

Routes in Pitlab & Zbig FPV System

This feature is available in OSD firmware versions 2.50 and later.

Overview

Routes in the Pitlab & Zbig FPV System is new functionality for defining long, multi segments routes and then following these predefined paths during flight. Unlike waypoints the Routes feature has virtually no limit on the length or shape of predefined flight paths. Defining and editing of a route is easy using the FPV_manager and Google maps interfaces.

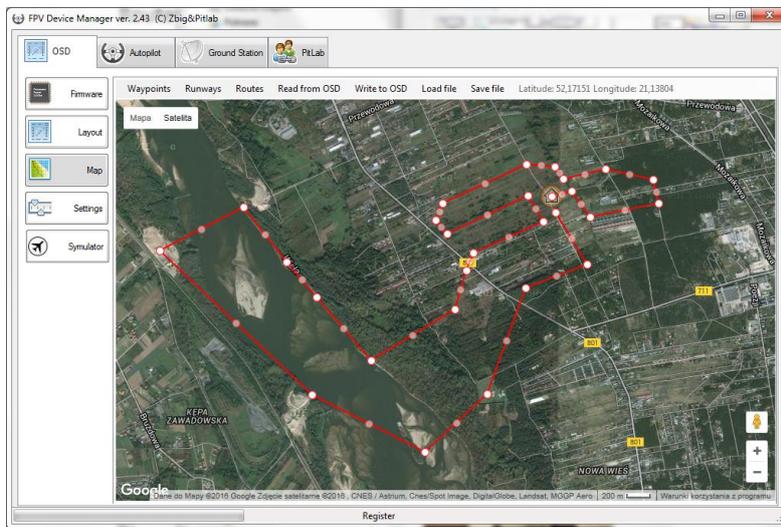


Figure 1 – Sample route defined in the FPV_manager application

The system allows for the definition and use of up to 10 routes on the OSD and each route may have up to 127 segments. Each route has its own name given by the user. Routes are defined directly on a map just by dragging a vertex or a segment's mid point using a mouse.

During flight, the display of routes on the OSD is meant to be similar to routes shown on an automotive GPS navigation systems. Routes may be used in manual flights as well as for autonomous flights.



Figure 2 – Route visualization on the OSD screen during flight

Note: Routes presented on the OSD screen may look different from Google maps due to fact that the OSD radar's screen is not linear (like in Google maps), but closer to natural eye perspective when looking from the flight altitude. The OSD screen shows the view of the route from the perspective of the plane at all times. On automobile GPS navigation systems these different views are often described as "2D" and "3D."

Although each route has up to 127 segments, to keep the screen clear and displaying only relevant information, only 4 consecutive segments are presented on the OSD screen at a time.

During flight the pilot can select and activate any of the defined routes. This will cause that route to be displayed on the OSD screen and will activate navigation through the route. The OSD will show the course to follow the route and the distance to next vertex on the route. When a system is equipped with a PitLab Autopilot, the system can follow the route autonomously.



Figure 3 – Display of a GPS log from a real autonomous flight executing a sample Route

Routes are always unidirectional, from the beginning to the end. The beginning of a route is marked on the designer screen with a home icon.

There are three steps to using the Routes feature: First specific individual routes need to be defined using a PC, then these definitions need to be loaded into the OSD, and finally during flight a predefined route needs to be activated.

Creating routes

Routes can only be designed using the FPV_manager.exe application running on a PC computer. Due to the complexity of Routes, it's not possible to define or change routes using the OSD menu.

The latest version of the FPV_manager application is available for free from Pitlab's web site:

<http://www.pitlab.com/fpv-system/software.html>

This application does not require special installation or additional system drivers, it works directly after downloading and unpacking from the zip file. It can run even from a pen/flash drive on any computer with Windows XP, Vista, 7, 8, or 10. It works fine on Macintoshes running a Windows PC emulation environment.

To define a route, run the FPV_manager application and go to the OSD/Map page. This page will show Google Maps in the main working area. If a map is not present, check your internet connection (an on-line internet connection is necessary for Route definition).

