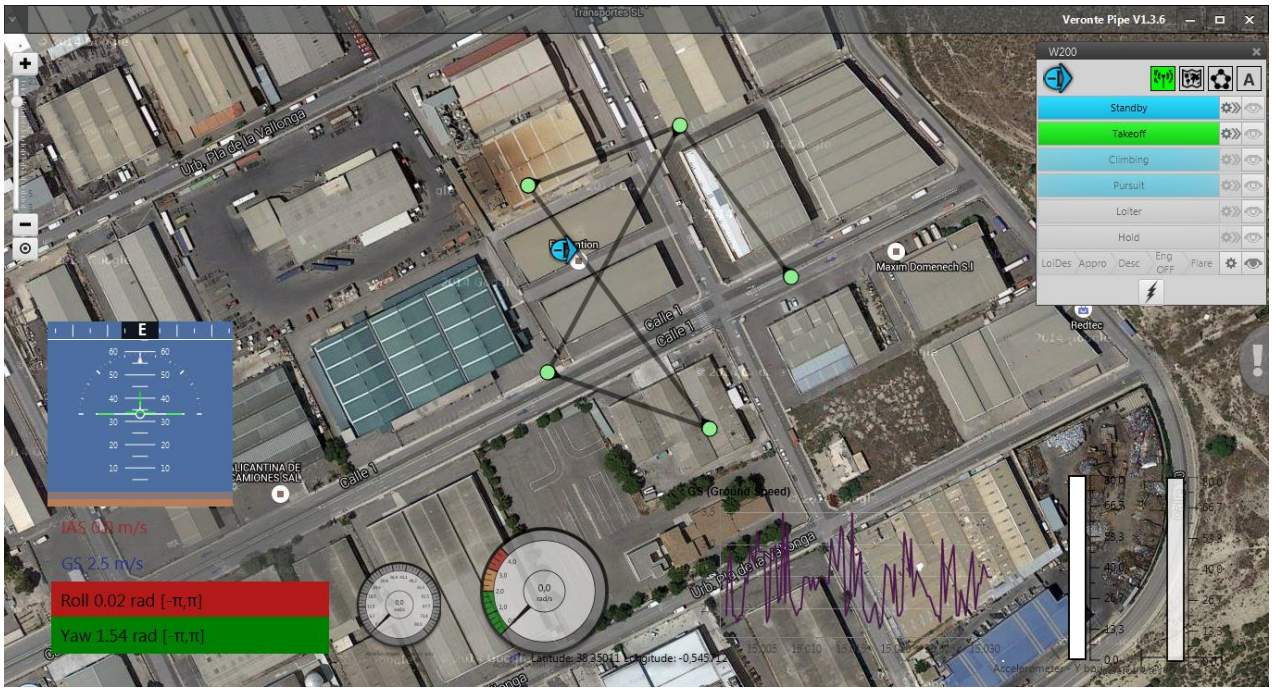
VERONTE

PIPE

Software User Manual



EMBENTION

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Acronyms

HUM	Hardware User Manual
ID	Identification
PFD	Primary Flight Display
REC	Record
RPAS	Remotely Piloted Aircraft
SUM	Software User Manual
SRS	Software Requirements Specifications
UAV	Unmanned Aircraft Vehicle
WP	Waypoint

1. OVERVIEW

1.1. System Overview

Veronte Pipe is the software designed for operating any Veronte powered platform. Users achieve a combination of easy-to-use application, real-time response and, firstly, safe operations.

It has been developed using software standard model of IEEE STD 830-1998, Recommended Practice for Software Requirements Specifications (SRS) and STANAG 4671 documentation, subpart I about UAV Control Stations adapted to Veronte system.

Supported operations include:

Telemetry: View real time on-board UAV metrics, such as sensors, actuators and control states.
Telecommand: Support for all synchronous operator control commands that can be sent to the flight segment, e.g. operational mode switch, mission management, payload control and so on.
Mission design: Configure missions with waypoint definition, payload target definition and coverage analysis.
Mission analysis: Rebuild all recorded data from a previous flight and generate plots and reports.
Configuration: Edit RPAS settings, such as servo trim, interface/port management and so on.
Multiple Users: One or more operators can work simultaneously.

Veronte powered systems have two main elements, air and ground segments.

Figure 1: Veronte System Overview

Veronte Air includes any necessary element to; communicate with ground segment, take flight measures, control the aircraft and control the payload.

Veronte Ground redirects stick and PC data to the air segment, and manages bidirectional communications between Veronte Pipe and Veronte Air.

1.2. Veronte Pipe Interface

Workspace on Veronte Pipe is distributed as shown on Figure 2:

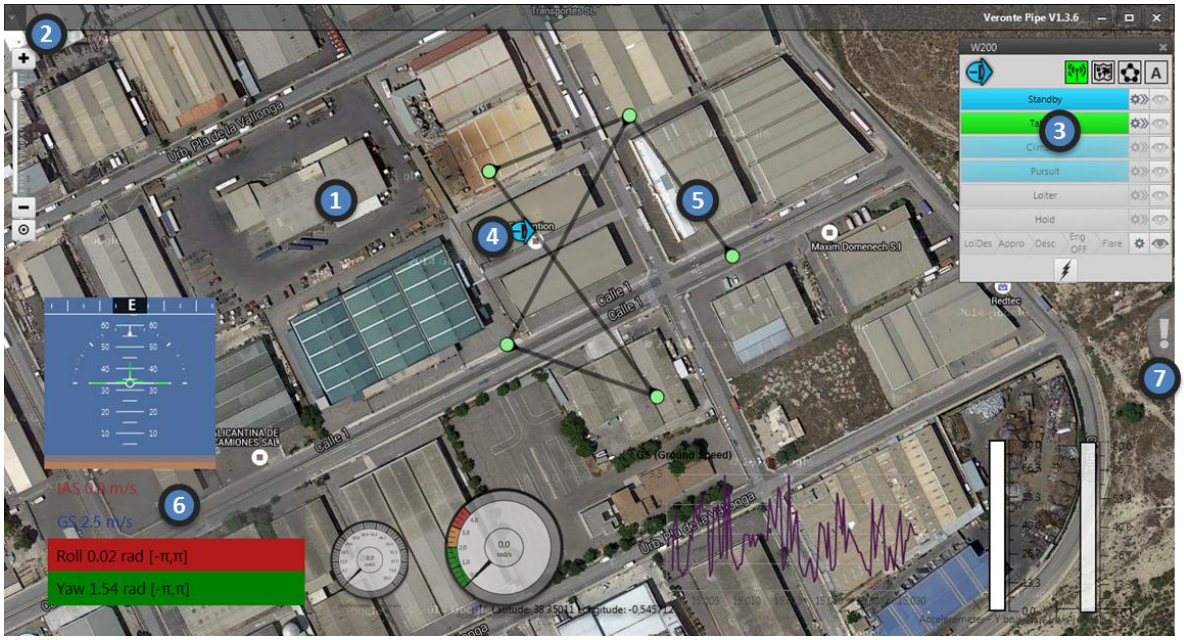


Figure 2: Interface

- **1:** Main display
- **2:** Menu
- **3:** Veronte Panel
- **4:** Veronte position
- **5:** Mission
- **6:** Telemetry displays
- **7:** Side panel

Each section has the following functions:

- **1 - Main Display:** Displays a selectable background map or a plain colour together with most important mission data.
- **2 - Menu:**
  - **User:** Manage user preferences.
  - **Setup:** Configure Pipe and Veronte autopilot.
  - **Workspace:** Select the way flight information is displayed.
  - **Mission:** Create and edit missions.
  - **Log:** View operation data log and introduce custom events.
  - **Post Flight:** Tools for recorded data analysis.
  - **License:** Manage license preferences.
  - **Help:** Shows help information available.
- **3 - Veronte Panel:** Veronte information and telecommand buttons.
- **4 - Veronte Position:** Veronte location on map
- **5 - Mission:** Defined mission on Veronte
- **6 - Telemetry:** Configurable drag & drop flight information displays.
- **7 - Side Panel:** Shows linked Veronte information.

Menu items are displayed as toolbars which can be pinned to the top bar or moved freely along the screen.

2. INSTALLATION

2.1. Veronte Pipe installation

To install Veronte Pipe just execute “Veronte_Pipe.exe” and follow the indications.

2.2. Upgrade

Veronte checks for updates on system start up. A setup wizard will be displayed in order to guide the user on the update process. For manual updates follow the indications below.

⚠ **Caution!!** Although newer versions are usually compatible with older ones, when upgrading the system, updates must be done in the correct order. It is mandatory to update **Veronte Pipe** on first instance, **Veronte Onboard** second and last one should be the **Veronte on the Control Station**. Otherwise, part of the system could become unreachable.

⚠ **Caution!!** Never turn off Veronte during the update process. It could cause irreversible damage to the unit.

After installing las Veronte Pipe version, Veronte units on the side bar will be displayed as follows and Veronte compatibility alert will be displayed

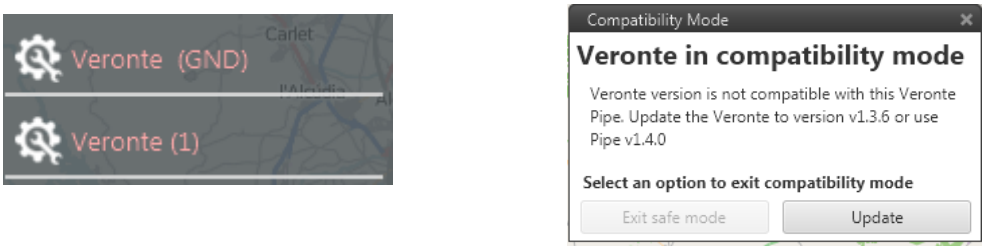
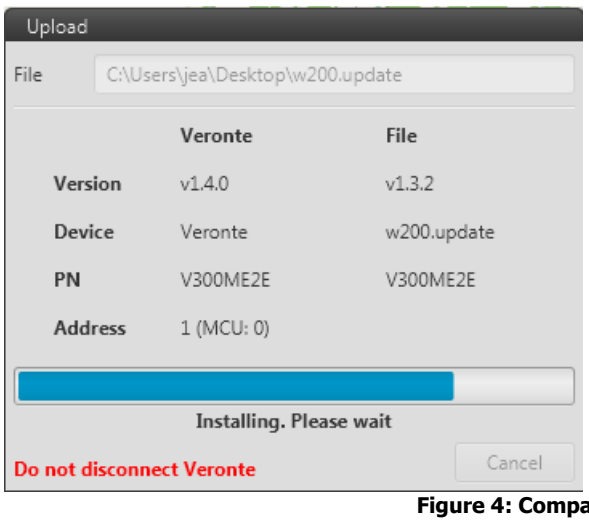


Figure 3: Compatibility mode

In order to perform the update, click on update and press select the update file. The upload process will start.



⚠ **Caution!!** During the update the system will reboot so never perform an update during an operation.

Figure 4: Compatibility mode

2.3. PC connection

Veronte unit on the control station must be connected to the same network than the pc running Veronte Pipe. In order to establish communications with Veronte, PC network interface IP must be in the same range than Veronte. IP can be changed in adapter settings in the Windows control panel, it must be set to IP: 192.168.137.XXX where XXX can be any number selected by user except from 106. Once the IP has been changed, network interface must be selected in Veronte Pipe preferences.

3. SETUP

In order to configure Veronte Pipe or any Veronte device, use the setup toolbar. Veronte Setup dialog can be opened on the main menu:

Figure 5: Setup Toolbar

	Details	Displays configurable fields.
	Open	Open Veronte configurations. Units connected to the PC will automatically be opened.
	Load	Select Veronte configuration to edit.
	Close	Close an opened Veronte configuration.
	Discard	Discard all changes.
	Save	Save all modified data.
	Import	Import a configuration form disk.
	Export	Export configuration on Veronte to disk
PLANE	**X-Plane**	Open X-Plane configuration. Refer to the HIL Simulator manual in order to configure the HIL parameters.
Tunnel UDP	**Tunnel UDP**	Select configuration of tunnel UDP. User can select IP and Port to send data from Veronte Pipe.

Table 1: Setup Toolbar

Configurable items are distributed on tabs, the following structure is followed:

Veronte autopilot:

Tab	Description
Veronte	Introduce Veronte information and aircraft layout.
Connections	Configure I/O connections on Veronte.
Devices	Configure any connected devices: servo, radio, camera...
Control	Introduce control variables or active adaptive control.
Modes	Manage flight modes and their parameters.
Navigation	Configure navigation parameters on the system.
Automation	Configure automatic actions on event detection (go home, turn on lights...).
Variables	Customize variable names and traffic: log, telemetry…
Checklist	Configure pre-flight checks.
HIL	Configure parameters for Xplane Simulator

Table 2: Setup Tabs

Veronte Pipe:

Field	Description
Preferences	Veronte Pipe preferences
Units	Configure unit preferences

Table 3: Veronte Pipe Preferences

3.1. Veronte Pipe

3.1.1. Preferences

Veronte Pipe preferences permit to configure general application parameters. User must select the PC network interface used for interfacing with Veronte systems.

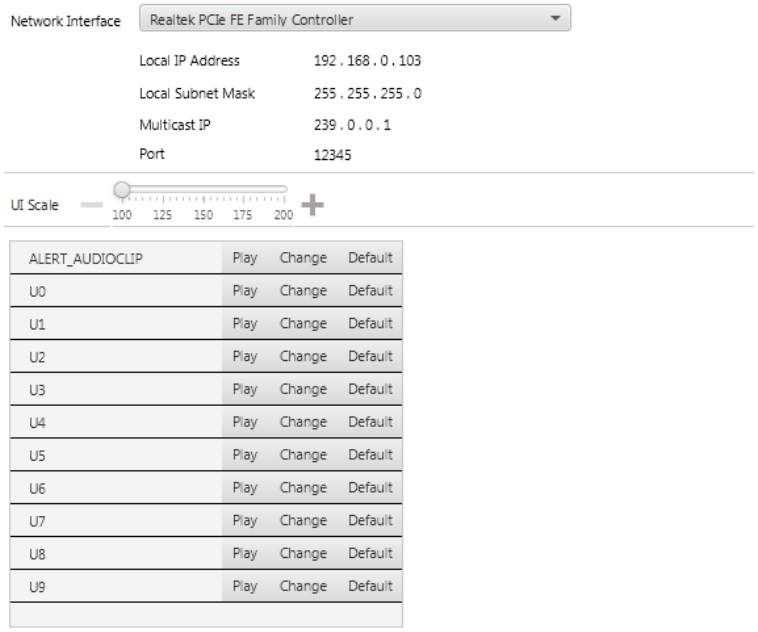


Figure 6: Veronte Pipe - Preferences

IU Scale permits to set the interface scale for adapting the application screen to the screen size on the system.

