frac{\text{sensorWidth} \times \text{heightAgl}}{f}; \)
   
   b. \( \text{frameHeight} = \frac{\text{sensorHeight} \times \text{heightAgl}}{f}. \)

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 based on the "snake".

**Area scan**

Area scan is the same tool as Photogrammetry except in Area scan you don’t need to select Ground resolution (GSD) and camera settings. This is simpler
way to plan flights over area. You should specify height, side distance and perimeter.

Also all common options available for this tool plus:

**Flight height** – altitude of flight along the area.

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

**Side distance** – size 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)** – additional space for turn. More proper route following. See Figure 36.

**Allow partial calculation** – option to allow route calculation in this cases:

a. The part of route exceeds maximum AMSL of route
b. Relief height is unavailable at some point(s) of route
c. The part of route exceeds the maximum fence radius
d. The part of route in No-fly zone (NFZ)

Also you can get route calculation error if trajectory fixed height is lower than safe height over terrain at some route point.

**AGL Tolerance (m)** – additional waypoint will be added if difference of height is more than this value.

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

**Perimeter**

Also all common options available for this tool plus:

**Flight height** – altitude of flight along the perimeter. This altitude is not affected by the altitude type chosen for the route.

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

---

**Note:** The route segment can be selected by clicking on the corresponding pin or on the line connecting it to the next segment. The selected segment is highlighted together with the connecting line.
Log Window
At the bottom of the mission editor is a log window (Figure 13). The log window displays messages about the status of operations (calculation of the mission, uploading, changing vehicle modes, video recording) and the results of the commands. In case of insufficient battery voltage, low number of GPS satellites or low telemetry, warnings are shown in the log window. All errors are accompanied by a sound signal. The timestamp of new messages is highlighted for 10 seconds. Messages older than 1 day look darker. There is also a possibility to copy contents of the log window to clipboard by clicking the corresponding icon (Figure 37, a).

![Log window](image)

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

The calculation process is executed by clicking the Calculate button ( ). The mission is automatically saved 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 closed and all parameters must be correctly specified before proceeding. Correct parameters must also be supplied for actions attached to the route segments.

Calculated route build around NFZ and (refer par. “NFZ”) and buildings (refer par. “Building”).

To ease error correction for a route, a message is displayed pointing to incorrect values before route calculation proceeds. The first route segment with an invalid parameter is automatically selected. After the problem has been fixed, click the Calculate button again. If no more errors are found, the calculation process will be launched.
Processing Errors

Common errors for route calculation are provided below:

The starting (ending) point of a route is not passable. The first (or last) point of the route has an AGL altitude less than the minimum required by the vehicle or is inside an obstacle. Modify the first (or last) route segment to fix the problem.

The server failed to calculate path. The route is too complex or terrain is too tricky. Please set more precise route and try again. Usually shown when the landscape configuration is too complex to produce a path. Substitute route segments created using tools with plain waypoints or add/remove additional waypoints.

The point exceeds the maximal altitude specified for the route. One or more points are set too high. Either lower it/them or change the maximal altitude parameter in the route options.

The distance between the point and an obstacle (building) is less than the safe distance specified for the vehicle. At least one of the points is too close or inside a building and has to be relocated to a safe distance from the building. If a point is set inside the building, temporarily turn off the buildings layer by clicking the 3D objects button to reveal and move the point.

The distance between the point and the ground is less than the safe height specified for the vehicle. At least one of the points is not high enough to satisfy the minimal altitude condition and must be elevated.

The total number of waypoints in the route exceeds the maximum number of waypoints that the vehicle can handle. Please reduce the complexity of the route. The route needs to be simplified to have less waypoints.

To make a route less complex the following techniques can be used:

Observe the calculated route to find out which route segments produce the densest sequences of waypoints. Then substitute these segments with waypoints (use the Waypoint tool for that).

Sometimes a large amount of waypoints is produced to avoid collisions. In such cases try placing basic waypoints in a way that takes the UAV over less obstacles.

Simply removing a certain amount of route segments which are not crucial for the aim of the mission can fix this limitation of the UAV.

Of course there is always the option to consider the use of an UAV which supports the required amount of waypoints.

Estimated time of flight by route exceeds the maximum flight time specified for the vehicle. Please reduce the length of the route. The route is too long for the endurance of the selected vehicle. Some segments can be removed to make route shorter. Other options include an increase of the flight speed or installing a battery with a larger capacity (maximum flight time parameter of the vehicle should be updated). For more information about how to update vehicle profile parameters please see the Edit Vehicle Profile section.

Speed of the vehicle specified for the segment must be greater than zero.

The path cannot be found. Please try to change the location of the basic point(s) or values of parameters. One of the segments of the route cannot produce a path. That particular segment should be modified.

The radius of the circle is too small (less than a meter). Radius of the circle has to be one meter or more.
The number of approximating points cannot be less than three. Change the Number of approximating points parameter of the Circle to be three or more.

The height of the circle’s centre above ground level is less than the safe height specified for the vehicle. Increase the elevation of the circle.

The minimum height is less than the safe height specified for the vehicle. Increase the minimum height of the building scan segment.

The minimum height is higher than the max height. Review the Minimum height and Maximum height parameter values of the Building tool. If Maximum height is not specified, make sure that minimum height is less than the height of the building.

The scanning step exceeds the difference between maximum and minimum heights. Either decrease the scanning step or increase the maximum altitude of the building scan mission.

The calculated route will cross other buildings with the given values of parameters. Please change values of parameters or determine the route manually. This means that there are buildings situated too close to the selected building for a safe path to be found. Increase the Minimum height parameter in order for scanning to begin (or end) higher than the neighbouring buildings. Another option is to change the Safe distance parameter value.

No cameras are assigned to the vehicle. To assign a camera open the main menu “Profiles”, edit vehicle profile and add an appropriate camera into the section “Payload”. The route has at least one segment created with the Area scan tool, but the payload does not contain a camera as one of its elements. Attach a camera to the vehicle (using the route options dialogue) or remove the Area scan segments.

The true focal length for the selected camera must be specified. There is a camera amongst the payload items but its parameters are not specified. Make sure that the focal length is set to a correct value.

**Hint:** If you get “strange” error message in Area Scan mission try to uncheck “Allow partial calculation” option.

Other possible errors are described in the Troubleshooting chapter.

**Calculation Results**

As soon as calculation is completed, the results will be available (Figure 38, b). All successfully calculated segments of the route are connected by green lines. Each route drawn previously will be shown with waypoints prepared for upload to the vehicle. All calculated segments include arrows, which show direction of movement for vehicle. The elevation profile shows landscape elevation along the path with proper altitudes of the path shown.

Both absolute and relative altitudes of each generated waypoint can be seen by moving the mouse pointer over the waypoint. Statistics of the calculated route are presented above the elevation profile (Figure 38, a). These are estimated flight duration, route mileage, total number of waypoints and min/max values of AMSL (above the mean sea level) and AGL (above ground level) altitudes of the path. Please ensure that the minimum AGL altitude value is sufficient for safe flight.

If there is more than one route in the mission, switch between them to observe calculation results.

To return to editing mode, click the Edit button. Clicking again on the Calculate button will re-calculate only the changed segments of the route. Therefore, re-calculations usually take less time.

**Elevation Profile**
After successful calculation, the “Elevation profile” screen will appear at the bottom of the screen. To enable/hide the window click the *Elevation profile* button on the route panel. The window shows the height profile (Figure 38, b) for the calculated mission.

On the elevation profile window you can see the profile heights trajectory (Figure 38, d) and ground level (Figure 38, e). If the route passes over a building, its profile is also displayed in the window. The window also displays the number of waypoints in the route, the approximate length and duration of the flight. You can view all variables for current point of the route on the tooltip (Figure 38, c). Tooltip is displayed after moving mouse cursor on to the trajectory on the elevation profile.

**Actions**

Each route segment can have a sequence of actions attached to it. An action is a task performed by the vehicle when it passes through the segment or one of its waypoints. Not all available actions can be performed using any vehicle. For more information about available actions refer to the vehicle’s manual.

**Adding, Removing, and Rearranging Actions**

To add an action, first select the route segment. Actions are found at the lower part of the segment properties window.

