



Virtual simulator
UAV Piloting

User
manual



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Terms and Definitions

The term	Definition
UAV	Unmanned Aerial Vehicle
Camera	A virtual tool invisible to the user, with the help of which he observes everything that happens in the Simulator
Roll	Rotational motion of the UAV around the longitudinal axis. Making a roll, the UAV tilts and flies to the right/left
Workspace	The area of the scene in which range features are located and the user interacts with them
Yaw	Rotational motion of the UAV around the vertical axis. When yawing, it rotates clockwise / counterclockwise
Simulation	The process of interaction of objects in three-dimensional space simulated in the Simulator
Stick	The control device of the game controller is in the form of a lever, the mobility of which is limited by two degrees of freedom
Stage	A virtual three-dimensional space within which the user can interact with objects. The concept of "scene" also includes current data (position of objects, their parameters, etc.)
Pitch	Rotational motion of the UAV around the transverse (or lateral) axis. Making a pitch, the UAV tilts and flies forward/backward
Simulator	Application "Virtual simulator "UAV piloting", section "Flight simulation for the initial level of training"

1 General information

The application "Virtual simulator "UAV piloting", section "Flight simulation for the initial level of training" (hereinafter referred to as the Simulator) is a virtual space with a set of components and mechanics of interaction with these components and allows the user to develop skills in controlling an unmanned aerial vehicle (hereinafter referred to as the UAV).

The simulator provides the following features:

- performing flights in free mode in arbitrarily selected conditions on UAVs of multirotor, aircraft or hybrid type;
- performance of flights in scenario mode along predetermined routes and tasks to master the basic skills of piloting UAVs of each presented type;
- conducting training in closed and open spaces;
- selection of flight space from a preset list;
- selection of the UAV model for flight from the preset list;
- training according to scenarios to master the basic skills of piloting UAVs;
- conducting pre-flight preparation for UAVs of each type presented;
- construction of closed spaces using elements of the environment;
- configuration of UAV parameters;
- monitoring of flight telemetry through the dashboard;
- telemetry display control — enable/disable specific parameters;
- control of the UAV through a keyboard, gamepad, professional control panel with the possibility of personal configuration;
- changes in weather conditions in free mode.

2 System Requirements

System requirements for the operation of the application "Virtual simulator "UAV piloting", section "Flight simulation for the initial level of training":

- **processor:** Intel Ivy Bridge series / AMD Bulldozer series, Apple Silicon M1 and newer;
- **RAM:** 8 GB or more;
- **graphics Card:**
 - integrated: Intel HD Graphics 5000 / Intel Iris and newer;
 - discrete: GeForce 400 series or newer / Radeon HD 7000 series or newer;
- **screen resolution:** 1920x1080 / 1920x1200 and more (4K and Retina screens require a graphics card with more power for comfortable work);
- **supported browsers:** Chrome, Yandex.Browser, Opera 44+, Firefox 51+, Edge 79+, Safari 15+;
- **supported operating systems:**
 - Microsoft Windows 10 (x64 versions) or higher with WebGL 2.0 driver support;
 - MacOS X Snow Leopard 10.6 or higher with WebGL 2.0 driver support;
 - Linux or Debian with WebGL 2.0 driver support.

3 Control devices

The following types of control devices can be used in the Flight Control Simulator:

- keyboard (see [3.1 «Keyboard Control»](#));
- Xbox and PlayStation series controllers (see [3.2 «PS DualSense control»](#), [3.3 «XBOX Wireless Controller Control »](#));
- professional control panels (see [3.4 «Professional Remote Control»](#)):
 - RadioMaster Pocket M2 (ELRS) and compatible models;
 - FlySky FSi6S and compatible models.

The preset controls are values by default and can be reassigned in the control settings (see [10.1.1 «Control Settings»](#)).

The axis designations of the sticks are shown in the Figure 101.

3.1 Keyboard Control

In the table 1 UAV control commands and keys for launching these commands from the keyboard are given.