Alert Audioclips is used for managing audio files used on the application. It can be associated to system alerts on the Workspace configuration.

3.1.2. Units

There are multiple system variables defined Veronte, arranged in categories. For each category, user can set as many custom units as desired by entering the corresponding conversion formula, adding multiple points on the graph.

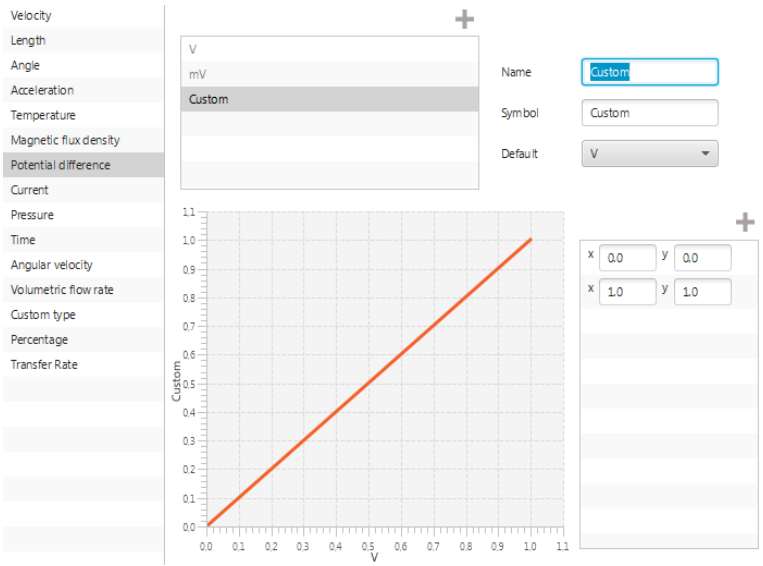


Figure 7: Veronte Pipe - Units

3.2. Veronte Autopilot

3.2.1. Veronte

Introduce Veronte identification and platform layout

Field	Description
Part Number	Introduce Veronte part number.
Aircraft	Aircraft name.
Address	Veronte unique identification number for datalink management.
ID	3 character ID for the platform.
Type	Select platform type.

Table 4: Setup – Veronte

Once platform type is selected, layout must be entered so the system can be configured.

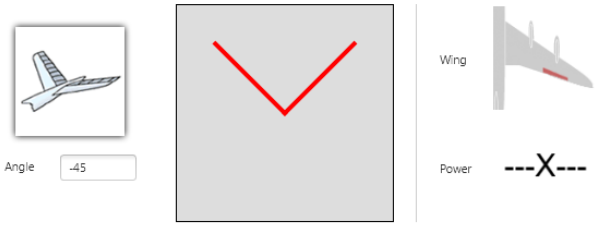


Figure 8: Setup - Veronte

For advanced platform configuration it is also possible to select custom type. US and SU matrix should be entered for configuring control output to actuators input.

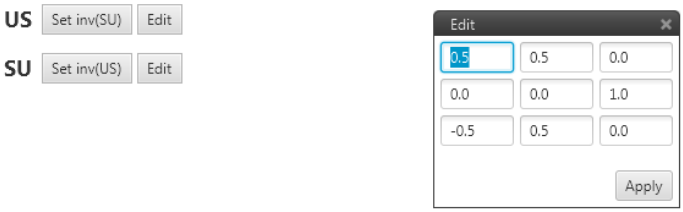


Figure 9: Setup – Veronte - Custom

S refers to actuators and U to control channels output. Set the actuator to control output in order to customize platform control.

On the SU matrix, rows refer to actuators and columns to control output. US matrix is the inverse matrix to SU, it can be automatically completed once the SU has been set by clicking on “Set inv (US)”.

Veronte position within the aircraft must be entered by clicking in one axis and selecting the Veronte axis that corresponds to this direction. Veronte and GPS antenna distance to mass centre must also be entered.

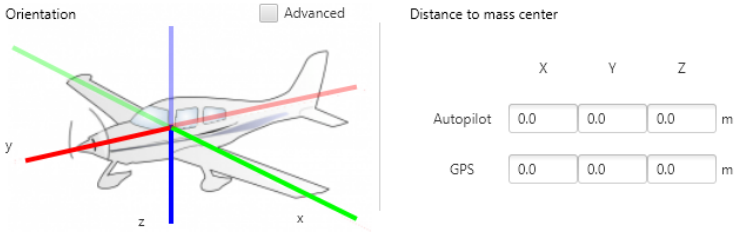
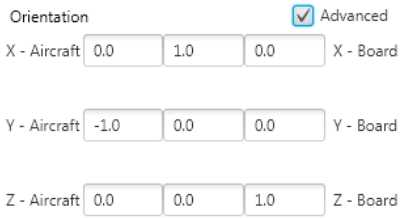


Figure 10: Setup – Veronte - Position



Advanced orientation configuration is also possible

Figure 11: Setup – Veronte – Advanced orientation

3.2.2. Connections

Connection tab permits to configure I/O ports on Veronte, by selecting the devices connected to each port and configuring the communications parameters.

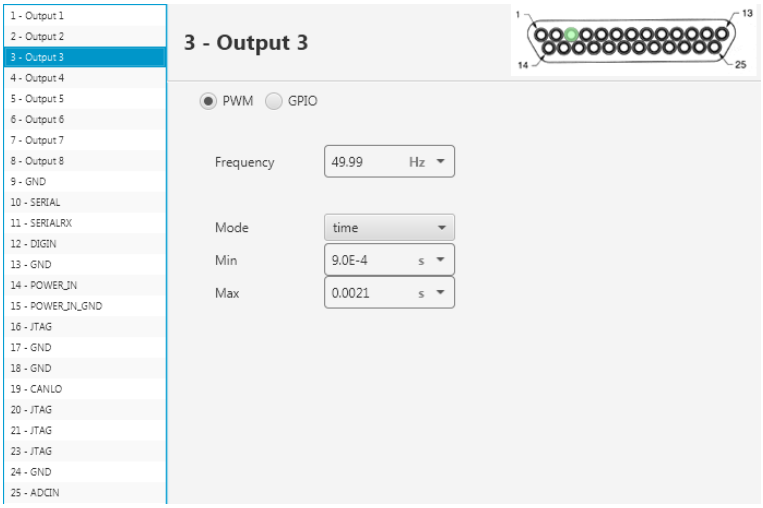


Figure 12: Setup – Veronte – Connections

For each connector pin on Veronte, user is able to configure the following:

Type	Description
Output	System outputs, configurable as PWM or GPIO with following parameters • **PWM:** × **Frequency:** Control frequency × **Mode:** time / duty cicle / fixed × **Min / Max:** output limits
Serial	RS232 port configuration • **Radio:** External datalink radio • **Tunnel:** Bidirectional tunnel • **GPS:** External GPS receiver • **Magnetometer:** External magnetometer connection • **Transponder:** Transponder connection • **Capture:** Input capture
DIGIN	Digital Input • **Stick:** PPM stick • **Tunnel:** Input tunnel • **RPM:** External RPM sensor • **Varconsumer:** Any device to be linked to a system variable
ADC IN	Analog input • **Selectable values:** Linked system variable × Measure = Sensivity x (Vin – Offset) • **Bound error:** Link system error to input data × Choose alarm and limit values

Table 5: Setup – Connections

3.2.3. Devices

Devices panel permits to configure any device (payload, sensors…) connected to Veronte and the internal Veronte ones.

3.2.3.1. Veronte

Frequenccy:

Working frequencies on Veronte Autopilot

Figure 13: Setup – Devices – Frequency

Type	Description
OS	Operative System working frequency
Low	Low priority tasks, mainly for telemetry, other operations…
High	Working frequency for GNC tasks
Super High	Sensor capture and high priority tasks frequency

Note: keep same frequencies on initial and stand by as this distinction is being removed on future versions.

3.2.3.2. Control

Actuators:

Calibration interface for connected actuators. On this panel it is possible to set actuator position for ach control signal output, permitting to configure the maximum and minimum values and custom performance

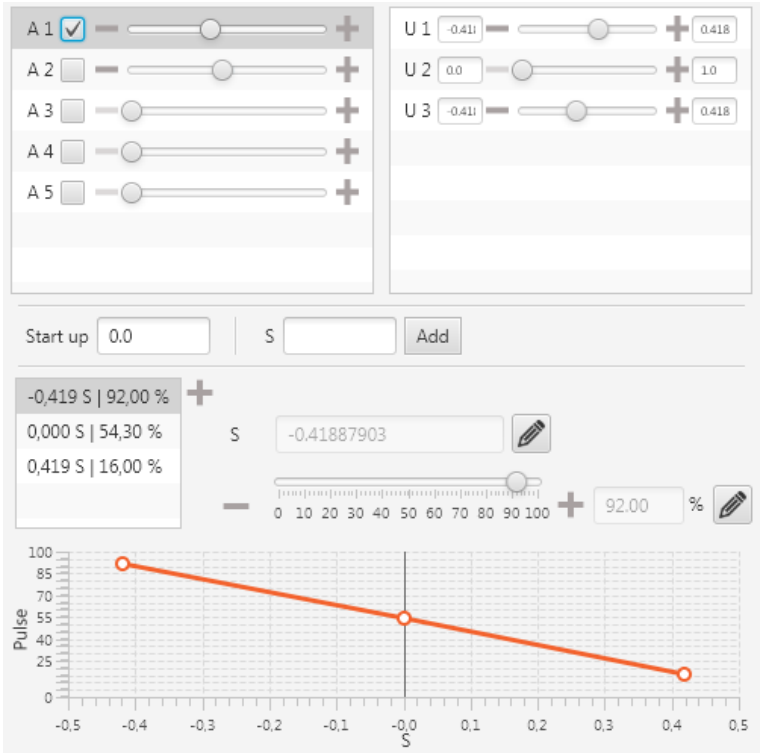


Figure 14: Setup – Devices - Actuators

Field	Description
A	Refers to each actuator on the system. • Mark the checkbox and move the bar in order to move the connected actuator
U	Refers to the control channels configured on the system. Each control channel can be linked to multiple actuators. • When moving a control channel bar, check boxed servos will move
Start Up	Enter servo startup value, preferred position on system initialization
S & Pulse	Draw as many points as needed in order to setup servo limits, assigning system pulse value to an actuator position (s)

Table 6: Setup – Devices - Actuators

Actuator position is given as an "S" parameter which refers to the control variable associated to the actuator. Default units given are:

- Control surfaces (aileron, rudder...): Angle (in radians).
- Motor: Value between 0 and 1 where 1 is max power and 0 is the point where the motor starts the moving.

For "0" motor position it is recommended to set a 5% signal margin in order to make sure that the motor fully stops in all configurations.

Actuator positions must be given according to the international aeronautical sign convention:

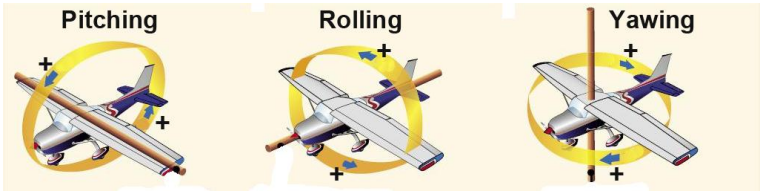


Figure 15: Sign Convention

Example, an elevator down position will generate a positive pitch so the elevator is considered positive on down position. Main actuators rules:

Actuator	Positive	Negative
Elevator	Down	Up
Rudder	Right	Left
Right Aileron	Up	Down
Left Aileron	Down	Up

Table 7: Actuator Configuration

⚠ **Note:** Maximum and minimum values must be set according to physical actuator limits. Configured limits will never be exceeded by the system in any flight mode.

3.2.3.3. Sensors

Encoder

Configure connected encoders on Veronte; draw as many points as needed in order to correlate the encoder input data on Veronte to the desired value on system.

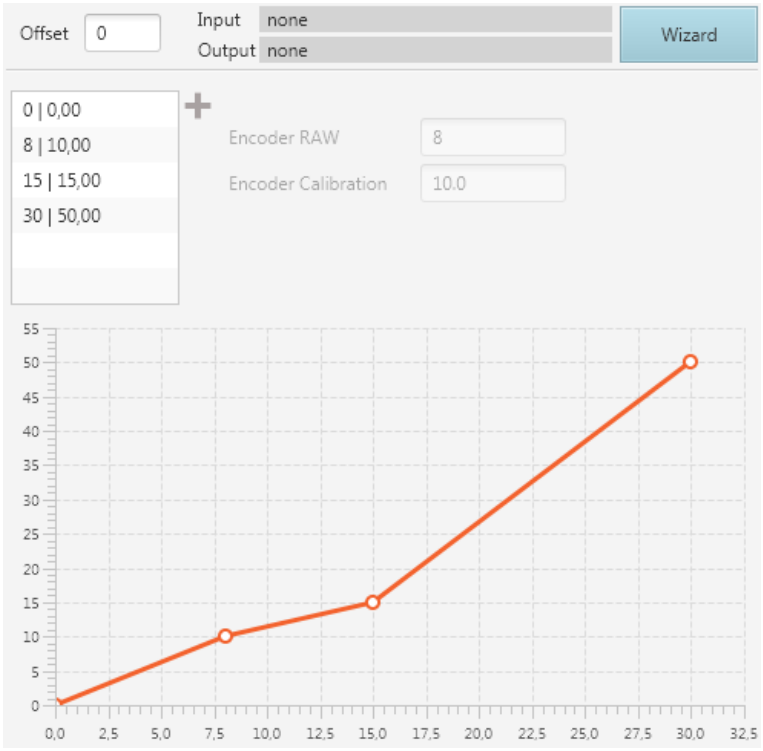


Figure 16: Setup – Devices –Encoder

Field	Description
Offset	The entire graph will be displaced the offset value
Graph points	Draw as many points as required for calibrating encoder performance • **Encoder RAW:** Real encoder captured data • **Encoder Calibration:** S value corresponding to the encoder data
UVar	Input variable for the encoder
RVar	Output variable for the encoder data

Table 8: Setup – Devices -Encoder

The calibration wizard can also be used for calibrating encoders. Follow the described steps for performing the calibration.