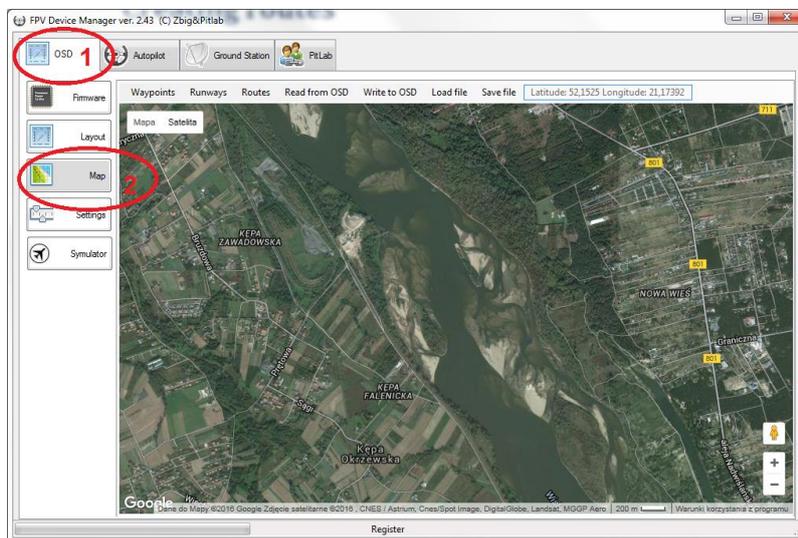


Figure 4 - FPV_manager Map (Route designer)

To define a new route, select **Routes** from menu above the map, and select the **New Route** option. A dialog box will appear with new route parameters. Enter a new name for the route and the flying altitude for this route, then press the OK button.

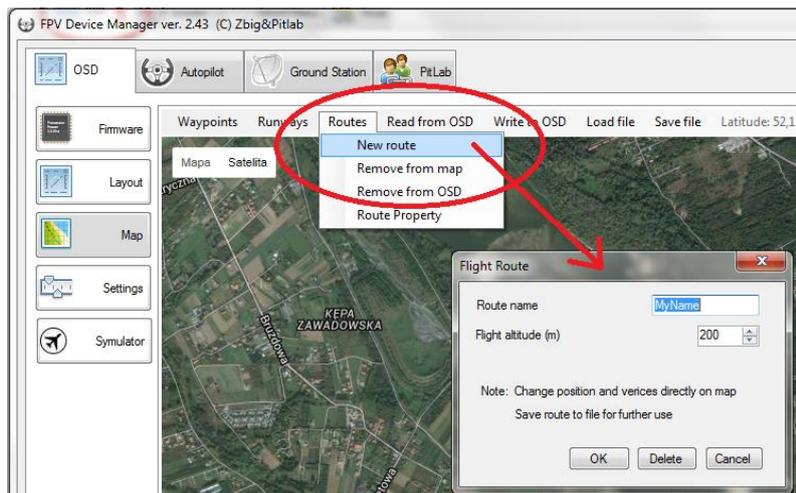


Figure 5 - Creating a new route using the Route designer

Routes are always shown on the Google map as red polygon lines, with a home icon at the beginning of the route. A new route consists of one short line with the home position at the center of the currently visible map. When the map scale is relatively big (zoomed out), only the home icon may be visible. In this case please zoom in the map until the entire route line is visible. A route line initially has 3 points: at the beginning, in the middle and at the end. You may click and drag any of these points, to alter the route's position and shape. When the middle point is dragged, the line is divided into two segments; each of the new segments will have a middle point as well. In this way a polyline can be grown and extended to include up to 127 segments.

Note: Only the single last action on a polyline can be undone. This is accomplished by clicking the undo icon next to the last changed vertex.



Figure 6 – Dragging the middle point will split a line into two segments

Clicking on a line (not on the vertex points) and dragging it allows moving the entire polyline without changing its shape or size.

By dragging the marked points of a polyline the user can freely edit a Route's shape, size and location.

Creating whole route may be a long process, for safety reasons your work should be periodically saved to disk. Do this by opening the menu **Save file** and selecting **Route**. A Standard File save dialog will appear to select a destination folder and file name.