Table 1 – UAV control keys from the keyboard

Team	Default Control Keys	Result
Turning on/off the UAV	Y	The first press — the motors start, the second press — the motors turn off
Arm/Disarm (unlocking/locking the engines)	Enter	The first press — the motors are unlocked, the second press — the motors are locked
Mode switching (ACRO/ANGLV/ANGL)	PageUp	The modes are switched at the touch of a button in order. The mode at the start of the simulation is ANGLV, unless otherwise specified in the task
Switching the camera	C	The mode at the start of the simulation (unless otherwise assigned to the mode) is FPV. The modes are switched at the touch of a button in order: – First Person View (FPV) mode; – tracking mode; – mode from the operator; – rear camera.
Throttle (height control)	W or ↑	UAV gains altitude
	S or ↓	UAVs descend
Yaw (rotation on its axis)	D or →	The UAV rotates counterclockwise
	A or ←	The UAV rotates clockwise
Pitch (flight forward/backward)	I	The UAV leans forward and flies forward
	K	The UAV leans backwards and flies backwards
Roll (flying sideways left/right)	J	The UAV tilts to the left and flies to the left
	L	The UAV tilts to the right and flies to the right

Team	Default Control Keys	Result
Hybrid		
Switching to Airplane/Multirotor (Copter) Mode	O	The modes are switched every time the button is pressed. Simulation start mode — multirotor (copter)
Aircraft		
Starting from the plant	Q	The plane is launched
Parachute release	E	The parachute is released

Limitations on the set of keyboard keys that can be assigned:

- Letter keys: A–Z;
- Special keys:], [, :, ", , /, \;
- Numeric keys (top panel): 0 – 9, -, =;
- Numeric keys (additional panel): 0 – 9;
- Special keys: arrow keys, spacebar, Enter.

3.2 PS DualSense control

Controller controls PS are presented in the Figure 1.



Figure 1 – PS controller controls

In the table 2 provides UAV control commands and controls for launching these commands with the gamepad PS DualSense.

Table 2 – Controls of the PS DualSense UAV

Team	Default Control Buttons/Sticks	Designation in the control settings	Result
Turning on/off the UAV	UAV On/Off	JOYSTICKBUTTON0	The first press — the motors start, the second press — the motors turn off

Team	Default Control Buttons/Sticks	Designation in the control settings	Result
Arm/Disarm (unlocking/locking the engines)	Bringing the sticks together in the middle and down 		First aim – engines unlock, First aim – engines lock
Mode switching (ACRO/ANGLV/ANGL)	ACRO/ ANGLV/ ANGL	JOYSTICKBUTTON1	The modes are switched at the touch of a button in order. The mode at the start of the simulation is ANGLV, unless otherwise specified in the task
Switching the camera	Switching the camera	JOYSTICKBUTTON3	The mode at the start of the simulation (unless otherwise assigned to the mode) is FPV. The modes are switched at the touch of a button in order: – First Person View (FPV) mode – tracking mode; – mode from the operator; – rear camera.
Throttle (height control)	LS ax Y	A2 (Invert)	UAV climbing/descending
Yaw (rotation on its axis)	LS ax X	A1	The UAV rotates clockwise/counterclockwise
Pitch (flight forward/backward)	RS ax Y	A5 (Invert)	UAV leans forward and flies forward/leans backwards and flies backwards
Roll (flying sideways left/right)	RS ax X	A4 (Invert)	The UAV tilts to the left and flies left/right and flies to the right
Hybrid			
Switching to Airplane / Multirotor (Copter) Mode	Airplane/Copter Mode	JOYSTICKBUTTON2	The modes are switched every time the button is pressed. Simulation Start Mode — Multirotor (Copter)
Aircraft			
Starting from the plant	Starting from the plant	JOYSTICKBUTTON5	The plane is launched
Parachute release	Release the parachute	JOYSTICKBUTTON4	The parachute is released

3.3 XBOX Wireless Controller Control

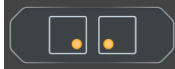
Controller controls XBOX Wireless Controllers are shown in the Figure 2.



Figure 2 – XBOX Wireless Controller controls

In the table 3 UAV control commands and controls for launching these commands from XBOXWireless Controller.