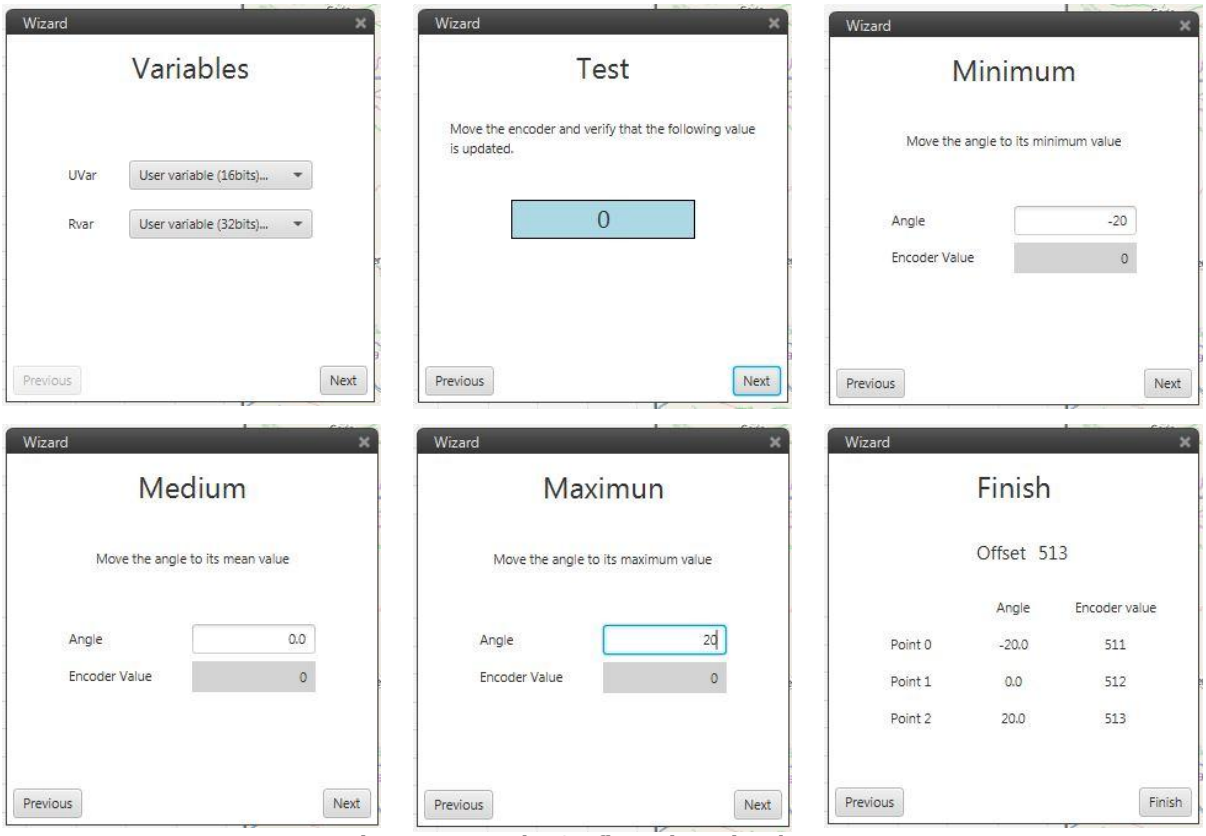


Figure 17: Encoder Configuration Wizard

Magneto Calibration

Magnetometer calibration should be performed once Veronte has been installed on the platform so the magnetic field during the operation is similar to the one measured during the calibration.

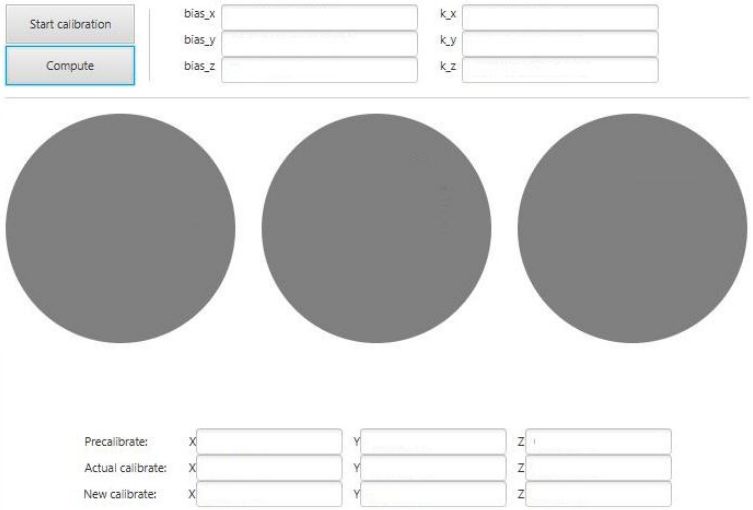


Figure 18: Setup – Devices – Sensor – Encoder

⚠ **Note:** Before initiating the calibration make sure that the following variables are active on telemetry (Setup – variables – telemetry – data link): "Magneto x", "Magneto y", "Magneto z"

In order to start calibration, press on the “Start Calibration” button so the system can capture magnetometer data. During the calibration the system must be oriented in all possible directions so enough data can be captured. Once enough data has been captured, “Compute Data” sets the calibration.

The procedure for acquiring enough data for performing the calibration is:

- Hold the platform with your hands on the “Y” axis and rotate it parallel to ground.
- While the platform is rotating, rotate also yourself so the platform turns in two axes simultaneously.
- Turn the platform 90 degrees within your hands and repeat the operation.

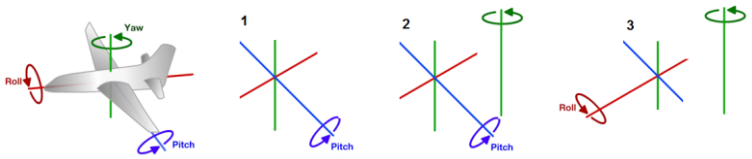


Figure 19: magnetometer calibration procedure

Once three circles have been drawn on the screen, captured data will be enough for saving the calibration data. The following image shows an example of the calibration result:

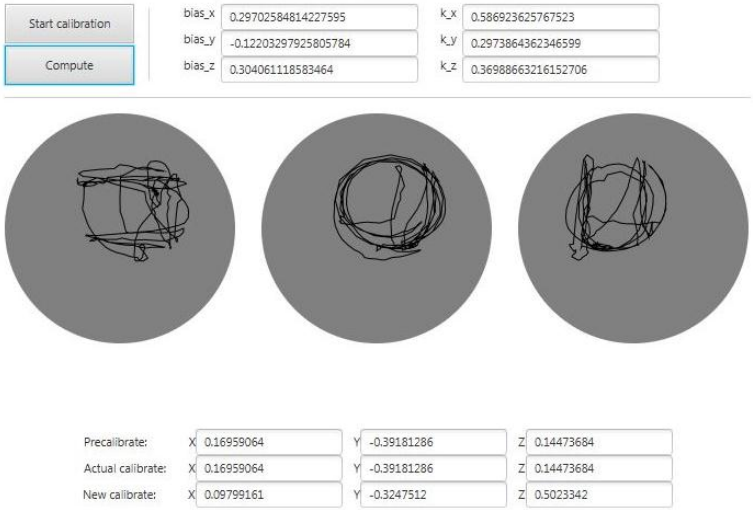


Figure 20: magnetometer calibration values

Magneto Navigation

Enable or disable magneto for navigation and configure magnetometer parameters.

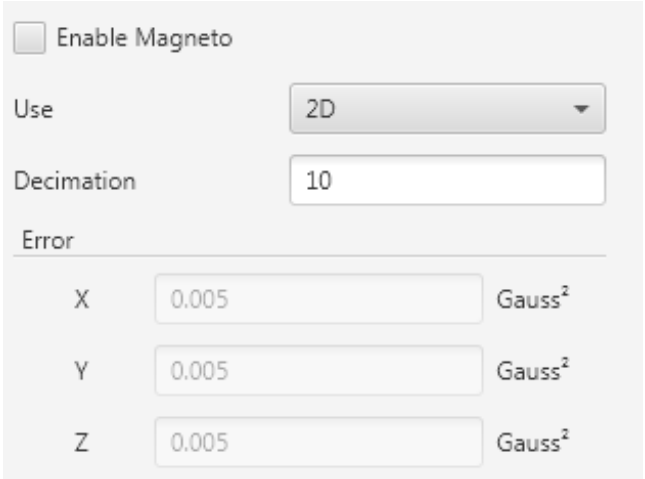


Figure 21: Setup – Devices –Magneto Navigation

Field	Description
Use	Choose angles for magnetometer use • **2D:** Only use horizontal measure for navigation • **3D:** Use 3 measures for navigation
Decimation	Magnetometer decimation
Error	Magnetometer error

Table 9: Setup – Devices –Magneto Navigation

Varconsumer ECAP

Configure Varconsumer connected on the digital input in Veronte.

Figure 22: Setup – Devices –Varconsumer

Dynamic Pressure

Configure dynamic pressure sensor input in Veronte

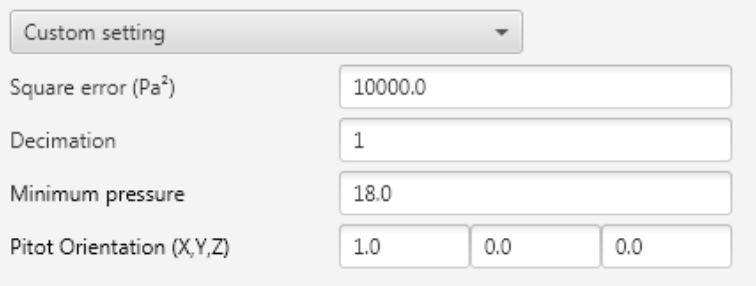


Figure 23: Setup – Devices – Dynamic Pressure

Field	Description
Type	Choose the dynamic sensor pressure use on the system • **Disabled:** Do not use dynamic pressure sensor for navigation • **Custom Settings:** Use sensor with custom settings • **Autocalibrated Variance:** Use sensor with automatic settings
Square Error	Sensor error
Decimation	Sensor decimation
Min. Pressure	Minimum pressure readable by sensor
Pitot Orientation	Pitot orientation on platform

Table 10: Setup – Devices – Dynamic Pressure

Radar Altimeter

Radaraltimeter settings, ask for compatible radaraltimeter options.

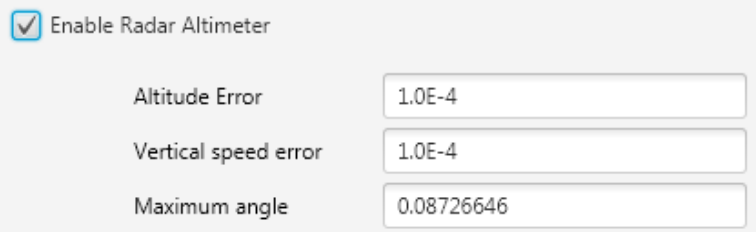


Figure 24: Setup – Devices – Radar Altimeter

GPS

Configure GPS sensor options, only for advanced users.

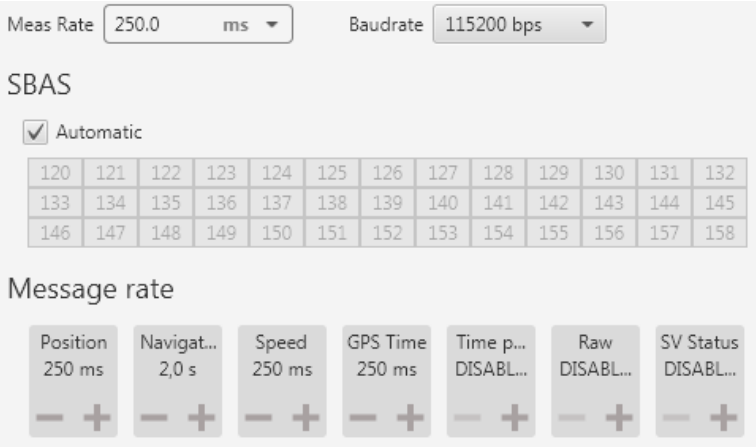


Figure 25: Setup – Devices –GPS

Static Pressure

Configure static pressure sensor use on the system.

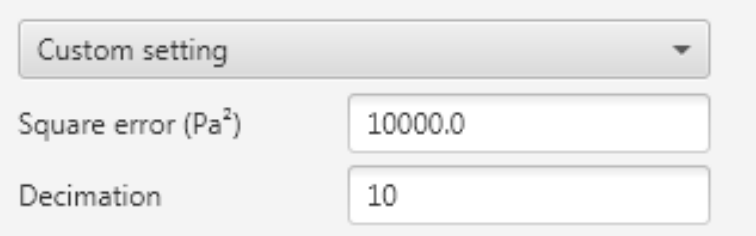


Figure 26: Setup – Devices –Static Pressure

Field	Description
Type	Choose the static sensor pressure use on the system • **Disabled:** Do not use static pressure sensor for navigation • **Custom Settings:** Use sensor with custom settings • **Autocalibrated Variance:** Use sensor with automatic settings
Square Error	Sensor error
Decimation	Sensor decimation

Table 11: Setup – Devices – Static Pressure

3.2.3.4. Stick

Test Stick

For each stick channel configured, user can set continuous movement commands to be performed. For configuring the stick select the wave type and enter the requested parameters.

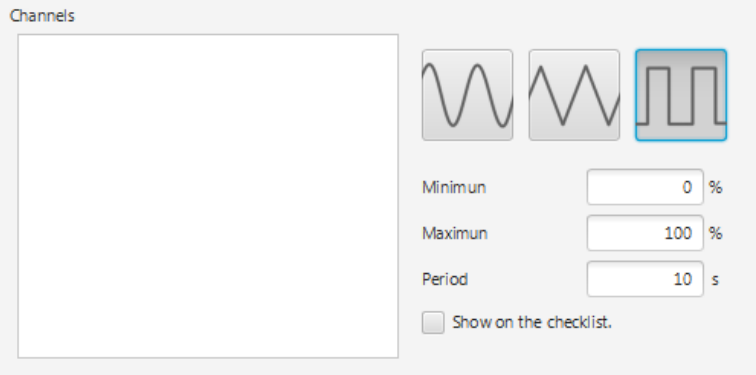


Figure 27: Test Stick Configuration

Configured parameters can be shown on the checklist in order to test the system prior to change flight phase.

To activate the automatic movement, use the activation button on the virtual stick configured on the workspace.

Stick

Configure stick parameters for manual and assisted manual system control.