To add an action, click on corresponding button from the list of actions (Figure 39). The new action will be added to the list. To change the order of actions, use the *Move up* and *Move down* buttons. An action can be removed from the list by clicking on the *Remove* button in the upper left corner.
Types of Actions

Camera mode allows you to choose one of the following modes: “Start recording” for continuous video recording, “Stop recording” to stop it and “Shot” for taking a single photo.

Camera mode by time allows you to shoot a series of images with a time delay between them. You can add a delay before the shot series are started. The series will consist of an automatically calculated number of shots with an interval between them.

Camera mode by distance allows you to shoot a series of images with a specified distance between each of the shots. You can add a delay before the series is started. The series will consist of an automatically calculated number of shots with a distance between each of them.

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 are displayed in log window after route calculation (Figure 16).

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

The Camera attitude / zoom action allows you to change the angles of camera pitch, roll, and yaw or to set the required zoom level of a camera. Angles can be defined from 0° (inclusively) through 360° (exclusively). Zoom levels are integral positive values.

The Yaw action specifies the nose angle relative to the movement direction. The value must be in range from 0° to 360°.

Point of interest (POI) sets the point of interest for the vehicle to face towards during the flight. It can be 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.

*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

*Wait* action – wait in the current waypoint for a certain time.

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

**Adding a Vehicle to a Mission**

To add a vehicle, click on the “+” button at the upper left corner of the map (Figure 41).

![Add new vehicle to mission.](image)

Figure 41. Add new vehicle to mission.

The *Add vehicle* button opens the list of registered vehicles. For more information about connection and registering a new vehicle please refer to the “Registering a New Vehicle” section. You can add multiple vehicles to a mission. To remove an inactive or unnecessary vehicle from the Active vehicle list, one must choose “Remove” from vehicle drop-down list (Figure 42).

![Remove vehicle from mission.](image)

Figure 42. Remove vehicle from mission.
After successfully adding a new vehicle and connecting it, you can see some information about the vehicle status in this section (Figure 43). When experiencing status changes, they can be seen instantly by looking at this set of indicators. Any of those icons will change from green – good status to red – attention needed.

![Vehicle indicating icons](image)

**Figure 43. Vehicle indicating icons**

(a - Battery level, b- uplink status, c- downlink status and d- GPS status)

In the drop-down menu there are additional options and actions for the chosen vehicle (Figure 42):

*Select profile* - It is possible to choose a different profile for the current vehicle, if the wrong profile is selected. To do this you must click “Select profile” and choose a new profile for the current vehicle.

*Take-off altitude* – You can set a new take-off altitude for the vehicle. Please see more information in the [Take-off Altitude](#) section.

*Gain control* – lock control for the chosen vehicle.

*Release control* - unlock control for the chosen vehicle.

*Show avatar* – hides/shows the vehicle icon on the map.

*Show telemetry* – choose whether to display telemetry info or not.

*Show commands* – choose whether to display vehicle command buttons or not.

*Show log* – remove or show vehicle specific information in the log window.

*Show video* – hides/shows window with video sources and start/stop video recording buttons.

*Show camera footprint* – hides/shows display a footprint on ground surface.

### Take-off Altitude

Take-off altitude – this is the height above ground of the starting point or the current point of the vehicle in the current moment. Its installation is necessary to adjust the heights of the waypoints before uploading them into the vehicle, because sensor readings (barometer) accumulate errors during long stays in the air.

When creating a new mission, the altitude status can be “not available”. This is because either, for the specific vehicle profile, the default take-off altitude is not set or was not set automatically by our software. We will further explain the importance of proper take-off altitude.

To set take-off altitude please choose vehicle at the top of the map and click the drop-down menu (Figure 44, a).
Take-off altitude is set to zero automatically by our software when a new mission is uploaded to a disarmed vehicle. So the software predicts that aircraft is disarmed and on ground level.

But prior to uploading a new mission to an armed vehicle, take-off altitude must be set manually in the vehicle menu (upper left corner). This is because of altitude drift that can happen due to vehicle sensor specifics and can cause incorrect altitude reporting. Sometimes the take-off altitude (after resetting power on the vehicle) can reset and you will need to set it again. There are 3 ways to set it. Enter it manually (Figure 44, b), sample it from terrain by clicking the map while holding Shift, or setting it from the current terrain altitude under the vehicle (Figure 44, c).

It must be noted, that 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 the take-off altitude it is displayed in the vehicle card.

**Uploading route**

If you are satisfied with pre-calculated routes, missions can be uploaded to vehicles. Upload is done by clicking the *Upload* button (Figure 45, a). The mission is saved and forms the waypoints uploaded to the assigned vehicles.
During uploading, information upload process progress is shown in the log window (Figure 45, b). When the route is being uploaded to the vehicle you can see the following message on the log window: “Vehicle name: Uploading route “Route name”“. Do not interrupt the connection between the computer and the vehicle.

When the route has been successfully uploaded you can see the following message on the log window: “Vehicle name”: Route “Route name” successfully uploaded”.

If the upload to the vehicle fails, you can see the following message on the log window: “Vehicle name”: Route “Route name” upload failed”. Error can be caused by a malformed path if the route calculation was not completed before the upload attempt. Alternatively, the connection to a vehicle was lost in the middle of the process or the vehicle did not accept the set of commands. This state is an unrecoverable error that aborts route uploading. In case of error it is recommended to check the connection to the vehicle, and the calculated path before the next upload attempt.

When a route is planned for a vehicle profile which has differences from the profile for the current vehicle, during route uploading, a window is displayed with several options (“Cancel”, “Copy”, and “Set profile”). The “Cancel” button aborts the upload and returns to the route editor to continue work. The “Copy” button copies the current route to the new instance with the default current vehicle profile which is now selected for the vehicle. The “Set profile” button returns you to the route editor, and you can select a new vehicle profile for the current vehicle. When you reassign profile route convert procedure will check the availability of using algorithms, turn types & fail-safe operations. If some of these operations not available, you will be informed
with system message (Figure 46) and can choose between aborting this procedure or continue (all unavailable actions and operations will be removed).

![Figure 46. Unavailable operations during profile change](image)

When mission upload is completed, the mission is ready for execution.

**Setting Manual Start Point**

By default, vehicle start mission from the first point but you can change this behaviour. It’s possible to manually specify the point on the route from which vehicle should start the mission. This is very useful for battery replace, large area scanning and other. For selecting Start point you can use “Select start point” button and select point to start from see Start point selector Figure 47. Flag icon should appear on that point – Figure 48.

![Figure 47. Start point selector](image)

Every vehicle profile has maximum waypoints parameter and maximum travel time (see Editing a Vehicle Profile) if your mission has the larger points number or longer than max travel time route you will be notified about this –

- 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).

and route will be uploaded partially. At this case when you press upload button warning message appears.

If number of waypoints from start point exceed Max waypoint option in vehicle profile you receive “Only a part of the calculated route from point # to point # will be uploaded to the vehicle. Please control your battery during the flight to return home vehicle before point of NO-RETURN.” By pressing “Continue” button the part of route will be cut from *Selected start point* to *Selected start point*+Max waypoint (from vehicle profile).
If calculated route time exceeds Maximum travel time from vehicle profile you will be noticed with “Estimated
time of flight by route () exceeds the maximum flight time specified for the vehicle profile (). Please control
your battery during the flight to return home vehicle before point of NO-RETURN.” message. By pressing
“Continue” button route will be sent to vehicle.

Note: When you uploading mission to vehicle, actual number of loaded points may be different. So if you
have 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:UsersUSER_NAMEAppDataLocalUGCSlogsVEHICLE_VSM_FOLDER

![Figure 48. Selected start point](Image)

**Direct vehicle control**

There are several commands that allow operator to directly control vehicle. You can find these commands in
the right command bar. (Note: If you doesn't have a control over vehicle, Command and Upload buttons won't
be displayed while the corresponding vehicle is selected.)

UGCS Client can show the command buttons in different shades. You can always press all buttons disregarding
of shade. Highlighted buttons suggest recommended commands (for example Figure 49), depending on the
current state of the vehicle.
**Arm/Disarm** activates/deactivates all systems and makes the vehicle ready for flight.