Table 3 – Controls of the XBOX Wireless Controller UAV

Team	Default Control Buttons/Sticks	Designation in the control settings	Result
Turning on/off the UAV	UAV On/Off	JOYSTICKBUTTON0	The first press – the motors start, the second press – the motors turn off
Arm/Disarm	Bringing the sticks together in the middle and down 		First aim – engines unlock, First aim – engines lock
Mode switching (ACRO/ANGLV/ ANGL)	ACRO/ ANGLV/ ANGL	JOYSTICKBUTTON1	The modes are switched at the touch of a button in order. The mode at the start of the simulation is ANGLV, unless otherwise specified in the task
Switching the camera	Switching the camera	JOYSTICKBUTTON3	The mode at the start of the simulation (unless otherwise assigned to the mode) is FPV. The modes are switched at the touch of a button in order: – First Person View (FPV) mode – tracking mode; – mode from the operator; – rear camera
Throttle (height control)	LS ax Y	A2 (Invert)	UAV climbing/descending
Yaw (rotation on its axis)	LS ax X	A1	The UAV rotates clockwise/counterclockwise
Pitch (flight forward/backward)	RS ax Y	A5 (Invert)	UAV leans forward and flies forward/leans backwards and flies backwards
Roll (flying sideways left/right)	RS ax X	A4 (Invert)	The UAV tilts to the left and flies left/right and flies to the right

Team	Default Control Buttons/Sticks	Designation in the control settings	Result
Hybrid			
Switching to Airplane/Multirotor Mode	Airplane Mode/Copter	JOYSTICKBUTTON2	The modes are switched every time the button is pressed. Simulation Start Mode — Multirotor
Aircraft			
Starting from the plant	Starting from the plant	JOYSTICKBUTTON5	The plane is launched
Parachute release	Release the parachute	JOYSTICKBUTTON4	The parachute is released

3.4 Professional Remote Control

The controls of the RadioMaster Pocket M2 professional remote control (ELRS) are shown in the Figure 3.



Figure 3 – Controls of a professional remote control

In the table 4 UAV control commands and controls for launching these commands from the control panel, as well as keys for launching these commands from the keyboard are given. The keyboard is recommended if the professional remote control you are using does not have buttons to execute any commands.

Table 4 – UAV controls with a professional remote control

Team	Default Control Keys	Default Control Buttons/Sticks	Designation in the control settings	Result
Inclusion/UAV shutdown	Y	UAV On/Off	—	The first press — the motors start, the second press — the motors turn off

Team	Default Control Keys	Default Control Buttons/Sticks	Designation in the control settings	Result
Arm/Disarm (Engine Lock/Unlock)	Enter	Bringing the sticks together in the middle and down 	Blocked	The first press — the motors are unlocked, the second press — the motors are locked
Mode switching (ACRO/ ANGLV/ ANGL)	PageUp	ACRO/ ANGLV/ ANGL	—	Switching modes by pressing a button in order. The mode at the start of the simulation is ANGLV, unless otherwise specified in the task
Switching the camera	C	Switching the camera	—	The mode at the start of the simulation (unless otherwise assigned to the mode) is FPV. Switching modes by pressing the button in order: – First Person View (FPV) mode – tracking mode; – mode from the operator; – rear camera.
Throttle (height control)	W or ↑ S or ↓	LS ax Y	A3	UAV climbing/descending
Yaw (rotation on its axis)	D or → A or ←	LS ax X	A4	The UAV rotates clockwise/counterclockwise
Pitch (flight forward/backward)	I K	RS ax Y	A2	UAV leans forward and flies forward/leans backwards and flies backwards
Roll (flying sideways left/right)	J L	RS ax X	A1 (Invert)	The UAV tilts to the left and flies left/right and flies to the right
Hybrid				
Switching to Airplane/Multicopter Mode	O	—	JOYSTICKBUTTON1	Switch between modes every time you press a button. Simulation Start Mode — Multirotor
Aircraft				
Starting from the plant	Q	—	JOYSTICKBUTTON0	The plane is launched
Parachute release	E	—	JOYSTICKBUTTON1	The parachute is released

4 Types of UAVs

This Simulator uses 3 types of UAVs:

- multi-rotor;
- aircraft;
- hybrid.