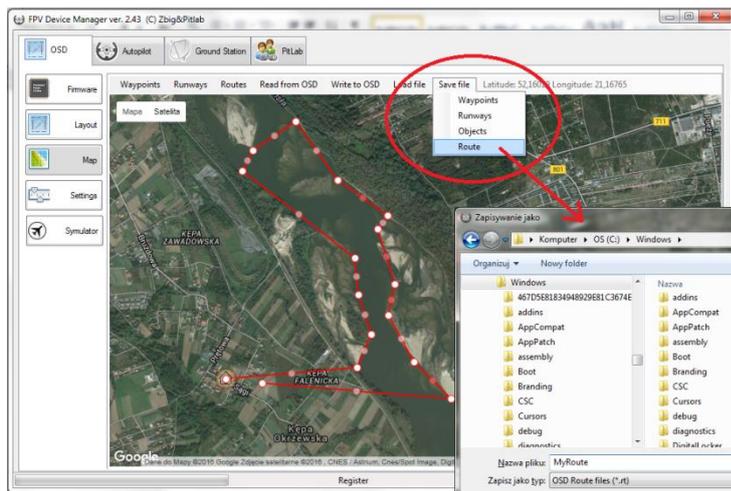


Figure 7 – Saving a Route definition to a file on disk

In a similar way you may restore a route from a previously saved route file to continue your work. Use the **Load file** menu and select **Route**.

Note: Although the OSD can hold up to 10 routes, only one route at a time can be shown or edited in the Route designer. Loading a route from a file or creating a new route will clear the current route in the designer (Map) window. Many different individual routes can be created and stored on a PC, then loaded into the FPV_manager as needed for modification or use in the OSD.

Once a route has been created, the user can change the route name or flying altitude by opening the Route Property dialog box (menu **Routes** and option **Property**).

Loading Routes into the OSD

A route created in the designer can be loaded into the OSD using a standard USB connection. When transferring routes to the OSD, it is enough to simply connect the OSD to the PC with a USB cable - it is not necessary to power the OSD or Autopilot. The OSD will be powered directly from USB port. If you wish to view and check Routes in the OSD menu using the video output from the OSD, you will need to power up the whole FPV system (OSD). The USB can remain safely connected while the system is fully powered.

Note: You may check the USB connection and verify the OSD Firmware version in the FPV_manager application on the OSD/Firmware page.

To store the route into the OSD connect the OSD to your PC using a mini USB cable. The OSD device will be automatically detected by Windows and FPV_manager. Next select the menu commands **Write to OSD** and then **Route**. This will show a dialog box with all the routes already stored on the OSD, and free positions to store new routes.

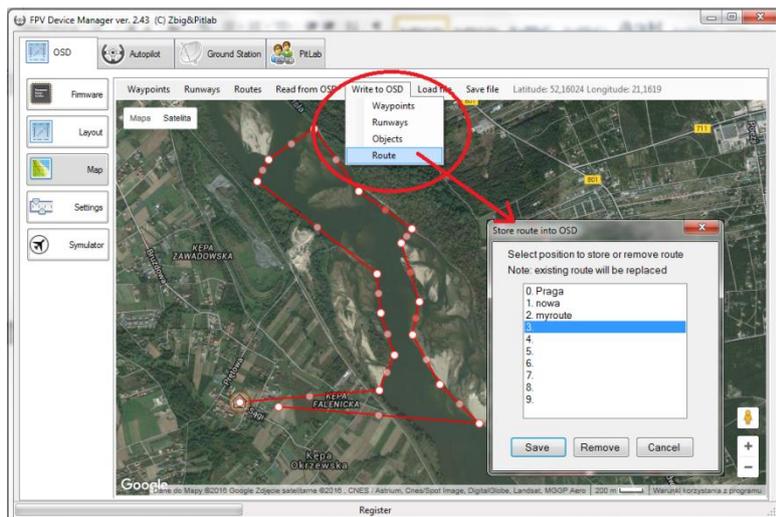


Figure 8 – Loading a route from FPV_manager into the OSD

If a route with the same name as the route being edited in the designer already exists on the OSD, that route will be selected. Otherwise a new, free slot will be selected. Clicking the **Save** button stores the route on the OSD. If you have chosen an existing route, that route will be removed from the OSD and the new route stored in its place. This is the way to replace an existing route with a new, edited version. Any existing route may be also removed from the OSD by selecting its name and clicking the **Remove** button.