**Auto/Manual Mode** switches the vehicle between automatic flight mode and stabilized manual mode.

**Click & go** – allows to specify target waypoint for the vehicle.

**Joystick** – enable joystick control mode. See section Joystick mode below.

**Hold** – suspends current operation. In case of mission (Auto mode) puts mission execution 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 were put on hold.

**Land** lands the vehicle.

**Camera Trigger** – triggers the camera switch if the vehicle is equipped with one. For example, DJI A2 and Wookong autopilots support general purpose servos which can be used to trigger the camera.

**Return home** returns the vehicle home.

Please refer to our vehicle specific manuals for more information on mentioned commands. For some vehicles there are exceptions in described behaviour.

---

**Click & Go**

**Note:** Please note that to use Click & Go vehicle should be in Armed state.

**Note:** Please note if “Take-off Altitude” is not specified for the vehicle you will be prompted to do that.

When you press “Click & Go” button you need to make double click or SHIFT+click on the map to define target waypoint. In the window (Figure 50) you can adjust point altitude AGL, approach speed and optional heading.

---

![Figure 50. Target point inspector.](image)
By default approach speed is current vehicle speed or default ground speed from vehicle profile. AGL should be in a range of “Safe height over terrain” and “Max latitude AGL” profile parameters. Speed should not exceed “Max horizontal speed” from vehicle profile.

If command sent successfully vehicle will move towards the point specified. You will see dashed line connecting vehicle and target point. If you hover the point head, you’ll see distance to approach and estimated time.

![Figure 51. Target point inspector](image)

After vehicle approaches the target point (i.e. enters the acceptance radius defined for vehicle profile), target point disappears.

**Joystick mode**

![Figure 52. Joystick mode](image)

You can connect up to three Joysticks to U|g|CS and use them with DJI & Ardupilot vehicles (see vehicle connection manuals for more information and Appendix A for supported platforms) and Emulator devices. Joystick tuning described at Configuration section of this manual. At Figure 52, you can see input device status:

- ![icon](image) – control device enabled & profile available
- ![icon](image) – control device is active
- ![icon](image) – device is disabled by user
- ![icon](image) – device enabled but no profile available

Pressing those icons opens “Input devices window” - Figure 53.
You can choose suitable device profile from list, enable/disable device by checking/unchecking its checkbox and bind for this operations:

- ✅ – control map
- ⚡ – control vehicle
- 🔌 – control payload 1 & 2

Text area show current mapping and highlight received command (green) with its strength (red).

To enable Joystick control you should connect joystick (see Configuration section of this manual), enable it on Input Device window (Figure 53) and choose controlled operations (map, vehicle or payloads). Next, you should send Joystick command to the vehicle by pressing “Joystick” button from commands list see Figure 54.
Joystick mode will be automatically disabled (warning screen appears) when you send commands “auto”, “manual”, “Click & Go” and when you select another vehicle or leave mission planning window (exit to menu, telemetry player, open new mission dialog…)

**Note:** Only one operator can use Joystick mode for same vehicle in multi-operator mode.

**Measurement Tools**
Several tools are available to ease mission planning:

- **Distance measurement**
- **Area measurement**
- **Visibility range**

![Measurement tools](image)

Figure 55. Measurement tools.

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

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

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

You can deselect current tool by clicking tool icon.

**Telemetry Window**
When the mission is in progress the telemetry window (Figure 55) 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. This gauges will have a white, orange or red colour depending on the charge or the quality of the signal.
Figure 56. Telemetry window.

**Principal values (Battery, GPS, Telemetry and RC link).** These values indicate the level of the battery voltage, the number of GPS satellites and quality of telemetry signal and Radio Control link.

**State – State of vehicle status – 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).

**Control mode** - Control mode status - automatic flight mode or manual mode.

**Altitude Raw** – Altitude data sent from the vehicle (without any additional interpretation). This value is 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 rising or descending. A positive value means an increase of AMSL altitude, and negative means descending. Next to the numerical value is a visual indicator showing upward or downward movement of the vehicle.

**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 is 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.

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 will be displayed as a red triangle with “H” within it. Above that one can see the angle to home location and if home location is not set, it displays “N/A”.

_Downlink_ - Downlink connection status.

_Uplink_ - 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.

**Vehicle Models**
The model will be shown above the map in the last known location of the vehicle. The vehicle model is an alternative method of representation for some of the telemetry values, namely the WGS-84 coordinates (latitude, longitude, and AMSL altitude), heading, and yaw. Coordinates affect the location of the model. The orange arrow shows the direction where the ‘front’ side of the vehicle is facing (heading). The green arrow shows the direction of movement of the vehicle while the vehicle is moving (course).

![Vehicle model](image)

Figure 57. Vehicle model.

To focus on the last known position of the vehicle, click on its name.

Sometimes altitude value is unavailable because there is no take-off altitude for the vehicle. It will be displayed after _setting the take-off altitude_.

**No-Fly Zones (NFZ)**
As the name implies, no-fly zones (NFZ) are areas on the map where flying is prohibited. NFZ can be divided into two categories – aerodrome zones, which are in-build into UgCS and custom zones which can be created by the operator.
Creating a NFZ

Creating custom NFZ is very similar to creating missions in UgCS. NFZ can be created by clicking on one of the two bottom icons on the left side of the screen (Figure 57).

![NFZ icons](image)

Figure 58. NFZ icons

The operator can create a custom NFZ of either of the two shapes:

- Prism
- Cone

The creation of prism NFZ is very similar to creating an area scan and the creation of cone NFZ is similar to creating a circle.

To start creating a NFZ click on either of the two bottom icons on the left side of the screen and shift-click on the map. To create a NFZ in the form of a prism, at least 3 points are necessary. The cone NFZ requires only one point. To finish creating a NFZ click on the selected NFZ icon again. To edit the finished NFZ click on the zone on the map. To delete a NFZ click on the trash can icon in the editing screen.

You can change the following parameters for each of the NFZ:

- Name of NFZ
- No-fly zone starts from – altitude from which the NFZ begins. For instance, if set at 50 m, flying at 40 m inside the NFZ will be allowed, but flying at an altitude of 55 m will not. 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 at which the 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.

Disabling NFZ

To disable NFZ, enter route settings and deselect either Aerodrome NFZ or Custom NFZ, whichever you want to not take into account when creating the route (Figure 58).

**Note:** Your application should be activated to do this (refer par. “License”)!
To change the visibility of NFZ, click on the Layers button at the very top right-hand corner of the screen. A menu will appear in which you will be able to deselect Aerodrome NFZ or Custom NFZ so that they are not displayed on the map (Figure 17). Keep in mind that this does not disable the NFZ, it simply hides them. If you want to disable NFZ, refer to the section “Disabling NFZ”.

**NFZ and route-creation algorithms**
You will not be able to calculate a mission with single waypoints in a NFZ. However, if a part of a circle or an area scan mission intersects a NFZ, the flight path will be calculated around the NFZ automatically (refer par. “NFZ”). Also the result of calculation should include correct fly-by of buildings (refer par. “Building”).

**Placemark**
Placemarkers are part of UgCS functionality that are meant for informing user about possible dangers in a place on 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 goods (solids, liquids or gases) that can be harmful
- Incidents – to warn about dangers caused mainly by human activity
- Natural Events – for warning about natural disasters or dangers

To place a placemark do a right mouse click on desired area, select “Create placemark here” and chose from the available placemarks in the desired category to add a new placemark on the map (Figure 59).
You can also add description to placemark to not forget the purpose of placing it.

To remove a placemark, one must do a right mouse click on the placemark and chose “Delete placemark”. It is also possible to move a placemark by doing a right mouse click on a placemark, choosing “Move placemark” and then doing a left mouse click on the area one wants to move the placemark to (Figure 61).

It is possible to import custom markers in *.KML format using UgCS Client.

**Building**

UgCS has 3D building import feature which allows users to import 3D objects in UgCS. Imported objects may range from small poles up to whole blocks of buildings. Not only these objects are visually appealing, they will be taken into account when calculating a route – UgCS will avoid imported objects and calculate route around or over them. Do not forget to enable

To add a new 3d building, one must do a right mouse click anywhere on map and select “Add building” from the appearing menu. Choose building source in pop-up menu for 3d models importing. Click “Browse...” to locate files for import.
When appropriate files are located, click on each file to select it or use button "All" to add all files from a directory. The list of files for import will be shown, click “Add” to start import. UgCS will notify how many files were added, were already imported or had errors during import.