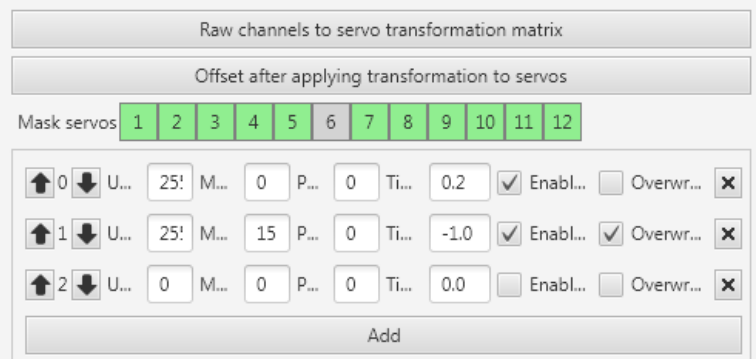


Figure 28: Stick Configuration

Use the raw channels to servo transformation matrix in order to make virtual servo missing and for customizing servo outputs.

Offset value will be added to output once the transformation is performed.

Click on “Mask Servos” in order to disable the stick control over those actuators.

It is possible to set multiple joystick inputs with the respective priority, from top to bottom.

UAV, MCU & Port refers to the Veronte unit where servo is connected, time is the time without reception to change to the following input. Enable enables receiving data from that stick and overwrite permits to have multiple inputs for different channels.

Virtual Stick

Configure virtual sticks on the system, select an input variable containing the stick data and select the Veronte unit destination to control.

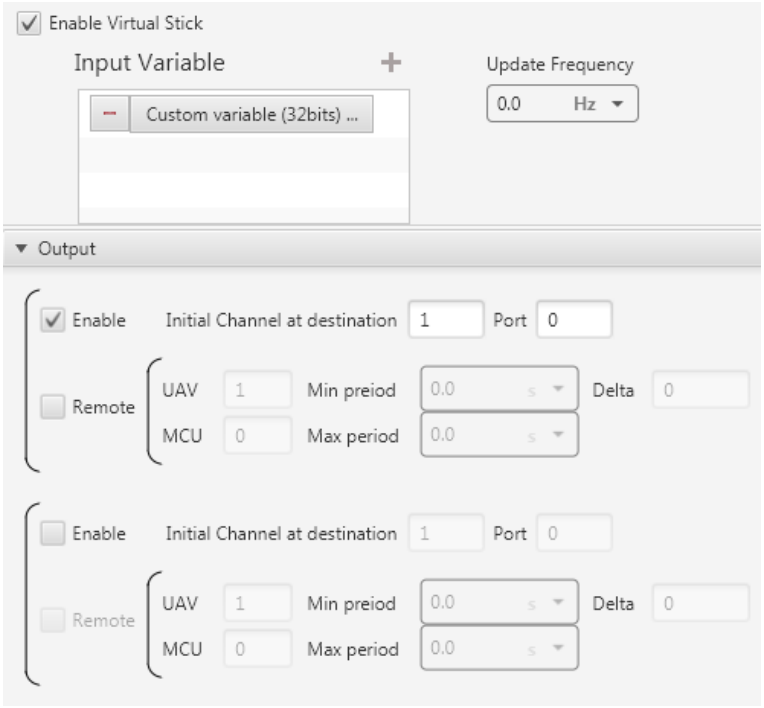


Figure 29: Virtual Stick Configuration

3.2.3.5. Micro

GPIO Manager

Enable or disable ports at microprocessor level.

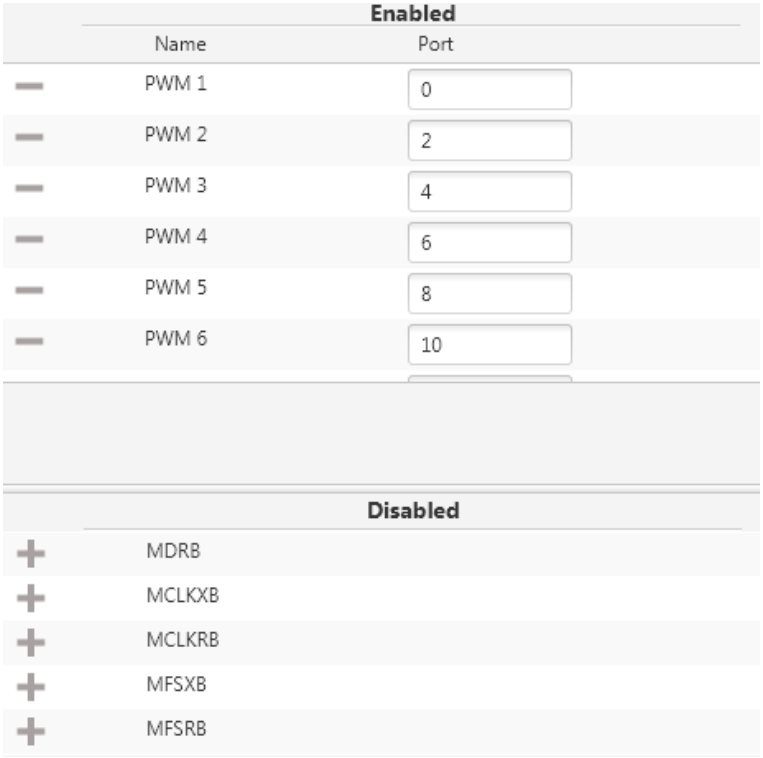


Figure 30: GPIO Manager

3.2.3.6. Others

Radio

Configure radio settings.

Payload

Configure connected payload settings.

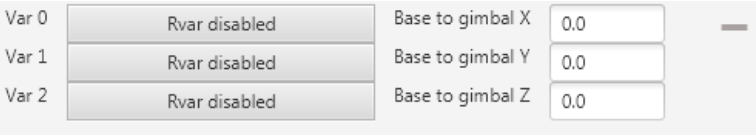


Figure 31: Payload configuration

Sets relationships between variables and gimbal control.

3.2.4. Control

User can configure platform control parameters for setting the unmanned system performance during the operation.

⚠ **Caution:** Only for experienced users

On the left side of the Control interface, user can enter as many control phases as needed. A control phase refers to a set of specific control parameters defined for a concrete operation step (take off, waypoint route, hover…). Control parameters will be defined for each phase; user will be able to set automatic phase switch (on automation display) or use manual switch on Veronte Panel.

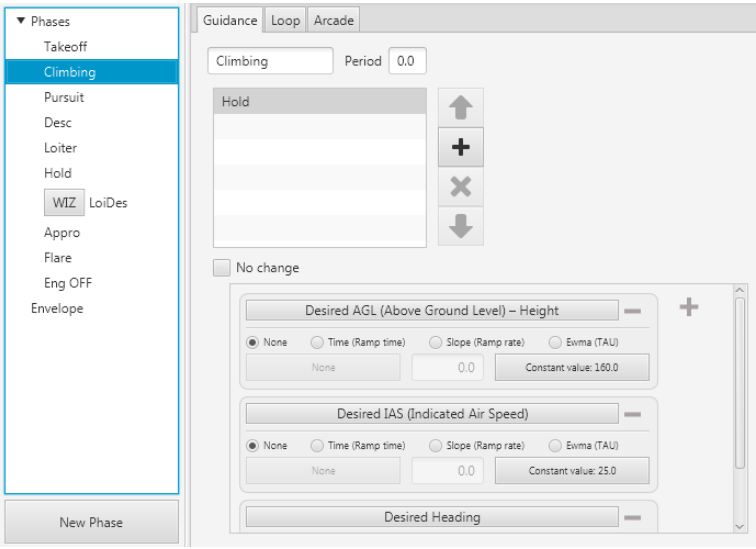


Figure 32: Setup - Control

For each phase user must configure three main elements:

Value	Description
Guidance	Select guidance type and main parameters
Loop	Set control loops
Arcade	Configure arcade mode for assisted manual control

Table 12: Setup Control

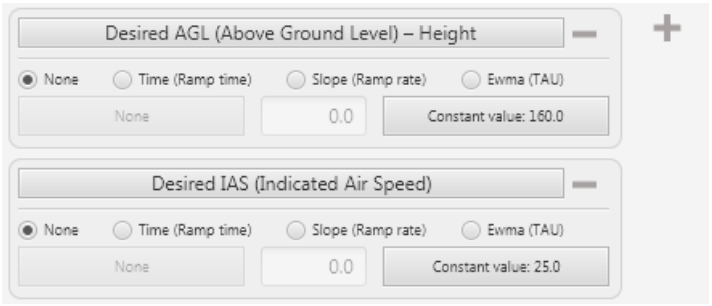
3.2.4.1. Guidance

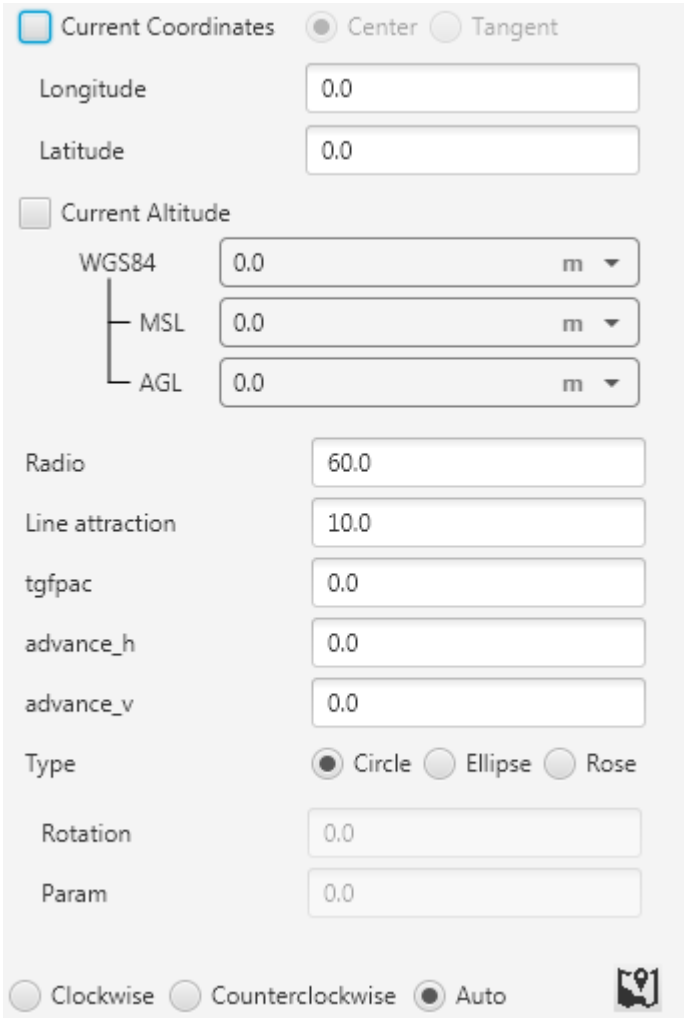
In order to configure the guidance, the following parameters must be entered:

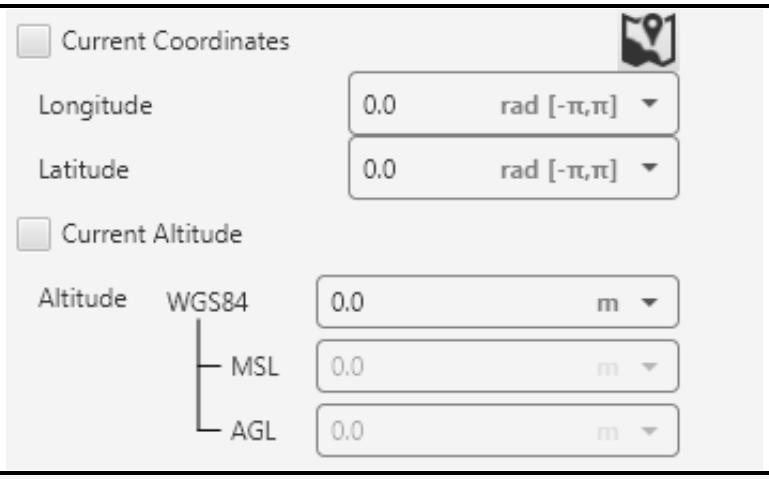
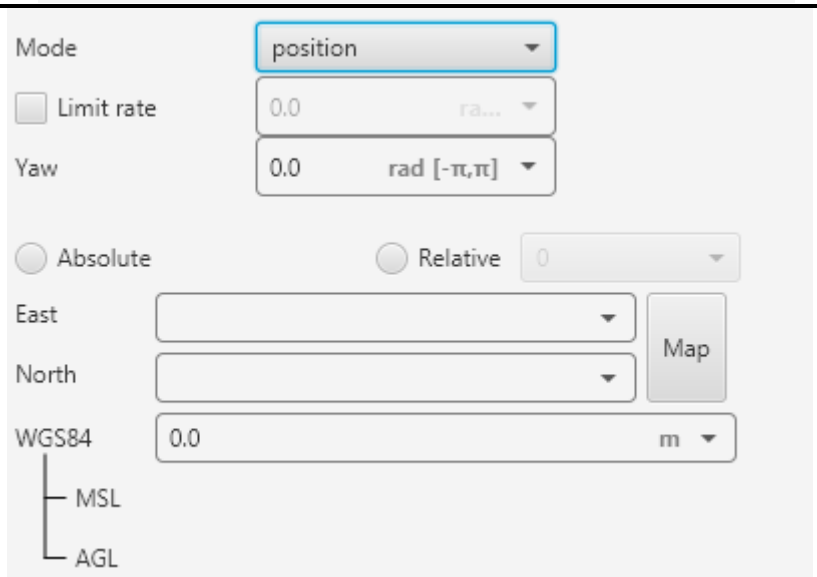
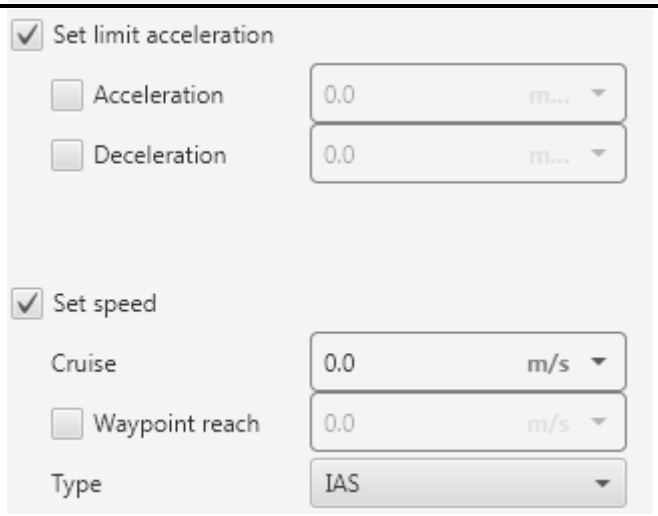
Value	Description
Name	Set a custom name for the control phase, to be displayed on Veronte Panel
Period	Enter a control step period for the control phase
Type	Select the guidance type from available, described below
Change	When “No Change” is selected, control parameters on phase entering will be maintained

Table 13: Guidance Settings

For each guidance type the following parameters are configurable:

Type	Interface
Hold: Maintain certain variables on the system **None:** Set variable value **Time:** Set a time tamp between an input and an output variable **Slope:** Set a ramp rate for changing form input variable to output variable **Ewma:** Exponential rate form input to output variable, enter tau parameter	

Loiter: Select loitering parameters and coordinates to perform the manoeuvre. **Position:** Enter position and altitude for the loitering centre **Radius:** Set loitering radius **Line attraction:** Force the platform to follow the desired track. Higher values means lower attraction **Tgfpac:** Altitude change rate **Advance_h /v:** Parameter for setting the guidance form tangent to line attraction **Circle:** Circular loiter **Eclipse:** Eclipse loiter - ***Rotation:*** angle in radians - ***Param:*** eccentricity (0-1) **Rose:** Rose loiter - ***Rotation:*** angle in radians - ***Param:*** number of petals	
Way: Select the waypoint to go on phase entering and control parameters. **Waypoint:** First waypoint to go **WLine: Line attraction:** Force the platform to follow the desired track. Higher values means lower attraction **Banking turn:** Desired platform backing on turn	

Hover: Maintain position and attitude. **Position:** Enter position and altitude for the hover centre	
Yaw: Yaw control. **Current:** Maintain current yaw **Fixed:** Set fxed yaw value **Heading:** Maintain current heading. **Position:** Point to a fixed position. **Limit rate:** Maximum yaw rate **Yaw:** Desired Yaw	
Hspeed: Speed control **Limits:** Set maximum acceleration and deceleration limits **Cruise:** Set cruise speed **WP Reach:** Set speed on waypoint reach	

Runway: Enter runway parameters for landing. **1 & 2:** Runway limits **Line attraction:** Force the platform to follow the desired track. Higher values means lower attraction	

Table 14: Control Type

3.2.4.2. Loop

On each phase, controller parameters can be set for each control channel defined on Veronte Configuration. Each one of them having the following status options:

Value	Description
Off	Disables the PID controller.
On	Enables the PID controller.
Fixed	Sets the control parameters to a fixed value.