Note: The OSD allows for different routes with the same name. To avoid this, it is up to the user to create unambiguous name that are easy to use during flight.

Following routes

After storing one or more Routes into the OSD, a new OSD menu item “**Route**” will be added to the existing **Waypoints** menu. Under the **Routes** submenu all stored routes are available and their names are listed as sub-menu items.

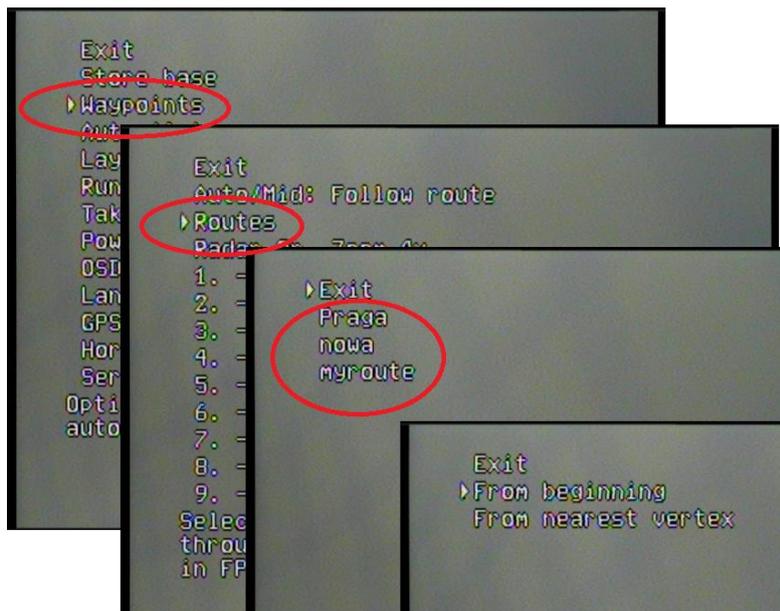


Figure 9 – New Routes OSD menu structure

With each selectable route two actions are available:

- Follow route from beginning
- Follow route from nearest vertex

When **From beginning** is selected, navigation (course, distance) is aimed toward the beginning of the route, and after reaching this first point (with 60 meters or 180 feet accuracy, similar to waypoints mode) the navigation target is moved to the next vertex on the route.

When **From nearest vertex** is selected, the OSD searches the entire selected route to find the vertex closest to the actual current GPS position and navigation is aimed at this point. After reaching this point, further consecutive points along the route become the new navigation targets. This allows you to join the middle of a route rather than starting at the beginning.

When the last vertex of a route is reached, navigation will be aimed at this last point. In autonomous flight the airplane will circle this point.

Note: Routes are always unidirectional, from the first vertex to the last. The beginning of the route is marked on the designer screen by the home icon.

When Follow Route is active, all navigation information on the OSD screen is route-relative; course difference and distance are presented relative to the next vertex, not the base (starting) point.