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

**Video**

Video Service is a standalone component designed to grab video data from various video sources and to stream it to UgCS clients. The “Show video” check-box (Figure 63, a) shows/hides the video window (Figure 63, b) in the client. You can expand the video window to full screen by double clicking on it (Figure 63, b). To view a list of available video streams, click the button in Figure 63, c. Also you can broadcast video data to web services using the Share button (Figure 63, d). Then all available video sources will be displayed in the video window (Figure 64) and you will be able to select a source by clicking on it. You can record video from any source and replay it from your OS. You can find record files in subfolder \UGCS\video\ of user data folder on the Windows OS.
Figure 64. Video window.

Figure 65. Video source in the video window.
In the share menu you can choose a web service to broadcast (Figure 66). As example, to use Ustream service (http://www.ustream.tv/) you should put insert your channel’s URL (Figure 66, b) and to set flag of permission to broadcast to service (Figure 66, a). Now you can check your stream on Ustream channel. Note that it could be a delay that is set by default in Ustream service.

Video Service runs under control of Service Manager. Video service works with different video sources such as capturing devices, web cameras and network streams (GoPro or ArDrone video streams for example). Video Service provides information about available video sources to UgCS client so you can pick up desired stream just from client.

For every video device or stream found, Video Service starts video stream (MJPEG) on specific http port. Device streaming begins when at least one client is connected to specific port. There is more information about component configuration options below.

**Camera footprint**

Camera footprint depends on the camera attitude values supplied by VSM. By default camera footprint highlights the area right under the drone. Out of the box there are no VSMs which know the exact camera position during the flight. If drone autopilot provides such kind of data VSM SDK can be used to add support for this feature.
Offline map
To save elevation information around camera view point for offline usage you should press Offline map button in the upper right corner (Figure 67). Cache file will be saved for current map provider. Wait until animated progress bar on the button will disappear. Do not forget to press Offline map button after any camera view point changing for getting proper data.

Figure 68. Offline map

You can find cached files in subfolder \UGCS\db\elevation\, \UGCS\db\MapTiles_Cache\ and \UGCS\db\elevation\HeightmapTiles_Cache of user data folder on the Windows OS.

ADS-B
U\g\CS supports ADS-B (Automatic dependent surveillance-broadcast) receivers and transponders. When using ADS-B receiver, U\g\CS warns the user about collision possibilities between vehicles. If using an ADS-B transponder, one can configure and use it during flight with the help of U\g\CS.

Note: ADS-B receiver support is available only for U\g\CS One and Pro users, but ADS-B Transponder support is available only for U\g\CS Pro.

ADS-B Receiver
U\g\CS gives warnings about dangerous convergences concerning vehicles controlled by U\g\CS, and vehicles observed by U\g\CS, via the ADS-B receiver. Collision possibility calculation is based on three parameters:

- H – horizontal distance (meters)
- V – vertical distance (meters)
- T – warning time (seconds)

Values for the vehicles, controlled by U\g\CS:

- H = 20 m
- V = 15 m
- T = 60 sec.

Values for the vehicles, observed by U\g\CS:

- H = 9 260 m (5 NM)
- V = 300 m
- T = 60 sec.

Warnings about possible collisions (Figure 68) 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.

Figure 69. Warning about collision possibility.

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 are created only for vehicles which have been 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 (Figure 69). It is displayed green if a connection with at least one such device is active, and grey otherwise.

Figure 70. ADS-B receiver connection indicator.

As of this moment U|g|CS supports microADSB receivers as sources of ADS-B data. Multiple devices can be used simultaneously for improved reception of ADS-B transmissions.

Important: Vehicle detection may use the same ports that microADSB device uses. Its driver, however, requires it to be properly shut down via a specific procedure after a connection attempt, possibly leading to misdetection and device “hanging” as VSMs launch their vehicle detection routines.

You should alter port searching patterns for VSMs to exclude ports that you use for microADSB devices (see note in “Registering a New Vehicle”). In the event such device “hangs” for any other reason, simply unplug it, then plug it back in.

**ADS-B Transponder**

If your vehicle is equipped with an ADS-B Transponder or you wish to do so, it is possible to configure and transmit ADS-B messages using U|g|CS. As of this moment U|g|CS 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 digits: 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

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 72).
- SQUAWK parameter can be defined when necessary any time during the flight (Figure 71, a).
- Flight ID should be set during preparation for take-off. That can be done in the Preflight section (Figure 71, b).

Available transponder modes (Figure 71, 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** – Is displayed if there is no GPS signal.
- **ICAO** – If there is no valid ICAO address set.
- **ES** – Is displayed if the extended squitter has failed.

![ADS-B settings menu displaying XPDR and GPS error codes](image)

Figure 74. ADS-B settings menu displaying XPDR and GPS error codes
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, select the **Player** button (Figure 74, a) in the upper left corner. And to return to mission view, just click the **Mission** button to the left of the **Player** button.

It is necessary to select the vehicle whose telemetry was recorded. It can be done in the same way as in the Mission view. Please view the “Adding a Vehicle” section for further information. Then click the button “Open calendar” (Figure 74, b) and use the calendar to choose the date on which the flight took place; all the dates having recorded telemetry are highlighted in the calendar. If the telemetry data was recorded, it is displayed on a timeline (Figure 74, c). It might take some time to load the mission player and the recorded data.

Above the section with the recorded telemetry indication, the icons are displayed. Icons are schematic representations of commands that were sent to the machine at the time.

**Note:** For emulator vehicle telemetry doesn’t store by default. On telemetry player you can see icons only, without recorded data.
Icons correspond to the following commands:

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>🏷️</td>
<td>Upload</td>
</tr>
<tr>
<td>🠆</td>
<td>Arm</td>
</tr>
<tr>
<td>🠆</td>
<td>Disarm</td>
</tr>
<tr>
<td>🠆</td>
<td>Auto Mode</td>
</tr>
<tr>
<td>🠆</td>
<td>Manual Mode</td>
</tr>
<tr>
<td>🠆</td>
<td>Joystick Mode</td>
</tr>
<tr>
<td>🠆</td>
<td>Click &amp; Go</td>
</tr>
<tr>
<td>🠆</td>
<td>Hold</td>
</tr>
<tr>
<td>🠆</td>
<td>Continue</td>
</tr>
<tr>
<td>🠆</td>
<td>Return Home</td>
</tr>
<tr>
<td>🠆</td>
<td>Land</td>
</tr>
</tbody>
</table>

Figure 76. Telemetry player workspace.

First move the seek bar (Figure 74, d) to a time when telemetry has been recorded. To start the playback, use the Play (▶) button (Figure 74, i). At any moment playback can be paused using the Pause (■) button.

To navigate through the timeline one can use mouse and just **click and drag** in the desired direction or use the buttons to the right of the timeline. To zoom in or out one can use mouse wheel or the “+” or “−” buttons next to the timeline.

Figure 77. Vehicle menu in the telemetry player.

Playback speed can be adjusted using the speed button on the top side of the screen (Figure 74, f). Button “1x” provides a normal speed. Speed can be increased by up to eight times (button “8x”).

66
To delete the recorded telemetry from the selected vehicle, click on vehicle avatar in the left corner (Figure 76, a). It is possible to delete only the telemetry currently seen on the timeline by clicking “Clear selected telemetry” (Figure 76, b). To remove all telemetry from the selected vehicle, choose “Clear all telemetry” (Figure 76, c).

![Figure 78. Layout menu in the telemetry player.](image)

The software automatically saves the current Player layout and selected vehicles, so that next time the client is used it will return to its previous state. To rename the current layout, just click on its name (Figure 77, a). It is also possible to save many different layouts. To do so, click on the drop down menu next to the layout name (Figure 77, b) and create a new layout.

In the same drop down menu telemetry import and export options are located. To import telemetry data just click “Import telemetry”; to export click “Export telemetry” and locate the desired file. Telemetry records are saved in XML format.

**Note:** All the values displayed in the mission player are the recorded values. No real time data is shown or produced.