Table 15: PID Control Status

PID Settings

When configuring a PID, up to three control loops can be configured, select on the combo box the desired option.

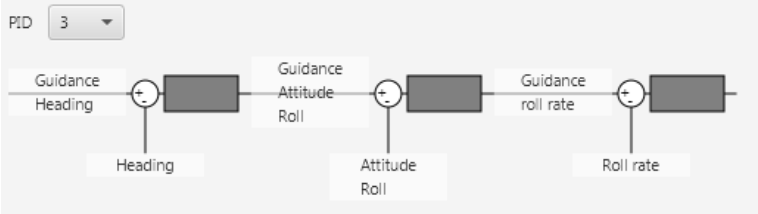


Figure 33: PID Architecture

For setting PID variables, select the variable to set and a list with available options will be displayed.

For setting the PID parameters click on the grey boxes and the PID diagram will be shown:

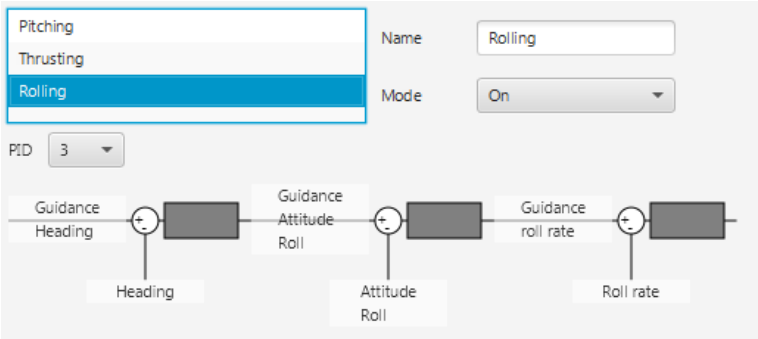


Figure 34: PID Diagram

For each block it is possible to configure the PID:

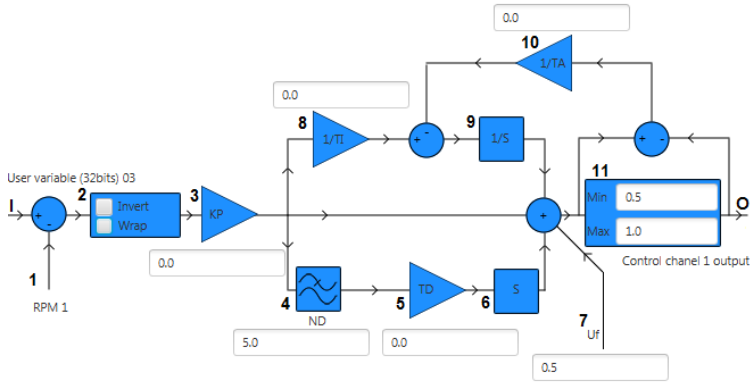


Figure 35: PID elements

Value	Description
I	Set Point
1	Measure
2	• **Invert:** Change error sign • **Wrap:** Wrap to pi [-π, π] It is used in some angular variables (radians) for avoiding numerical errors on the –π to π change and keep continuity of the error signal
3	Proportional gain
4	Discrete filter parameter
5	Derivative time parameter
6	Derivative
7	Constant value added to output
8	Inverse integral time parameter
9	Integral
10	Anti-windup parameter
11	Output bounds
O	Output

Table 16: PID Elements

Output values for PID controller refer to virtual control channels, units must coincide with servo trim configuration settings.

PID diagram represents the following PID model:

$$C = K_p\left(1 + \frac{1}{T_i}IF(z) + \frac{T_d}{\frac{T_d}{N} + DF(z)}\right)$$

K_p=proportional gain

T_i=Integrator time

T_d=Derivative time

N=Derivative filter constant

For the derivation and integration models, Trapezoidal and Backward Euler models have been integrated:

$$IF(z) = \frac{T_8}{2}\frac{z+1}{z-1} \qquad ND(z) = \frac{T_8 z}{2z-1}$$

$ND = \frac{T_d}{\tau}$ where τ is the is the time constant on a first order FPB. When ND is set to 0, the FPB is disabled.

Sampling time has already been integrated: $K_i = \frac{K_p}{T_i}$.

Initial block permits to invert the input signal or apply a wrapper, it is used for angles to be maintained between $\pm 180º$.

On the output block it is possible to set the maximum and minimum values for the variable.

Exporting PIDs to other phases

Once it is considered that the PID is tuned, the user can easily export that PID in order to use it in other phases. To do so, just select *Copy* by right clicking on the desired PID and select the suitable phases.

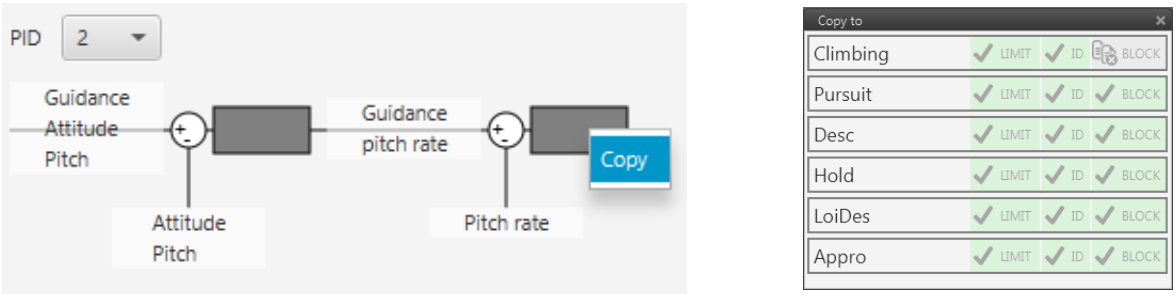


Figure 36: Copy Option

Fixed Settings

When fixed mode is selected the following diagram is displayed:

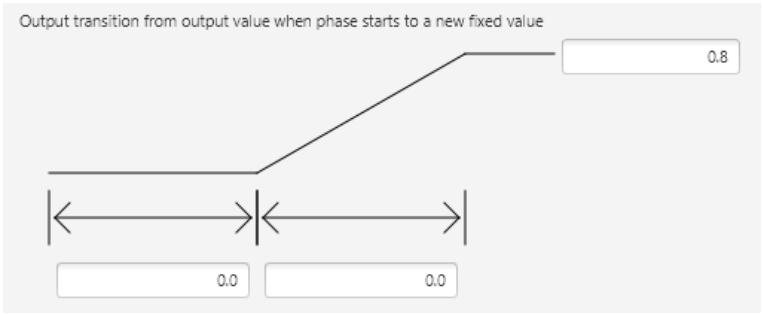


Figure 37: Fixed Value Settings

Three values must be entered, the remaining time in the starting conditions, the transition time and the variable final value.

3.2.4.3. Arcade Mode Settings

Arcade mode permits to have a simplified manual flight mode. The stick movements actuate directly over the control variables instead for a user friendly aircraft control.

Parameters are configured for each phase by setting values available when Show Arcade is selected.

Figure 38: Arcade Mode Settings

User can enter the affected control variables and the gain for each one. Select Integral for continuous variable value increase on joystick hold, or leave it unchecked for resetting the control variable value after joystick release.

3.2.5. Modes

In this section, users can select the controller for every mode. The main idea is to set who is controlling the platform dynamics. The interface options are:

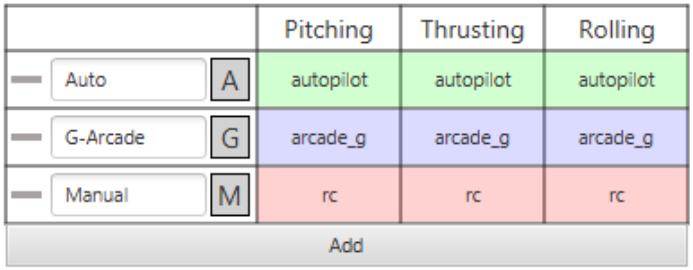


Figure 39: Mode Settings

It is every common to find an automatic mode where all the dynamics are controlled by the autopilot. Likewise, the manual mode is completely controlled by the remote controller (*rc*). To change any of this options, click on the cell you would like to change and the next option will be set.

3.2.6. Navigation

Navigation parameters are configured on navigation tab. Being possible to configure accelerometers, gyroscopes, sensor measuring filters, angular speed estimation filters, state vectors and wind influence.

Figure 40: Navigation parameters

3.2.7. Automation

Automation configuration permits to set actions to be performed under predefined detected events.

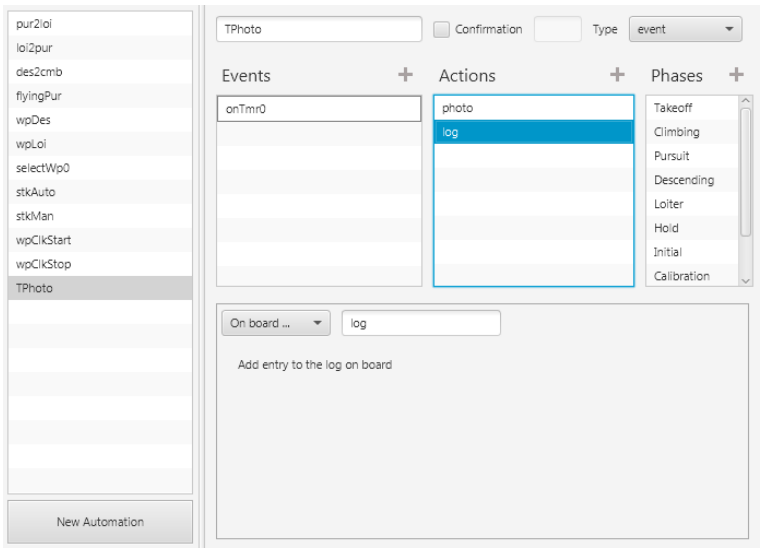


Figure 41: Automation Display

Automations are a combination of events and actions. All actions will be performed on event triggering. Each event on the list will individually activate the associated actions. Event groups permit to execute actions only once various events have been triggered.

When confirmation is active, a pop up window will be displayed before action takes place so user can cancel it. Type permits to select if once the event is triggered it remains as active (event) or if it is needed that all events take place at the same place to activate the action (condition). Phases where automation is active must be entered for avoiding automations to take place on undesired phases.

Following actions are available:

Type	Description
Phase	Change flight phase.
Onboard log	Record onboard information.
Mode	Change flight mode.
Periodical	Configure timer for periodic actions. To be used as an periodic event.
Fly to	Select a waypoint to fly to.
Servo	Set a servo position to a predefined position for a given time.

Table 17: Automation Actions

Activation events are:

Type	Description
Waypoint	Execute actions on waypoint arrival.
Polygon	Execute actions when inside or outside a defined area.
Timer	Select a preconfigured timer.
Alarm	Select system fail detector.
Variable	Select a variable value.
Button	Configure a button to be displayed on Veronte panel.
Phase	Enter a phase.

Table 18: Automation Activation Events

3.2.8. Variables

3.2.8.1. System Variables

Names

Enter custom variable names for predefined variables on the system. Click on table and enter custom name for variable.

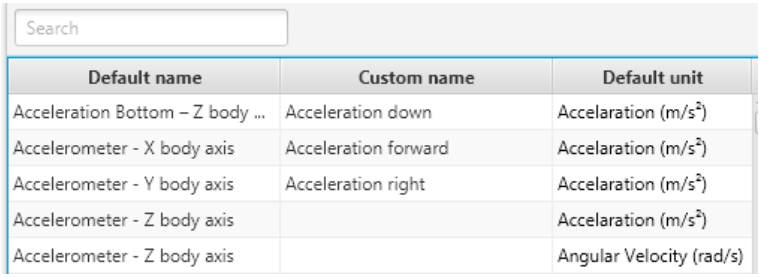
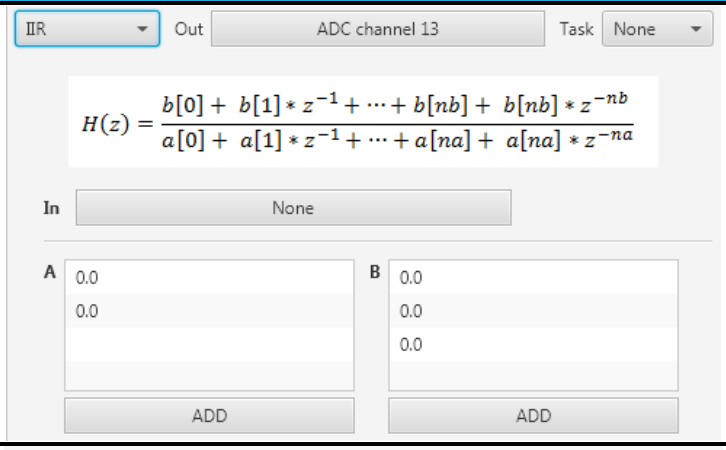
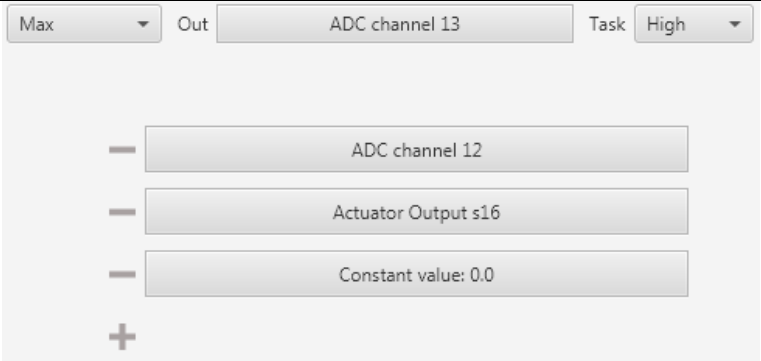


Figure 42: Variable name customization

Operations

It is possible to configure custom operations to be performed in Veronte by selecting the input and output variables and operation parameters.