The display and parameters of each type of UAV are given in the selection block and on the UAV cards (see [8.2 «UAV selection and configuration unit»](#)).

4.1 Multi-rotor UAV

Multicopter-type UAVs are divided by the number of motors into:

- quadcopters (Figure 4);
- hexacopters (Figure 5);
- octocopters (Figure 6).

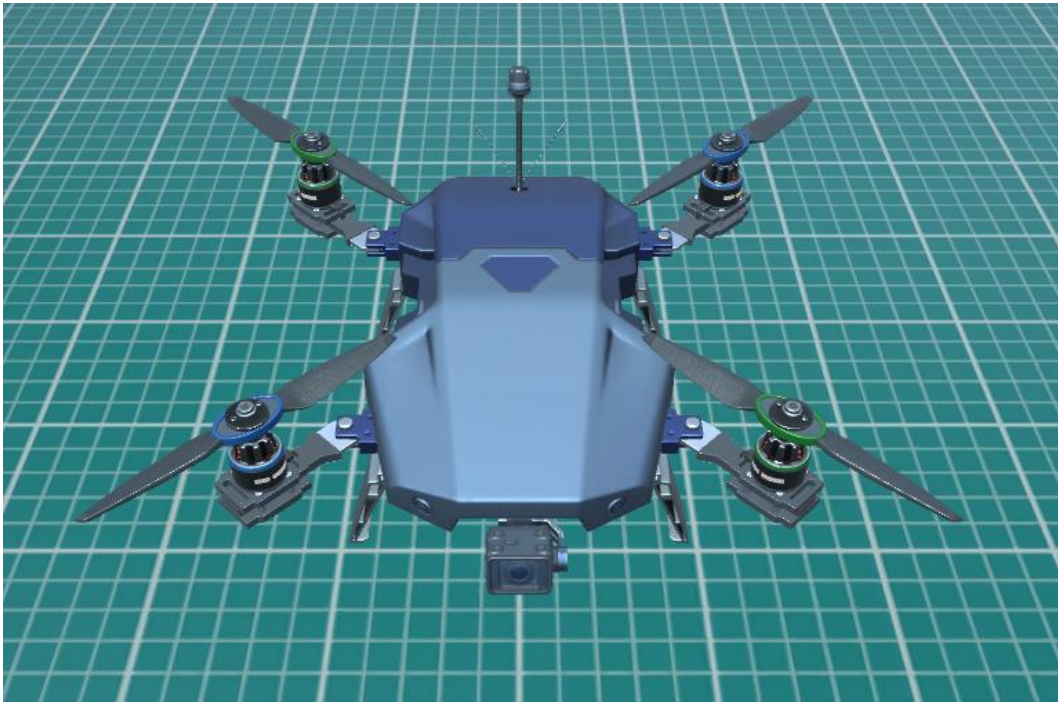


Figure 4 – An example of a multi-rotor UAV with 4 motors Quad-350

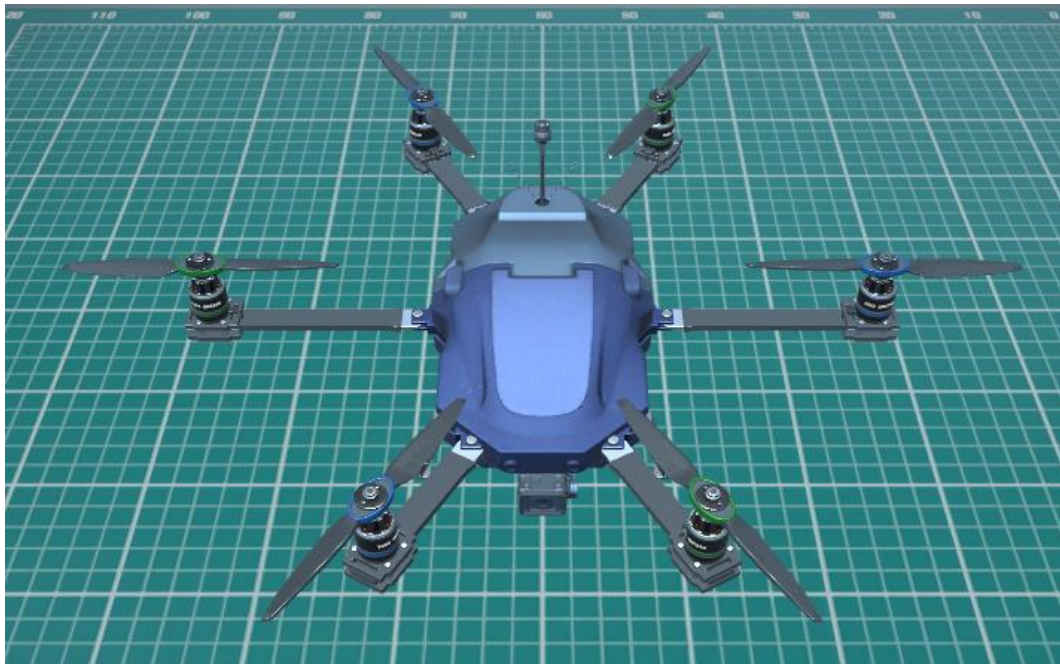


Figure 5 – Example of a multi-rotor UAV with 6 motors Hexa-500