**Geotagging**

UgCS allows to tag images taken from your drone with coordinates from recorded telemetry. Important note is that you need to know gap between your camera clock and clock on computer that recorded the telemetry.

**HINT:** the easiest way to remember the time difference is to shoot your computer clock with a camera on a drone. After that you’ll be able to compare time on the image with “modified” attribute of the picture. If you hover clocks placed in top right corner of UgCS you will get a hint with current time detailed up to milliseconds.

Geotagging tool is available from context menu of the vehicle in telemetry player (Figure 78).
After pressing “Geotagging” you will get next window (Figure 79).

![Geotagging menu](image)

Figure 79. Geotagging menu.

After pressing “Geotagging” you will get next window (Figure 79).

![Geotagging window](image)

Figure 80. Geotagging window

Press “Browse” to select images. For now, we support only JPEG.

You will see number of images time from the first and last image as start and end time.

The process of geotagging is pretty straight forward. We take image and try to find the closest telemetry record in the database. To make the search as more precise as possible you need to know camera time offset – the difference between camera clock and computer (where telemetry was initially recorded) clock.

If you process data on the computer with clock configured for another UTC time zone than your camera time zone, then you need to check “Set camera UTC time zone if it’s different from PC UTC time zone” and specify your camera UTC time zone.

After everything is configured you can press “Process”. Algorithm will try to find coordinates for the pictures.
After processing you can press “Show on map” to see camera position for each picture taken.

And if everything is fine, select altitude type from dropdown list - AMSL, AGL, RAW or None (see Figure 80) and press “Write tags to image files” to save coordinates and selected altitude as EXIF tags into pictures.

How to prepare photo for geotagging processing
1. In order to synchronize time between your capturing device and UgCS client, you need to make several photoshoots of UgCS client screen with open time toolbar.
   a. In UgCS client navigate your cursor over current time widget (Figure 81 a), located in the top right corner.
   b. The Time toolbar (Figure 81 b) will appear.
   c. Take your camera and shoot the computer screen.
2. Connect your device to the PC/notebook for telemetry data receiving from the drone.

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

**How to write geotags to photo files**

1. Copy photo files from camera and backup it.
2. Open telemetry player. Add drone to the vehicle list. Check what you can find telemetry data for selected drone (read more at the Telemetry Player paragraph).
3. Open geotagging window for selected drone (Figure 78).
4. Calculate time offset value. For this calculation you should compare camera time and photo time.
   a. Please photo UgCS desktop time by camera and select time from picture - this is photo time.
   b. Open UgCS client -> telemetry player -> add vehicle -> open geotagging window.
   c. Click Browse and select photo from previous step.
   d. Then you can see camera time in geotagging window at string after words “start time” (Figure 79).
   e. Calculate difference between two values in seconds.
5. Add all photos from camera (exclude photo with screen).
6. Set calculated camera offset. If you need you can set time zone of the camera.
7. Process and save geotags to photo files.
Vehicle List

Registering a New Vehicle

New vehicles should be registered in U|g|CS.

The registration process, step-by-step, is as follows:

1. To register a new vehicle, connect your vehicle to U|g|CS and ensure that the VSM for that vehicle type is running. For more information on specific vehicle workflows please refer to our manuals. How to do this for ArDrone, Ardupilot, DJI Naza-M V2/A2/Wookong-m/Phantom 2 Vision+/Phantom 3/Inspire 1, Microdrones and Mikrokopter can be found in folder “UgCS/docs”.

2. Provided that the vehicle is supported by U|g|CS, the VSM should detect a new connection and a new record in the vehicle list in the U|g|CS client should be created. Please refer to troubleshooting options further on in this section in case of failure.

3. After the automatic detection of vehicles in U|g|CS you can see a vehicle card in the main menu – vehicle list (Figure 82). U|g|CS will choose the most suitable vehicle profile for the vehicle.

4. If necessary, you can select a different profile for the device manually or edit the current profile. To select the profile for the vehicle you must click the “Gain control” and “Edit” buttons. After this, you can select a predefined vehicle profile (Figure 83).

**Note:** Vehicle registration can fail if the VSM does not detect a new port for the vehicle connection. The VSM uses the following default pattern for port searching: /dev/ttyUSB[0-9]+|com[0-9]+. You can change this pattern in the VSM configuration file that can be found at <UGCS INSTALLATION PATH>/vsm-*\vsm.conf. Please restart the VSM after configuration changes.

---

**Figure 83. Vehicle.**

**Figure 84. Select vehicle profile.**
## Vehicle Parameters

Below you can find the table of parameters that should be filled for the vehicle (Figure 82, Figure 83).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Mandatory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle name</td>
<td>User defined vehicle name</td>
<td>Yes</td>
</tr>
<tr>
<td>Tail number</td>
<td>Former ID field. Tail number of the vehicle.</td>
<td></td>
</tr>
<tr>
<td>ICAO address</td>
<td>ADS-B unique identification number.</td>
<td></td>
</tr>
<tr>
<td>Platform</td>
<td>Vehicle platform. You can edit this field in the vehicle profile list.</td>
<td></td>
</tr>
<tr>
<td>Profile</td>
<td>Choose an available vehicle profile or create a new vehicle profile</td>
<td>Yes</td>
</tr>
<tr>
<td>Payloads</td>
<td>View selected payload for the vehicle</td>
<td></td>
</tr>
<tr>
<td>Altitude mode, m</td>
<td>Current take-off point altitude. For more information about this field please see the “take-off altitude” section</td>
<td></td>
</tr>
<tr>
<td>Downlink connected</td>
<td>Downlink connection status</td>
<td></td>
</tr>
<tr>
<td>Uplink connected</td>
<td>Uplink connection status</td>
<td></td>
</tr>
</tbody>
</table>

### Removing a Vehicle

You can remove a vehicle from the list manually by pressing the corresponding buttons “Gain control” and “Remove”.

![Figure 85. Remove vehicle.](image-url)
Vehicle Profile List

Adding a New Vehicle Profile
You can add a new vehicle profile by creating a new card and filling in the parameters.

![Figure 86. Adding a new vehicle profile.](image)

Editing a Vehicle Profile
You can edit a vehicle profile by clicking on the profile card and pressing the “Edit” button. You can choose different avatars (3D) for vehicles by choosing avatars for the vehicle profile (Figure 87, a) and can also edit parameters (Figure 87, b).

Note: Profile changing leads to route convert procedure which can cause errors in some cases. If occurs, you would be notified with message and can choose accept or cancel changes.

Copying a Vehicle Profile
You can copy an existing vehicle profile by selecting the profile and clicking on “Copy” button (Figure 86). It will create a duplicate of the selected profile with a “- Copy” suffix. Works exactly the same as “Edit” (see above), except it will save a new copy upon confirmation.

![Figure 87. Copying a vehicle profile.](image)
**Adding a Payload to a Vehicle Profile**
You can add and remove a payload to/from the vehicle profile by editing the vehicle profile (Figure 87, c).