Type	Interface
IIR: IIR digital filter, enter the parameters for filtering the variable value.	
FXY: FXY matrix, complete the table for setting an output value according to two input ones.	

Linear Expresion: Output variable acquires the value of the sume of input variables multiplied for a constant value.	
Max / Min: Output variable takes the value of the maximum / minimum value from the ones on the input variables / constants	
Wrap: Output variable is wrapped to keep value between upper and down limits.	

3.2.8.2. Telemetry

Telemetry controls permits to configure data to be stored or transmitted on the system. There are 4 main items that can be configured within this panel:

Type	Description
Data Link	Configures the variables to send throughout the datalink channel.
Log	Sets the variables to be stored on system Log.
User Log	User Log for custom applications.
Fast Log	Saves data at the maximum frequency available on the system. Recording time depends on the selected variables.

Table 19: Telemetry Configuration

Configuration display permits to enable the desired variables for each telemetry file and to set the maximum and minimum values together with precision for each one.

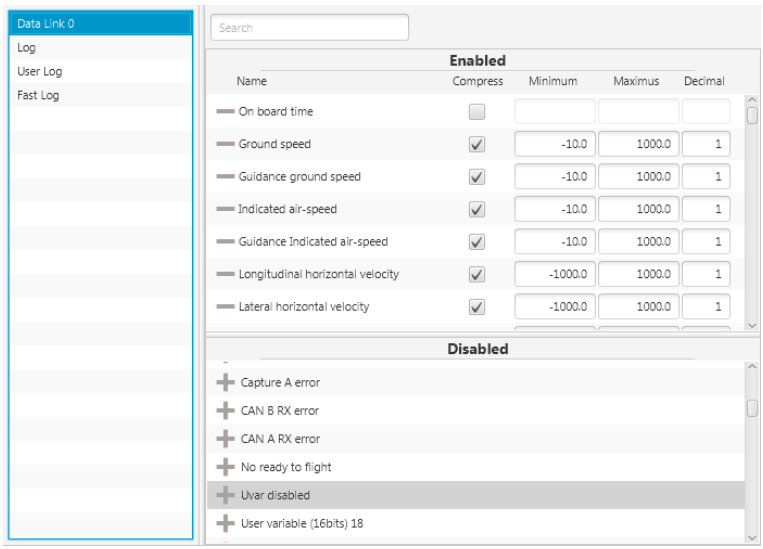


Figure 43: Setup – Telemetry

3.2.9. Checklist

A checklist is configurable for each flight phase. This checklist will be displayed on the Veronte Panel and must be completed prior to exiting from a phase.

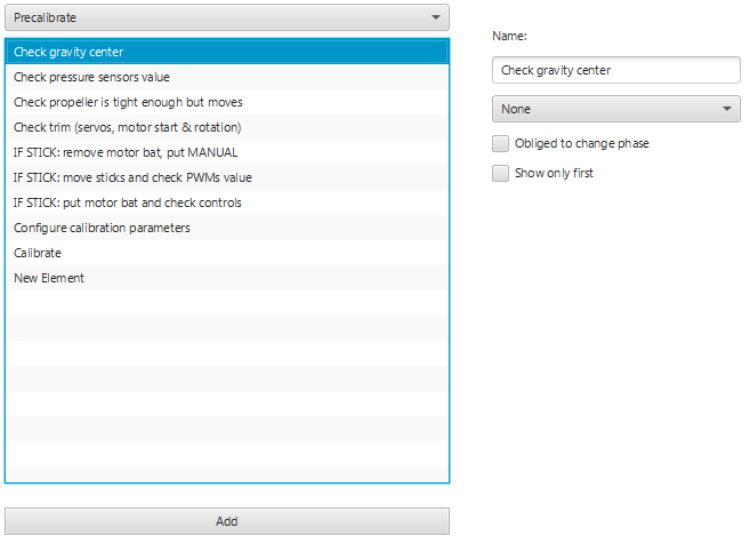


Figure 44: Checklist

Any custom test can be introduced to the checklist for performing customized checks; there are other system checks that can be included by selecting it form the combo box displayed. Main configurable items are described below:

Element	Description
Phase	Select the phase on which the checklist will be shown.
Name	Enter the checklist item name.
System checks	Select from the combo box preconfigured checklist elements.
Obliged to change phase	Select if required for phase change.
Show only first	Select for showing the checklist only once.

Table 20: Checklist Configuration

There are some preconfigured checklist items:

Element	Description
Atmosphere	Calibrate static pressure for altitude estimation (QNH)
Cparams	Enter sensor parameters for calibration
Calibrate	Start calibration (Required prior to Stand By)
Validate Mission	Check mission altitude
Asist GPS	Enter GPS position for quick GPS positioning
Test Servo	Test servos configured on stick
RTK	Enter control station GPS position for better RTK positioning

Table 21: Preconfigured Checklist

3.2.10. HIL

Refer to the HIL Simulator manual in order to configure XPlane parameters for simulation.

3.3. Tunnel UDP

The tunnel UDP allows the user to send data from Veronte autopilot to an external program or application. The system uses the **User Datagram Protocol (UDP)**.

3.3.1. UDP Tunnel menu

UDP Tunnel menu allows the user to select the IP and Port number to send the data from Veronte.

Figure 45: UDP Tunnel Config

3.3.2. UDP Tunnel file

Inside the folder containing Veronte Pipe, the user can find the file ***sa.tudp*** by following the following path:

\resources\UDPTunnel\sa.tudp

In this file we have several options to configure the data sent and format. Next, each of the parts of the file is explained:

Element	Description	Example
Head	User specified the head of UDP packet.	&HEAD 0201000000
LVARS	User can include JavaScript code to previously manage Veronte data.	L0 = false = L0?(u1_1_RVAR_1008 > 60) : (u1_1_RVAR_1008 < 70)
#OFFSET	Position data (in bytes) specified within the UDP package.	1, 2, 3, etc.
LONGITUD	Lengths of the data (in bytes).	1, 2, 4, etc.

MULT	Factor to multiply the input data.	0.01, 10, etc.
OFFSET	Factor to add to the input data.	-10, 100, etc.
TVAR	Type of the data of the output variable.	Float, UInt16, Byte, Int32, Bit
UAV	Address of the autopilot.	255, 1, 2, etc.
MCU	Microcontroller unit. Normally 0.	0, 1.
VERVAR	Type of the data of the impute variable.	RVAR, LVAR, UVAR, BIT, L_EQ, LIMIT, CUSTOM
ID	Number of the variable on Veronte autopilot. See ***Appendix 1***.	1, 2, 6, 1000, etc.
UNIT	Convert the unit of the output variable.	17 (rad to ºC).
DESC	Text to describe the data.	//Airspeed (Knots)

4. WORKSPACE CONFIGURATION

Workspace settings allow user to customize any information to be displayed on the screen for monitoring the operation. Custom workspaces can be created, set any workspace as default in order to open it automatically on system start.

Telemetry toolbar is shown below.

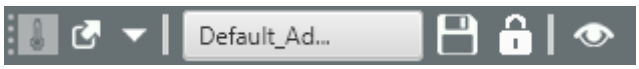


Figure 46: Telemetry Toolbar

	Load	Select the workspace to be displayed or create a new one.
	Save	For saving current telemetry configuration.
	Lock	Configured displays can be moved freely and resized along the screen. Press lock to avoid display free movement.
	Show	Display or hide workspace elements
	Details	Displays any configurable fields.

Table 22: Telemetry Toolbar

When creating a new workspace, the following options are available:

Workspace	Description
Empty	Creates an empty workspace.
Clone	Creates a copy of an existing workspace and permits user to edit it.
Merge	Creates a new workspace by merging any existing workspace.

Table 23: Workspace Creation

The following display items are configurable:

- **Map:** Configure map display items and create extra pop-up maps.
- **Gauge:** Select the variable to be displayed and configure the appearance.
- **Cam:** Configure displayable information on cam.
- **PFD:** Configure Primary Flight Display preferences.
- **Stick:** Configure virtual sticks for manual control.

Each display it permits to select the Veronte unit information to be displayed. Choose “Selected” to display telemetry information from selected Veronte. To select one Veronte unit, click on it at “Veronte panel” or “side panel”.

4.1. Map Display

Map widget permits to configure the background map, select from the available list for setting the main window map.

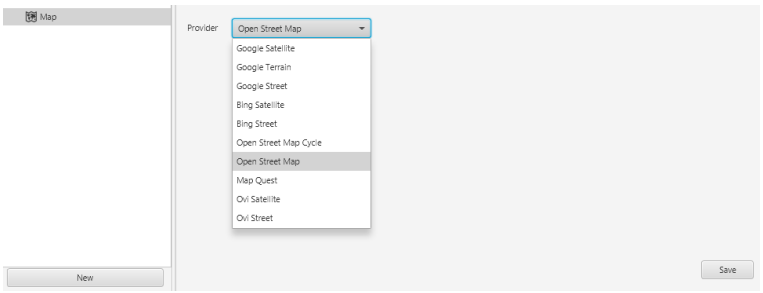


Figure 47: Map Settings

4.1.1. Custom Background Maps

Custom maps can be displayed in Veronte Pipe. It permits to include as many images as desired that will be displayed over the map.

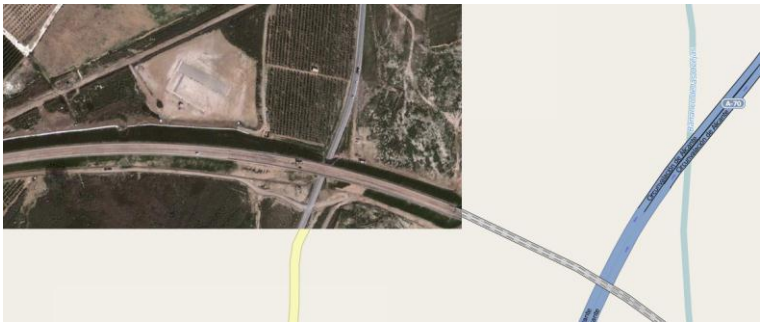


Figure 48: Background image example

In order to insert an image within the map, just drag the image and drop it on the map. A popup window will be displayed to position the image within the map. Click on save to go to the image manager where image coordinates can be entered manually.

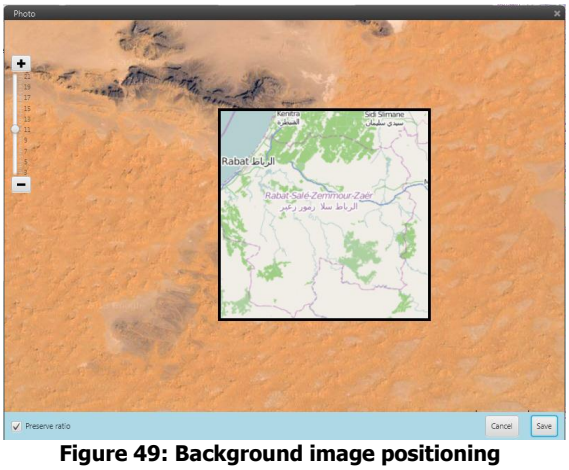


Figure 49: Background image positioning

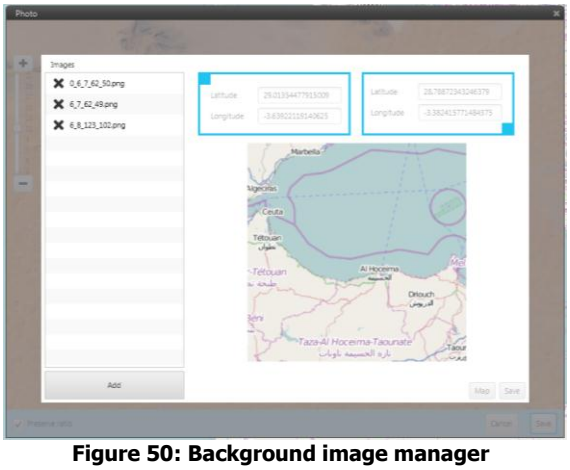


Figure 50: Background image manager

4.2. Gauge Display

Configure drag and drop displays for each telemetry variable and place it at any place on the screen.

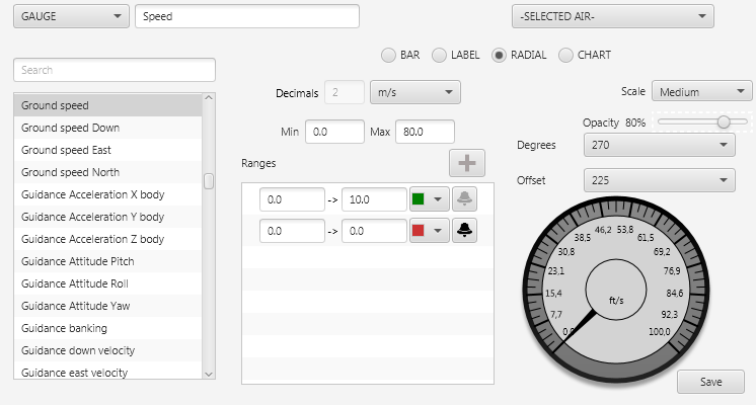
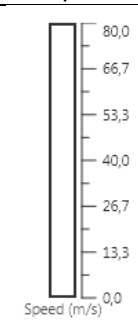
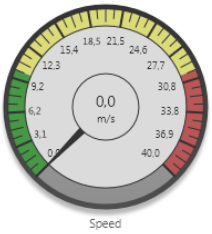


Figure 51: Gauge Configuration

In order to setup a gauge, select the variable to display from the available in the system and configure the display layout. Layout and colours are highly configurable, some gauge examples:

			
Bar	**Label**	**Radial**	**Chart**

4.3. Primary Flight Display

Primary flight display layout is highly configurable in colours and size. User can select the 2D and 3D visualization modes plus to display actuators and control channels.