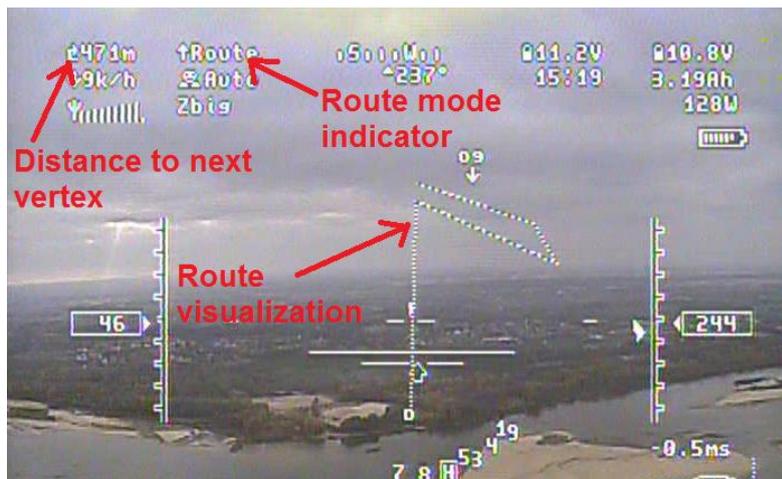


Figure 10 – Route navigation items on the OSD screen

When Route mode is active, the OSD menu command **Waypoints -> Auto/Mid: Hold course & altitude** will toggle to **Auto/Mid: Follow route**, indicating the autopilot's behavior in Auto mode when the throttle is in mid position (half throttle). Selecting this command will deactivate Route mode and switch navigation back to Normal/hold mode.

Each route has its own flight altitude, defined in the FPV_manager with 1m resolution. All segments of a route are flown at the same altitude. This altitude may be changed in the OSD menu **Autopilot->Waypoints->(selected route)->Altitude** from 50m to 600m but only in 50m increments. There is also an option to follow the route at the current flight altitude.

Note: Route altitude is always relative to the base (starting) point. The pilot should be aware of this when flying in hilly terrain and set the altitude high enough to avoid a crash.

Autonomous flight

Note: This section applies only to the full PitLabs FPV System equipped with Autopilot.

When a route is selected (and Follow Route navigation is active) the Autopilot can follow the route in autonomous flight. This is activated by switching the autopilot's mode to AUTO and setting throttle stick to Mid position (half throttle). The autopilot will fly to the current vertex on the route according to the settings chosen during route activation:

- If **From beginning** was invoked just before engaging AUTO/Mid mode, the autopilot will fly to the beginning of the route.
- If **From nearest vertex** was invoked just before engaging AUTO/Mid mode, the autopilot will fly to the vertex closest to the current airplane position at the moment when the action was invoked (not the nearest vertex when Auto mode was activated).
- If some vertices along the route were reached during manual flight (or previous AUTO/Mid activations) and then AUTO/Mid mode is activated, the autopilot will fly to the next vertex along the route and continue on the route from that point. (Routes may be interrupted and no route restart occurs when the mode is changed from Auto to Stab/Off or vice versa).

Vertices on a route must be reached one by one in the order specified in the route. E.g. if you are using Routes and flying manually, and the airplane has already reached vertices 1, 2, 4 and 5, when the autopilot is invoked, it will navigate to vertex 3 and continue the route from there flying by vertices 4 and 5 again. If you want to force the system to continue flying from the nearest vertex, just activate the current route again with the OSD action **From nearest vertex**.

Note: A vertex is considered "reached" or "flown to" when the airplane passes within 60 meters (180 feet) of that vertex.

If the autopilot is following a route and the system detects an RTH condition (Mode Auto and throttle down), the autopilot will switch into RTH mode and change all navigation information to RTH mode. If the system then detects the Follow route condition (Mode Auto and throttle in Mid position), the autopilot will return to the route, flying to the first previously unreached vertex on the route and continuing the route from there.

Note: In a failsafe situation with a low battery, this may not be desirable behavior. To avoid the plane possibly flying away from the RTH base in this situation, when flying with active routes, if a failsafe occurs and the plane should return to home, RTH mode should be manually invoked (Mode Auto and throttle down).

We wish you many safe flights with our FPV System.

Pitlab & Zbig

As always, comments:

- I'm not happy with the conventions we're using around Route, Routes, route, and routes. I'm not sure if it's the best convention, but I'm assuming that "Routes" refers to the entire set of functionality around the new feature. I'm using "route" to refer to a specific route being edited or used. Capitalizing a word makes it a formal noun, and I think we're just talking about generic "routes" here, not some new concept that needs a new title. What do you think?
- Could we change the top level menu item in the OSD to be "Waypoints and Routes" instead of just "Waypoints"?
- In FPV_manager243 I can't define Waypoints. I see things are changed from 240, but I can define them in the earlier version. Is this a known issue for you or would you like a more thorough description?
- I'd like to add a paragraph describing the differences between waypoints and routes and when you might use one versus the other. Is the only real difference that you can control the altitude of each waypoint, but only the entire route? What other differences should be considered? Do you have any use case scenarios for each?