**Vehicle Profile Parameters**
Below, you can find the table of parameters that should be filled for the vehicle.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Mandatory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle profile name</td>
<td>User defined vehicle profile name</td>
<td>Yes</td>
</tr>
<tr>
<td>Type</td>
<td>Vehicle type (helicopter, multicopter, fixed-wing).</td>
<td>Yes</td>
</tr>
<tr>
<td>Platform</td>
<td>Choose a vehicle platform from the available variables</td>
<td>Yes</td>
</tr>
<tr>
<td>Payloads</td>
<td>Edit available payloads for the vehicle profile</td>
<td>Yes</td>
</tr>
<tr>
<td>Charged battery voltage</td>
<td>Battery fully charged at voltage, V, shown as 100%. Voltage value shown in white colour if between this voltage and normal voltage.</td>
<td>Yes</td>
</tr>
<tr>
<td>Normal battery voltage</td>
<td>Normal battery voltage V. Voltage value shown in white if at or above this voltage, shown in yellow if below this voltage.</td>
<td>Yes</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
<td>Valid?</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Low battery voltage</td>
<td>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.</td>
<td>Yes</td>
</tr>
<tr>
<td>Discharged battery voltage</td>
<td>Battery zero level, V, shown as 0%. Shown in red.</td>
<td>Yes</td>
</tr>
<tr>
<td>Battery weight</td>
<td>Battery weight, kg</td>
<td>Yes</td>
</tr>
<tr>
<td>Normal number of GPS satellites</td>
<td>Normal number of satellites to provide a good level of accuracy. Shown in white colour if at or above this level. Number of satellites shown in yellow colour if below this level and between normal and low level.</td>
<td>Yes</td>
</tr>
<tr>
<td>Low number of GPS satellites</td>
<td>Low number of GPS satellites while still being enough to launch the vehicle. Number of satellites shown in yellow colour if at this level or between this and normal level. Number of satellites shown in red colour if below this level.</td>
<td>Yes</td>
</tr>
<tr>
<td>Normal telemetry level</td>
<td>Normal telemetry level. Telemetry level value shown in white colour if at or above this level. Telemetry level value shown in yellow colour if below this level and between normal and low level.</td>
<td>Yes</td>
</tr>
<tr>
<td>Low telemetry level</td>
<td>Low telemetry level. Telemetry level value shown in yellow colour if at this level or between this and normal level. Telemetry level value shown in red colour if below this level.</td>
<td>Yes</td>
</tr>
<tr>
<td>Max. waypoints</td>
<td>Maximum supported WPs by flight controller</td>
<td>Yes</td>
</tr>
<tr>
<td>Waypoint acceptance radius</td>
<td>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.</td>
<td>Yes</td>
</tr>
<tr>
<td>Max altitude AMSL</td>
<td>Maximum allowed altitude AMSL, m</td>
<td>Yes</td>
</tr>
<tr>
<td>Max altitude AGL</td>
<td>Maximum allowed altitude AGL, m</td>
<td>Yes</td>
</tr>
<tr>
<td>Fence radius</td>
<td>Radio link range radius, m</td>
<td>Yes</td>
</tr>
<tr>
<td>Maximum travel time</td>
<td>Maximum flight time in seconds</td>
<td>Yes</td>
</tr>
<tr>
<td>Safe height over terrain</td>
<td>Minimal allowed distance to terrain for the vehicle, m. Small vehicles can fly very close to terrain but larger ones should fly higher</td>
<td>Yes</td>
</tr>
<tr>
<td>Safe distance to obstacle</td>
<td>Minimal allowed distance to obstacles for the vehicle, m</td>
<td>Yes</td>
</tr>
<tr>
<td>Max. vertical speed</td>
<td>Maximum vertical speed, m/s</td>
<td>Yes</td>
</tr>
<tr>
<td>Max. horizontal speed</td>
<td>Maximum horizontal speed, m/s</td>
<td>Yes</td>
</tr>
<tr>
<td>Default climb rate</td>
<td>Default climb speed of copters for take-off waypoints, m/s</td>
<td>Yes</td>
</tr>
<tr>
<td>Default descent rate</td>
<td>Default descent rate of copters for landing waypoints, m/s</td>
<td>Yes</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
<td>Applicable/Uncertain</td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Default ground speed</td>
<td>Default horizontal speed relative to ground, m/s. Used as default speed for route segments and for click &amp; go mode.</td>
<td>Yes</td>
</tr>
<tr>
<td>Glide slope, %</td>
<td>Default glide slope, %</td>
<td>Yes</td>
</tr>
<tr>
<td>Airspeed during landing approach</td>
<td>Airspeed for fixed wing aircraft when approaching landing</td>
<td>No</td>
</tr>
<tr>
<td>Landing ground speed, m/s</td>
<td>Plane ground speed in last flight segment to landing point, m/s. Applicable for planes and not used for multirotors.</td>
<td>Yes</td>
</tr>
<tr>
<td>Landing flare altitude</td>
<td>Altitude in meters at which Landing Flare will be engaged, this parameter is secondary to landing flare time parameter</td>
<td>No</td>
</tr>
<tr>
<td>Landing flare time</td>
<td>Time in which fixed wing aircraft should reach ground during landing, when landing flare will be engaged, motors stopped and heading locked</td>
<td>No</td>
</tr>
<tr>
<td>Minimum landing pitch</td>
<td>Minimum pitch in ° during final landing stage (after flare), the algorithm will control pitch above this value to achieve proper sink rate</td>
<td>No</td>
</tr>
<tr>
<td>Controller sink rate to pitch gain during flare</td>
<td>Sink rate gain for pitch demand during final landing stage, m/°</td>
<td>No</td>
</tr>
<tr>
<td>Weighting applied to speed control during landing</td>
<td>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)</td>
<td>No</td>
</tr>
<tr>
<td>Maximum pitch in auto flight</td>
<td>Controls maximum pitch in ° during automatic mode, Rage: 0 to 45°, if set to zero, Maximum pitch param. will be used</td>
<td>No</td>
</tr>
<tr>
<td>Maximum pitch</td>
<td>The maximum commanded pitch up angle, Range: 0 to 90°</td>
<td>No</td>
</tr>
<tr>
<td>Minimum throttle</td>
<td>Minimum throttle setting in % which Autopilot will apply. For final landing stage this is ignored.</td>
<td>No</td>
</tr>
<tr>
<td>Landing sink rate (final stage)</td>
<td>The sink rate in meters/second for final landing stage. Range: 0.0 to 2.0</td>
<td>No</td>
</tr>
<tr>
<td>Enable rangefinder for landing</td>
<td>Enables the use of a rangefinder for automatic landing. The rangefinder will be used both on the landing approach and for final flare</td>
<td>No</td>
</tr>
<tr>
<td>Minimum rangefinder distance</td>
<td>Minimum distance in centimeters that rangefinder can reliably read</td>
<td>No</td>
</tr>
<tr>
<td>Height*</td>
<td>Vehicle height, m</td>
<td>Yes</td>
</tr>
<tr>
<td>Length*</td>
<td>Vehicle length, m</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Payload List

Adding a New Payload
You can add a new payload by creating a new card and filling in the parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Ignored</th>
<th>Future Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width*</td>
<td>Vehicle width, m</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Wind resistance*</td>
<td>Maximum allowed wind speed, m/s</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Dry take-off weight*</td>
<td>Dry take-off weight, kg</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Maximum take-off weight*</td>
<td>Maximum allowed weight, kg</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

* Currently ignored and reserved for future versions

Figure 89. Payload.
Below is a table with the parameter meanings:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Mandatory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payload name</td>
<td>User defined payload name</td>
<td>Yes</td>
</tr>
<tr>
<td>Weight</td>
<td>Camera weight, kg</td>
<td>Yes</td>
</tr>
<tr>
<td>True focal length, mm</td>
<td>True focal length</td>
<td>Yes</td>
</tr>
<tr>
<td>Sensor width, mm</td>
<td>Physical sensor width in metric units</td>
<td>Yes</td>
</tr>
<tr>
<td>Sensor height, mm</td>
<td>Physical sensor height in metric units</td>
<td>Yes</td>
</tr>
<tr>
<td>Sensor horizontal resolution, px</td>
<td>Sensor horizontal resolution in pixels</td>
<td>Yes</td>
</tr>
<tr>
<td>Sensor vertical resolution, px</td>
<td>Sensor vertical resolution in pixels</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Configuration**

**Connections**

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

**Use proxy** allows you to specify a HTTP proxy server. This setting can affect the loading of the map.
**VSM**
Records for each of VSM servers. By default, points to local instances. If you have a dedicated VSM installation and want core services to connect to it, add a new record with the appropriate host and port fields.

**Xbee connector**
U|g|CS supports XBee networks as a datalink. Please refer to our “XBee connector manual” for more information.

**Automatic VSM Discovery**
UCS can automatically discover local VSM instances (running on the same machine or on a host in a local area network) using Simple Service Discovery Protocol (SSDP). For this purpose, VSM processes advertise their locations (host and port to connect to) on startup and respond to the UCS search requests. When UCS discovers an unknown location, it attempts to connect to it.

Automatically discovered VSM instances do not appear in the user “VSM Configuration” list. It can be managed manually. UCS connects to the user-defined VSM instances alongside with the discovered ones.

Please note that emulator VSM does not use SSDP to avoid spam in the local network. It works only on the same computer as UCS.

Also note that SSDP works only for nodes located in the same subnetwork. So, for example it will not work for internet connections or over the gateway.