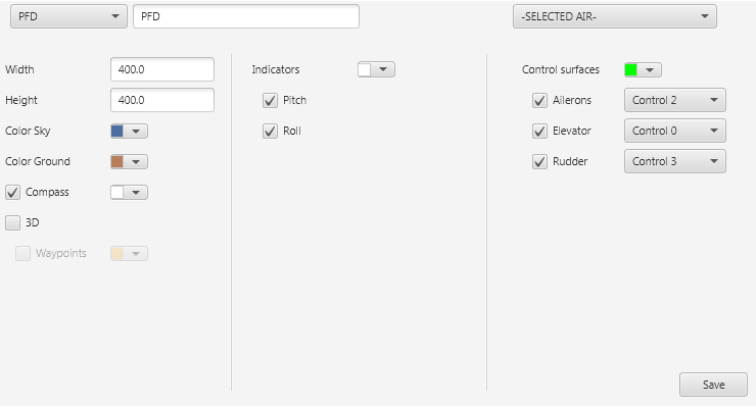


Figure 52:PFD Configuration

Some PFD display configurationas are shown as an example:

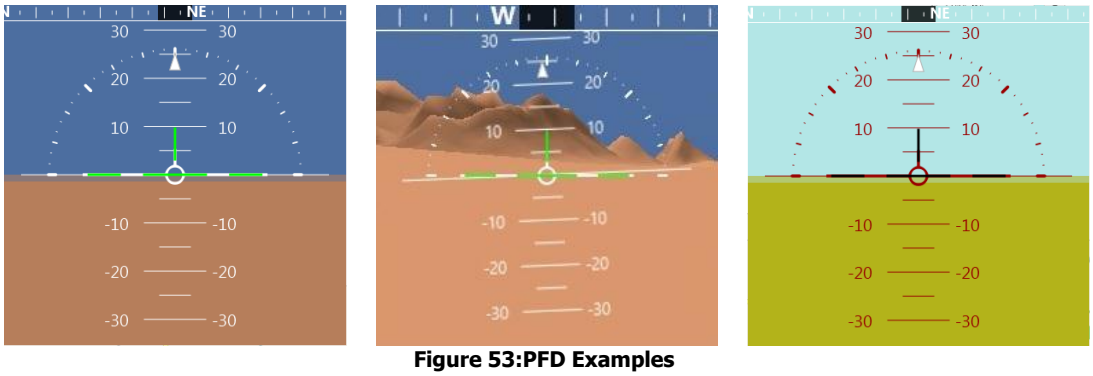


Figure 53:PFD Examples

4.4. Stick

Virtual sticks can also be created for manually control the control channels from the computer. Following setup options are available:

Item	Description
Scale Value	Select the scale to show on the stick.
Stick Channel	Select the channel to control with the stick.
Return	When selected the stick automatically returns to middle position on stick release.

Table 24: Stick Configuration

Configuration panel and drag and drop stick are shown below:

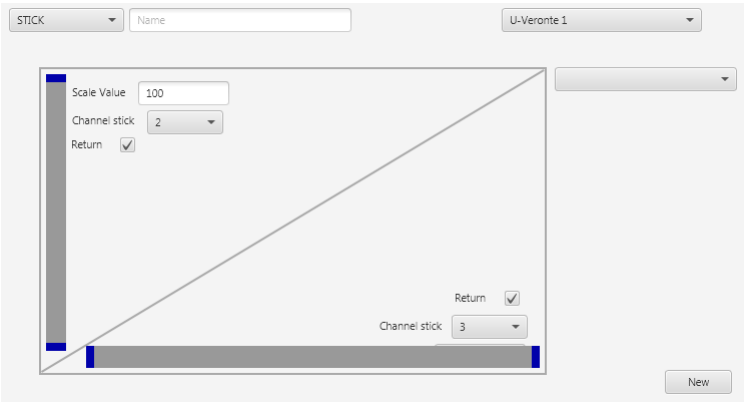


Figure 54: Stick Configuration

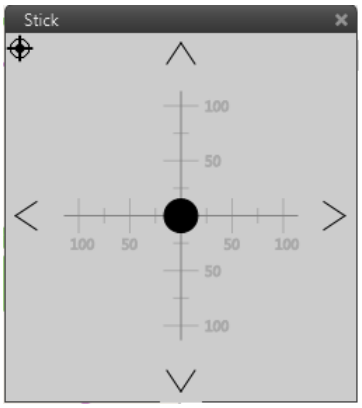


Figure 55: Stick Display

4.5. Cam

Cam display, permits to configure a camera view on Veronte. Video source can be configured as an input device (Video capturer…) or as a network source.

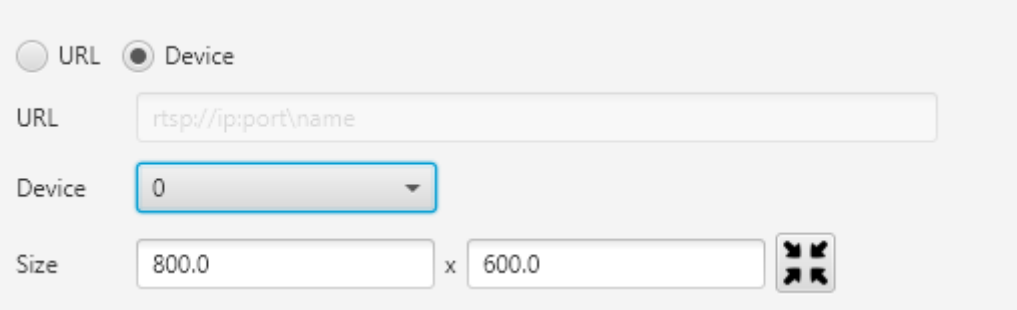


Figure 56:Camera display configuration

4.6. Terrain

Terrain display shows the terrain profile on the platform direction. Visualization configuration options are as follows:

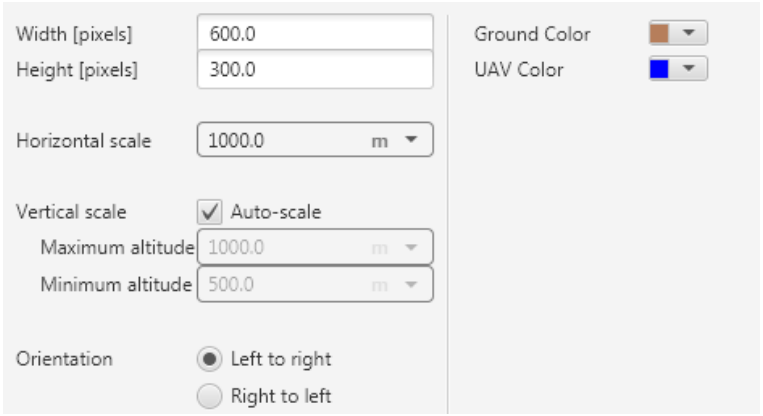


Figure 57: Terrain profile configuration

5. FLIGHT PLAN

For operation planning, the mission toolbar must be used:

Figure 58: Mission Toolbar

Main functions available are:

	Open	Open a mission to edit
	Load	Select mission to edit
	Close	Close loaded mission
	Discard	Discard changes
	Save	Save edited mission
	Sync	Save mission on change
	Select	Select a group of waypoints or targets.
	Add WP	Add new waypoint on click position.
	Polygon	Introduce number of polygon sides and draw it on the map.
	Link	Create and edit links among waypoints.
	Irregular Area	Draw irregular areas on the map for association with polygon events
	Regular Area	Draw regular areas on the map for association with polygon events
	Circular Area	Draw circular areas on the map for association with polygon events
	Mapping	Draw a polygon for mapping applications.
	Ruler	Measure on map.

Table 25: Mission Toolbar

5.1. Waypoint Creation

Use the Add WP tool and press on the map for creating waypoints, a display will appear for entering custom parameters:

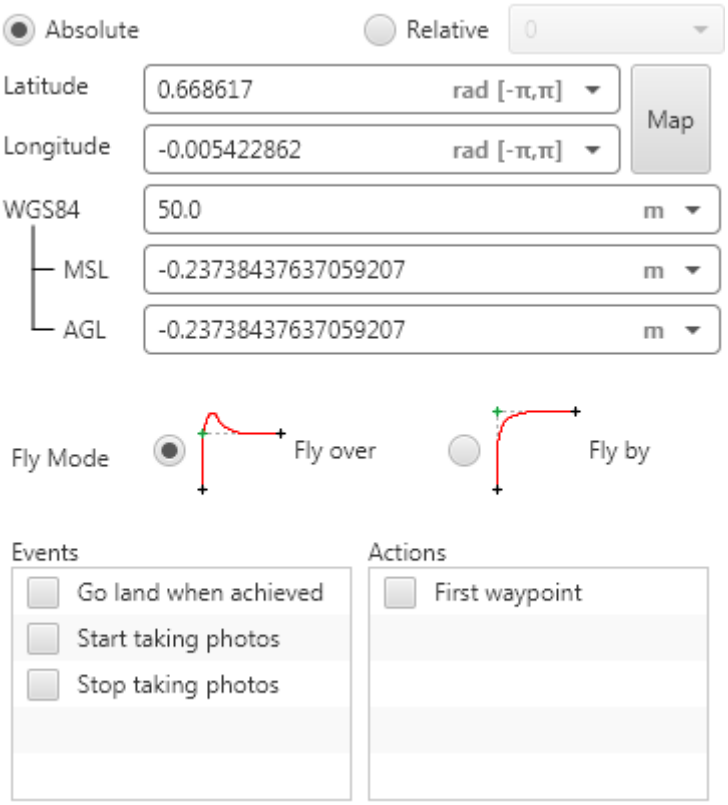


Figure 59: Waypoint Parameters

Item	Description
Mode	• **Absolute:** Fixed GPS position • **Relative:** Relative position to a predefined interest point
Position	GPS coordinates, press map to select on map
Altitude	• **WGS84:** Altitude over the ellipsoid • **MSL:** Mean Sea Level altitude • **AGL:** Above Ground Level
Fly mode	Waypoint achievement mode
Events	Waypoint events configured on automations, mark to activate event on reach
Actions	WP actions configured on automations, mark to start action on reach

Table 26: Waypoint

For moving waypoints, drag it to the desired position. For editing other parameters double-click will display editable fields.

For regular polygon drawing, select the polygon tool and enter the number of desired waypoints then click on the map for drawing:

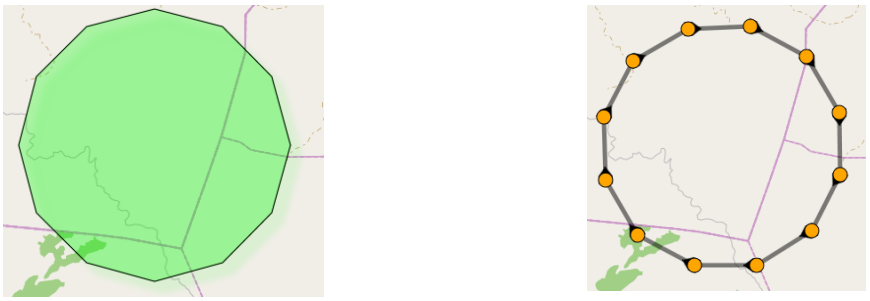


Figure 60: Polygon Creation

After the waypoints have been created, it can be joined creating the desired route with the link tool.

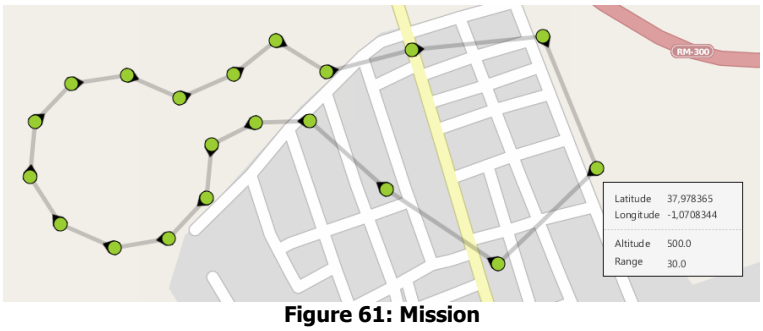


Figure 61: Mission

⚠ **Note:** Each waypoint can have multiple entries but just one output.

5.2. Mapping Tool

Mapping tool permits to draw a polygon on the map and configure camera parameters in order to automatically generate a mapping mission. Select the mapping tool and a display will be shown in order to create a new mission or select one mapping mission already created.