**Disabling discovery of the VSMs**
Automatic VSM discovery is turned on by default. To turn it off change the following property value of the ucs.properties configuration file to “false”:

`ucs.vsm.discovery=false`

Discovery of the particular VSM can be disabled by commenting the “service_discovery.vsm_name” property in the configuration file. For example, for Emulator VSM add “#” sign at the beginning of the line:

`# service_discovery.vsm_name = Emulator VSM`

**Map providers**
You can configure custom providers of map images. There are four kinds of providers currently supported: WMS providers, TileJSON providers, MBTiles providers and providers using the Google XYZ addressing system. To edit the list of usable providers, choose Map providers from the configuration menu. At the right, the list of registered providers will be shown (Figure 90).
Currently the following map providers are supported: Google hybrid, Google map, Google satellite, OSM Mapnik, Bing.

To edit the provider data, click on the corresponding item and choose the Edit option in the top right corner. Removal is also available (Figure 91).

When editing the provider data, you may set its type (Tiles for the providers using the Google XYZ addressing system, WMS for the WMS providers, MBTiles, Google map, and Bing maps) (Figure 92, a). The URL field contains the template of addresses, with which map images can be downloaded for the WMS and Tiles options (Figure 92, b). You can add a Description which will display in the tooltip of the map provider when you select it (Figure 92, c). You can also set a maximum cache size for every map provider (Figure 92, d). This is the maximum space the cache will be allowed to take up on the hard drive. After unchecking “Cache never expires” you will be able to set a period (in hours) after which the cache will be cleared (Figure 92, e). After the cache is cleared it will reload from the internet.
“Clear cache” button delete cache file for current map provider from hard drive.

**Tiles**
Type is for providers that are using the Google XYZ addressing system. You can paste URLs of providers such as:

Open cycle map - http://tile.opencyclemap.org/cycle/{2}/{0}/{1}.png

Hike & Bike - http://a.tiles.wmflabs.org/hikebike/{2}/{0}/{1}.png

**WMS**
For the WMS providers the URL is parsed and the real URL is synthesized during requests. The URL should contain at least the “layers” parameter.

For example: http://x.osm.omniscale.net/proxy/service?layers=osm

Other supported parameters are (they override defaults if specified):

- "crs" - Specify CRS to use. Currently supported values:
  - "epsg:3857" - Spherical Mercator (default)
  - "epsg:4326" - Geodetic projection
  - "crs:84" - Geodetic projection (differs from epsg:4326 only by axes order)
  - "styles" - default is empty.

Other specified parameters are either ignored and not included in the request URLs or overridden by request-specific generated values.

**TileJSON**
An example for overriding CRS: http://data.worldwind.arc.nasa.gov/wms?layers=esat&crs=crs:84

For the TileJSON providers the URL no need changes. You can paste your TileJSON provider URL as is.

For example: http://earthatlas.info/nz/tiles/nz-popden.tilejson

For the providers who use the Google XYZ addressing system, the URL might need some changes which are shown below.
Supply URLs in a parameterized form containing tokens \{X\}, \{Y\}, and \{Z\} or \{0\}, \{1\}, and \{2\}. If you have an address at hand containing \{X\}, \{Y\}, and \{Z\} tokens, you must respectively substitute \{0\}, \{1\}, and \{2\} for them, preserving the order they are used in.

\[
\text{http://map.host.com/europe/}\{Z\}_{\{X\}}_{\{Y\}}.jpg \quad \text{http://map.host.com/europe/}\{2\}_{\{0\}}_{\{1\}}.jpg
\]

**MBTiles**

To add new provider with the type MBTiles you have to specify URL address or browse it local at your machine by choosing *.mbtiles file (Figure 93).

![New provider (enabled)](Image)

Figure 94. New map provider with type of MBTiles.

To add a new provider, click Map providers > Add, then fill out the fields and click Save. Note that any changes made to the list of providers will not affect the application until it is restarted.

**Note:** There must be at least one provider on the list, otherwise you will not be able to access the map.

**UgCS Geoserver**

This map provider for sources which provided by Local Geoserver and will be added automatically when new map overlay uploaded. See more information in Manage map sources section below.

**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.
Manage map sources
All this data is managed by sources. To add a new data source, one must either add data to an existing elevation or map source or create a new one. To do so, one must go to “Main Menu”, “Configuration” then choose “Geoservers” and by clicking “Edit” on “Local Geographic Server” one can access manage sources menu (Figure 95).

Choose “Manage map source” to add or modify existing map data source. Select “New source” button and enter its name - Figure 96.

Press “Create” button and upload your georeferenced data to server – Figure 97.

After successful uploading a new map provider will be created at “Layers” menu in mission inspector and telemetry player windows – Figure 98. Press “Focus” button to navigate directly to this overlay.
Manage elevation sources
To add a new elevation source, one must either add data to an existing elevation source or create a new one. To do so, one must go to “Main Menu”, “Configuration” then choose “Geoservers” and by clicking “Edit” on “Local Geographic Server” one can access manage sources menu (Figure 95).

One can create up to four different elevation sources and each of those may contain several elevation files. To do so select “Manage elevation sources” (Figure 99).

Choose “New source” button (Figure 100), enter name for your data

Figure 99. Select user map source

Figure 100. Adding elevation source

Figure 101. New elevation source
And press *Upload* button to choose local file of terrain.

![Figure 102. Adding elevation source](image)

After successful upload see Elevation z-order section to add your source to list containing all elevation sources that may be currently used.

**Elevation z-order**

Currently UgCS supports ArcASCII, GeoTiff and SRTM formats, but all GDAL Raster Formats\(^1\) that feature Georeferencing should work.

![Figure 103. Elevation z-order menu.](image)

To use an elevation source, it must be first added to “Elevation z-order” list (Figure 102). 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.

![Figure 104. Creating new elevation source.](image)

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 (Figure 104).

---

\(^1\) [http://www.gdal.org/formats_list.html](http://www.gdal.org/formats_list.html)
Building sources
Currently UgCS supports the import of *.KMZ archives and *.KML files with external links.

To add new building source you should create it in “Geoservers” menu. The same as for elevation sources one must go to “Geoservers” menu and by clicking on “Local Geographic Server”, one can access “Manage elevation buildings” menu (Figure 105). Then create new one by pressing “New source” button (Figure 106).

After that one must add created source to “Building sources“ list (Figure 106). As for elevations sources that list contains all building sources that may be currently used. Press “Add” button and select created source.
Now the added building source is ready to be used. Imported building models will be loaded to current building source.

**Screen Resolution**
On this screen you can adjust the window resolution. Changes apply immediately.

**Skin**
Here one can choose from four available colour schemes – Default, Classic, Khaki and Pony. Changes apply immediately.

**Language**
On this screen you can select the language for the user interface.

**Measurement**
On this screen you can choose the measurement system for the user interface.

**Sound**
On this screen you can disable the sound signal in the U|g|CS client. Sound signals are used to notify user about errors in the vehicle log.

**Video**
You can find detailed instructions for configuring the video in separate document – «Manuals video-service». This document located in the install directory.

**Video configuration in client**
You can configure video service in client “Menu” > “Configuration” > “Video”. By default it points to a local instance. In the case of a multi node deployment network address and port of the Video service can be specified.

**Video configuration in video-service properties file**
You can configure video-service settings in video configuration file. It’s located in the following path:

Windows - <C:\{installation directory}\bin\vstreamer.conf>. By default this path is < C:\Program Files (x86)\UgCS\bin\vstreamer.conf>.

Mac OS - <~/Library/Application Support/UGCS/configuration/vstreamet.conf> or  
   </Users/{username}/Library/Application Support/UGCS/configuration/vstreamet.conf>.

Linux - </etc/opt/ugcs> directory.

About configuration file vstreamer.conf refer to «Manuals video-service».

**Performance**
You can decrease the client performance for battery saving by enabling the “Battery saving mode” flag. For maximum performance the “Battery saving mode” flag should be disabled.

“Smooth map texture transitions” flag allows you to turn on/off replacing the current one map texture with the fading to new detailing level. Multitexturing and time reference in shader is used. Turn on this setting to increase RAM, used by the Client.

To increase client performance, enable “Show buildings without textures” flag.
**Joystick**
Currently there is no special menu option to configure joystick. Joysticks can be tuned via configuration files (profiles) stored in %User%\AppData\Local\UGCS\configuration\client\Input folder. Each .xml profile describes one joystick. See configurable parameters in the table below:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>devices</td>
<td>List of compatible input devices</td>
<td>Each input device should be in this list. If full name match not available, tries looking for partial match.</td>
</tr>
<tr>
<td>is default for device</td>
<td>Default profile</td>
<td>If you have several pre-sets for one input device (example: one for vehicle control and another for payload) then you can mark one of them as default.</td>
</tr>
<tr>
<td>axes</td>
<td>Input axes configuration</td>
<td>Individual adjustments for axes, see next table for info.</td>
</tr>
</tbody>
</table>

Axes tuning parameters:

<table>
<thead>
<tr>
<th>Axis parameter</th>
<th>Description</th>
<th>Info</th>
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</thead>
<tbody>
<tr>
<td>type.</td>
<td>Parameter type</td>
<td>Always the same. For parsing purposes.</td>
</tr>
<tr>
<td>axis.string</td>
<td>Axis name (client)</td>
<td>Name of this input control</td>
</tr>
<tr>
<td>axisIndex.int</td>
<td>Axis index</td>
<td>Number (index) of joysticks axis. Usually starts from “0”. Including virtual axes (if available).</td>
</tr>
<tr>
<td>deadZone.float</td>
<td>Dead zone</td>
<td>Received input parameters that are lower than Dead zone will be ignored. For better input stability in “central point”.</td>
</tr>
<tr>
<td>invert.bool</td>
<td>Axis inverting</td>
<td>Enable\disable axis inverting</td>
</tr>
<tr>
<td>minusButton.string</td>
<td>Button for lowering parameter</td>
<td>Always maximum value. For keyboard – button code, for joystick – button number. It’s allowed to use multiple values separated by comma.</td>
</tr>
<tr>
<td>plusButton.string</td>
<td>Button for making some parameter higher</td>
<td>The same as minusButton but for the opposite axis.</td>
</tr>
</tbody>
</table>
License

Figure 109. License screen.

Shows you the version number of your UgCS software, information about activation and has the option to activate your software to the Pro version.

For activation you must enter/paste your “activation code” into the same field and click “Activate” button. After successful activation, the activation field will disappear and you will see that the software is “Activated”.

You can buy a license with an “activation code” online on www.ugcs.com or send a request to ugcs@ugcs.com.

There are three types of licenses:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Functional</th>
<th>Open</th>
<th>One</th>
<th>Pro</th>
</tr>
</thead>
<tbody>
<tr>
<td>3d Buildings</td>
<td>20 Buildings</td>
<td>100 Buildings</td>
<td>Unlimited</td>
<td></td>
</tr>
<tr>
<td>KML data import</td>
<td>—</td>
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<td>—</td>
<td>●</td>
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<tr>
<td>DEM data import</td>
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<td>—</td>
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</tr>
<tr>
<td>No fly zone – airport registry</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>●</td>
</tr>
<tr>
<td>Feature</td>
<td>Can’t be disabled</td>
<td>Can’t be disabled</td>
<td>Can be disabled</td>
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<tr>
<td>----------------------------------------------</td>
<td>------------------</td>
<td>------------------</td>
<td>-----------------</td>
<td></td>
</tr>
<tr>
<td>No fly zone – custom zones</td>
<td>—</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>ADS-B receiver</td>
<td>—</td>
<td>●</td>
<td>●</td>
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<td>ADS-B transponder</td>
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<td>—</td>
<td>●</td>
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<td>Fly Zone Limits for Routes</td>
<td>500m from first point</td>
<td>No Limits</td>
<td>No limits</td>
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<tr>
<td></td>
<td>120 meters AGL</td>
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<td>Multinode installation</td>
<td>—</td>
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<td>●</td>
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<tr>
<td>Camera footprint</td>
<td>—</td>
<td>●</td>
<td>●</td>
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</tr>
<tr>
<td>Drone types supported</td>
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</table>

Figure 110. Types of licenses - functionality.

<table>
<thead>
<tr>
<th>Support</th>
<th>Open</th>
<th>One</th>
<th>Pro</th>
</tr>
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<td>Public forum</td>
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<td>●</td>
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</tr>
<tr>
<td>Email support</td>
<td>—</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Phone support (5x8)</td>
<td>—</td>
<td>—</td>
<td>●</td>
</tr>
<tr>
<td>Support 24x7</td>
<td>—</td>
<td>—</td>
<td>●</td>
</tr>
</tbody>
</table>

Contact ugcs@ugcs.com

Figure 111. Types of licenses - support.
**Troubleshooting**

In case of any issues with the software, please report them to support@ugcs.com. Please send us a detailed description of the problem and your version number which you can find in the configuration -> license menu. Please try to provide screenshots and logs together with a description of the issue – Logs can be found in the following locations.

Windows - `<C:\Users\Username\AppData\Local\UGCS\Logs>` directory. This is an example of the path for Windows 7. You can find logs in a similar directory in other Windows versions.

Mac OS - `<~/Library/Logs/UGCS>` or `</Users/Username/Library/Logs>` directory.

Linux - `</var/opt/ugcs>` directory.

**U|g|CS client**

If you are having trouble seeing the client or if the client does not run on Windows, please run the client using the shortcut “U|g|CS client in OpenGL mode” from the Start menu.

**U|g|CS client doesn’t load map after internet reconnection**

Restart client or open “Layers” button and select current tile provider by double-click.

**The Vehicle Is Flying around One Point for a Long Time**

The most common problem is associated with specified small waypoint acceptance radiuses or poor accuracy of the determination of GPS coordinates. A possible solution is to increase the waypoint acceptance radius of the vehicle configuration.
<table>
<thead>
<tr>
<th>Platform</th>
<th>3DR APM</th>
<th>3DR APM</th>
<th>DJI A2</th>
<th>DJI Ace One</th>
<th>DJI Inspire 1</th>
<th>DJI Naza-M V2</th>
<th>DJI Phantom 2 Vision+</th>
<th>DJI Phantom 3</th>
<th>DJI Wooking-M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle type</td>
<td>Multicopter</td>
<td>Fixed wing</td>
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</table>
## Failsafe-platform Mapping

Failsafe actions which can be configured via VSM for each autopilot

<table>
<thead>
<tr>
<th>Platform</th>
<th>Vehicle type</th>
<th>RC loss</th>
<th>Datalink loss</th>
<th>GPS loss</th>
<th>Low battery</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>3DR APM/3DR Pixhawk</td>
<td>Helicopter</td>
<td>HLC</td>
<td>-</td>
<td>LW</td>
<td>HC</td>
<td>Continue possible only while in AUTO mode</td>
</tr>
<tr>
<td>3DR APM/3DR Pixhawk</td>
<td>Fixed-wing</td>
<td>HC</td>
<td>HC</td>
<td>-</td>
<td>HC</td>
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### Legend:
- **W**: Wait
- **L**: Land
- **H**: Go home
- **C**: Continue
- **Default value**
## Algorithm Mapping (part 1 of 2)

<table>
<thead>
<tr>
<th>Platform</th>
<th>3DR APM</th>
<th>3DR Pixhawk</th>
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### Algorithm Mapping (part 2 of 2)

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| Commands:       |          |            |            |             |           |           |            |
| Take-off        |           |            |            |             |           |           |            |
| Waypoint        | Y         | Y          | Y          | Y           | Y         | Y         | Y          |
| Circle          | Y         | Y          | Y          | Y           | Y         | Y         | Y          |
| Perimeter       | Y         | Y          | Y          | Y           | Y         | Y         | Y          |
| Area scan       | Y         | Y          | Y          | Y           | Y         | Y         | Y          |
| Photogrammetry tool | Y      | Y          | Y          | Y           | Y         | Y         | Y          |
| Land            | Y         | Y          |            |             |           |           |            |
# Appendix E

## Turn Types (part 1 of 2)

<table>
<thead>
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<th>DJI Phantom 2 Vision+, 3, 4</th>
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## Appendix E
### Turn Types (part 2 of 2)

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*Default type is green*