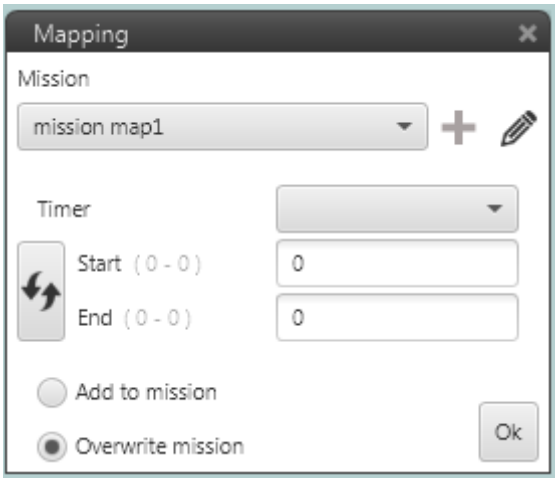


Figure 62: Mapping Mission 1

For creating a new mission, select the desired area for mapping:

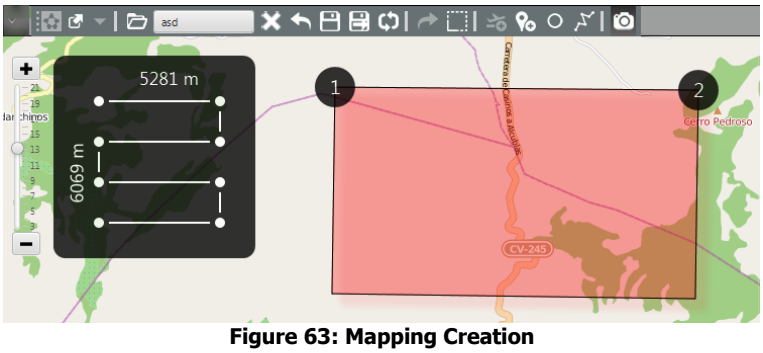


Figure 63: Mapping Creation

Enter the requested parameters so the mission can automatically be generated:

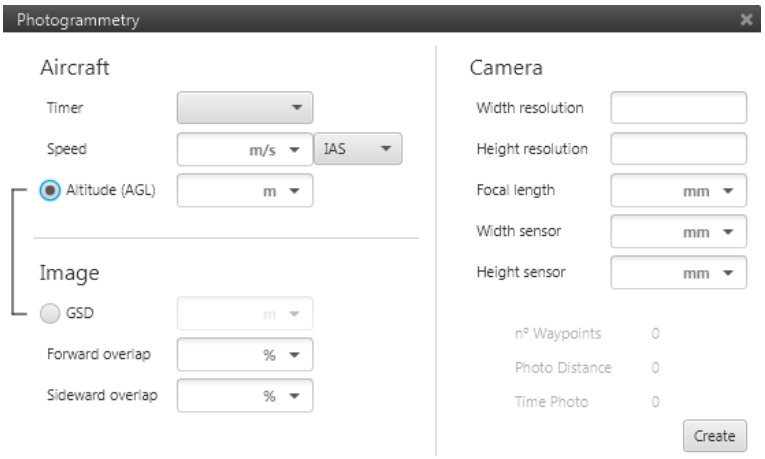


Figure 64: Mapping Parameters

Click on crate and the mission will be generated:

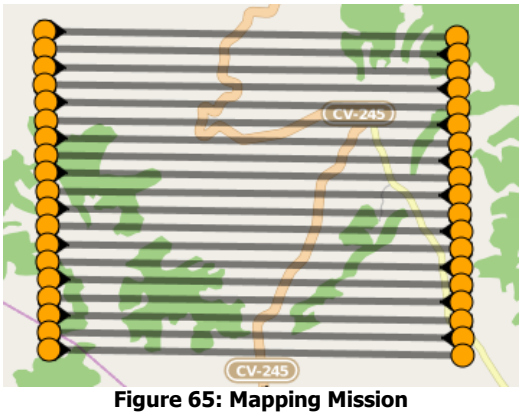


Figure 65: Mapping Mission

Once the mapping mission has been generated, the complete mission or the selected part can be included to the mission on Veronte. Select if the mission must be added to the existing mission (selected on the mission toolbar) or if it must be overwritten and press “Accept” to save it.

6. OPERATION

Once both Veronte units, the one on the control station and the one onboard, are configured and the mission has been loaded to the aircraft, the system is ready to start the mission. A list with linked Veronte units is displayed on the side panel. This display shows information and warnings.

Figure 66: Side Panel

Click on any Veronte to display Veronte Panel; it permits to control any telecommand actions.

Figure 67: Veronte Panel

Current phase is marked in green, select one of the blue phases to change to phase manually. In order to change phases all required checklist elements must be completed. In order to enter a phase there are two options. By clicking on the phase name the system will enter on the phase with the preconfigured parameters, click on the settings button on the right for entering to the flight phase changing the phase parameters. The view icon enables the visualization of the phase on the screen.

Phase parameters can also be configured on the control tab on the setup menu. Dependencies between phases and automatic phase transitions are configured on the automations panel.

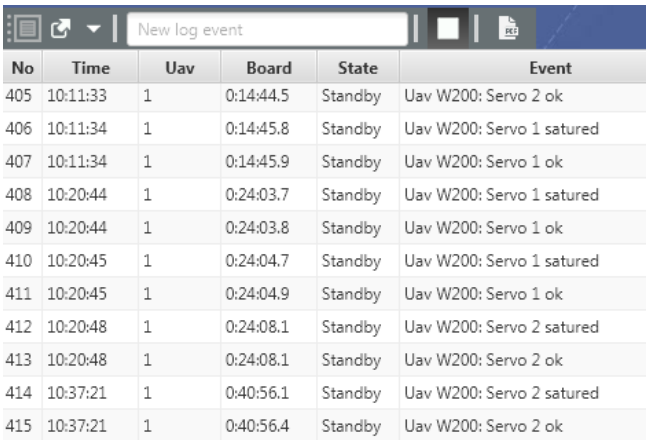
During the operation, the following actions can be performed:

- **Flight monitoring:** Flight data can be monitored on the control station using telemetry displays. Telemetry display configuration can be edited during the flight.
- **Edit mission:** Mission can be edited prior or during the flight.
- **Change phase:** Phases permit to set the vehicle configuration to a specific performance. Click on a phase to initiate this phase.

- **Activate manual / assisted manual modes:** By pressing the preconfigured joystick button or selecting manual in Veronte panel, it is possible to control the aircraft in manual mode. Once the manual mode is deactivated it will continue in automatic mode, continuing with preconfigured route.
- **Abort mission:** ´Go Home´ button can be configured to appear in the Veronte panel. It can be configured on the automations panel.

7. Log

Log toolbar shows recorded events and permits to introduce custom events to be saved. Introduce event information and press enter to record it on the log.



No	Time	Uav	Board	State	Event
405	10:11:33	1	0:14:44.5	Standby	Uav W200: Servo 2 ok
406	10:11:34	1	0:14:45.8	Standby	Uav W200: Servo 1 satured
407	10:11:34	1	0:14:45.9	Standby	Uav W200: Servo 1 ok
408	10:20:44	1	0:24:03.7	Standby	Uav W200: Servo 1 satured
409	10:20:44	1	0:24:03.8	Standby	Uav W200: Servo 1 ok
410	10:20:45	1	0:24:04.7	Standby	Uav W200: Servo 1 satured
411	10:20:45	1	0:24:04.9	Standby	Uav W200: Servo 1 ok
412	10:20:48	1	0:24:08.1	Standby	Uav W200: Servo 2 satured
413	10:20:48	1	0:24:08.1	Standby	Uav W200: Servo 2 ok
414	10:37:21	1	0:40:56.1	Standby	Uav W200: Servo 2 satured
415	10:37:21	1	0:40:56.4	Standby	Uav W200: Servo 2 ok

Figure 68: Log Toolbar

Record button permits to stop capturing log information. By clicking on REC, a new log saving will start.

It is possible to generate a PDF reports containing saved log information. Click on the “Report” icon and enter requested information to generate the report.

Figure 69: Report Information

8. POST-FLIGHT

Once the mission is finished, the operator can download telemetry data from Veronte to perform a virtual tour. Use the post flight toolbar:

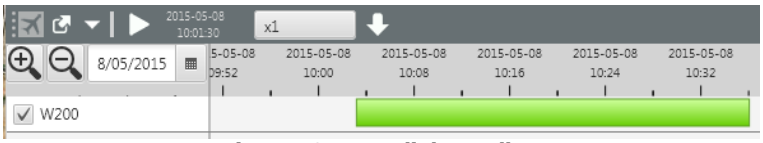


Figure 70: Post Flight Toolbar

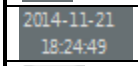
	**Play / Pause**	Manage tour play.
	**Time**	Control the time progress.
	**Speed**	To speed up the tour.
	**Export**	Download Veronte files and export data

Table 27: Post Flight Toolbar

8.1. Data export

Flight data stored in Veronte Pipe is saved at a low frequency, in order to improve the tour accuracy it is possible to download the information on the autopilot by using the download button. This panel permits also to erase data from both Veronte Autopilot and the system.

Select the Veronte unit for data downloading and choose the flight files to be download. Right panel will show file download progress.

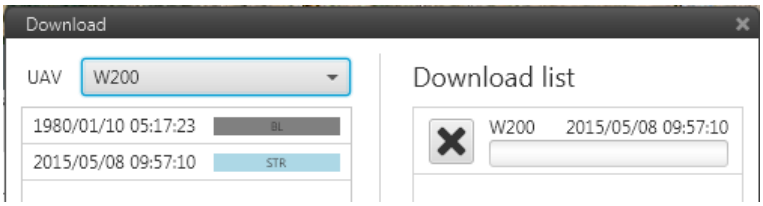


Figure 71: Data Export

8.2. Tour

Flight data can be played on Veronte Pipe permitting to display all available flight information as done during the flight.

In order to play a tour, select the date and mark the Veronte Autopilot information to be played, flight data available will be shown on the timeline.

9. APPENDIX 1

The number ID of the most important variables of the Veronte autopilot and their description are shown in the following table:

Type	ID	Description
RVAR	0	Desired IAS (Indicated Air Speed)
	1	IAS (Indicated Air Speed)
	2	Desired TAS (True Air Speed)
	3	TAS (True Air Speed)
	4	Desired GS (Ground Speed)
	5	GS (Ground Speed)
	6	Desired Heading
	7	Heading
	8	Desired Flight Path Angle
	9	Flight Path Angle
	10	Desired Bank
	11	Bank
	12	Desired Yaw
	13	Yaw
	14	Desired Pitch
	15	Pitch
	16	Desired Roll
	17	Roll
	18	Desired Along-Track Position Error
	19	Along-Track Position Error
	20	Desired Cross-Track Error
	21	Cross-Track Error
	22	Desired Vertical Error
	23	Vertical Error
	24	MSL (Height Above Mean Sea Level) - Altitude
	25	AGL (Above Ground Level) – Height
	26	Desired Roll Rate
	27	Roll Rate
	28	Desired Pitch Rate
	29	Pitch Rate
	30	Desired Yaw Rate
	31	Yaw Rate
	32	Desired Forward Acceleration – X body axis
	33	Forward Acceleration – X body axis

	34	Desired Right Acceleration – Y body axis
	35	Right Acceleration – Y body axis
	36	Desired Bottom Acceleration – Z body axis
	37	Acceleration Bottom – Z body axis
	38	Desired RPM
	39	RPM
	40-48	Control Output u1-u9
	51	Time since hardware start-up
	52	Longitude
	53	Latitude
	54	WGS84 Elevation (Height Over The Ellipsoid)
	55	GS (Ground Speed) North
	56	GS (Ground Speed) East
	57	GS (Ground Speed) Down
	58	Sensor IAS (Indicated Air Speed)
	59	Angle Of Attack – AoA
	60	Sideslip
	61	Accelerometer - X body axis
	62	Accelerometer - Y body axis
	63	Accelerometer - Z body axis
	64	Gyroscope - X body axis
	65	Gyroscope - Y body axis
	66	Gyroscope - Z body axis
	67	Magnetometer - X body axis
	68	Magnetometer - Y body axis
	69	Magnetometer - Z body axis
	70	Power Input
	71	Analog Input
	82	Pitot Dynamic Pressure
	83	Barometric Static Pressure
	84	Internal Temperature
	94-105	PWM 1-12
	108	Radar AGL (Above Ground Level) – Height
	109	Radar Ground Speed Up
	112-127	Stick Input r1-r16
	128-143	Stick Input y1-y16
	150	Used Memory Space
	151	Free Memory Space
	180-189	Clock 1-10

	190	Desired GS (Ground Speed) North
	191	Desired GS (Ground Speed) East
	192	Desired GS (Ground Speed) Down
	193	Front GS (Ground Speed)
	194	Lateral GS (Ground Speed)
	195	Desired Front GS (Ground Speed)
	196	Desired Lateral GS (Ground Speed)
	202	GPS ECEF Position X
	203	GPS ECEF Position y
	204	GPS ECEF Position z
	205	GPS Velocity North
	206	GPS Velocity East
	207	GPS Velocity Down
	208	Desired MSL (Height Above Mean Sea Level) - Altitude
	209	Desired AGL (Above Ground Level) – Height
	210	Desired WGS84 Elevation (Height Over The Ellipsoid)
	211	Velocity - X body axis
	212	Velocity - Y body axis
	213	Velocity - Z body axis
	214	GPS Accuracy
	215	GPS Time of Week
	216	Estimated Dynamic Pressure
	217	Barometric Pressure at Sea Level (QNH)
	220-228	Stick Input u1-u9
	229-238	Stick Input d1-d9
	272	Longitudinal (Forward) Load Factor - X body axis
	273	Lateral (Right) Load Factor – Y body axis
	274	Vertical (Bottom) Load Factor - Z body axis
	275	Desired Longitudinal (Forward) Load Factor - X body axis
	276	Desired Lateral (Right) Load Factor – Y body axis
	277	Desired Vertical (Bottom) Load Factor - Z body axis
	278	RX Datalink Error Rate
	279	TX Datalink Error Rate
	292	Accelerometer bias - X body axis
	293	Accelerometer bias - Y body axis
	294	Accelerometer bias - Z body axis
	295	Gyroscope bias - X body axis
	296	Gyroscope bias - Y body axis
	297	Gyroscope bias - Z body axis

	300-331	Actuator Output s1/32
	400-431	Distance to Object of Interest 1 - 32
	800	Wind Velocity North
	802	Wind Velocity East
	803	Wind Velocity Down
	804	Wind Velocity North Estimation Covariance
	900-999	X-plane simulation variables
	1000-1099	Custom Variable 1 (single precision) 1 - 100
	2000	No selected variable
BIT	**0**	No code value
	3	GPS navigation code
	4	Fdr not writing code
	5	Ready to fly code
	6	File system code
	8	Georeference code
	9	CAN A RX code
	10	CAN B RX code
	11	CAP A code
	12	CAP B code
	13	SCI A code
	14	SCI B code
	15	SCI C code
	16	McBSP (Multichannel buffer) code
	17	Stick receive watchdog
	18	CAN A TX code
	19	CAN B TX code
	20-31	SERVO 1 -12 code
	32	EKF: Cholesky inverse code
	33	EKF: Inverse; condition number code
	35	System general start up BIT code
	53	Power A BIT code
	54	Power B BIT code
	62	Task 0 real time error
	63	Task 1 real time error
	64	Task 2 real time error
	65	Task 3 real time error
	66	Task 4 real time error
	67	Calibration step not completed yet
	1000-1999	User bit

	2000	No selected BIT
UVAR	**0**	Control Mode
	1	Mission Phase ID
	2 -17	ADC Channel 1-16
	18	Next Waypoint
	19	Last Achieved Waypoint
	20-51	GPS Satellite
	52	Radar Status
	900-909	Simulation variables
	1000-1099	Custom Variable 1-100 (16 bits)
STR	**0**	Link quality
	1	Guidance path currently active
	2	Go home mitigation status
	3	Parachute mitigation status
	4	Set auto mitigation status
	5	Climb mitigation status
	6	Cut engines mitigation status
	7	Link quality of his pair
	9	Position
	10-41	Object of interest i