Figure 6 – Example of a multi-rotor UAV with 8 motors Octo-900

4.2 Aircraft-type UAV

Aircraft-type UAV Airplane 1 (Figure 7) and Airplane 2 (Figure 8) are designed to perform aerial photography work on vast territories.

The aircraft are not used in the closed range due to their high speed.



Figure 7 – Airplane 1

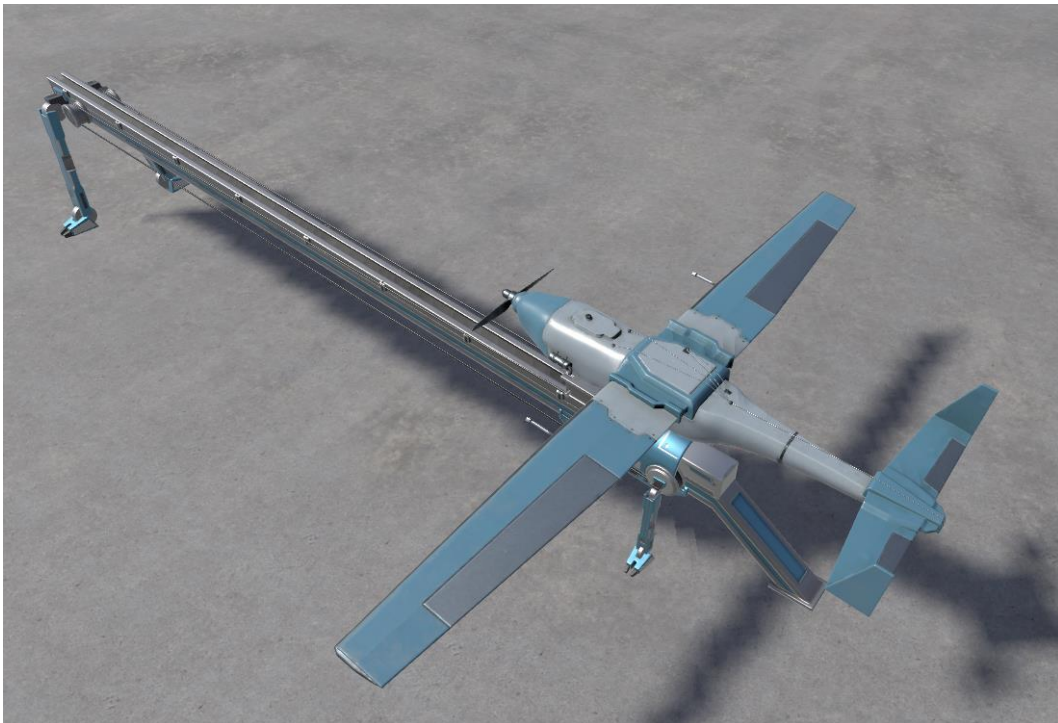


Figure 8 – Airplane 2

4.2.1 Launcher

Aircraft-type UAVs are launched using a launcher. There are rods on its body, with the help of which the device is fixed before launch.

Dimensions of the launcher:

- length: 5.5 m,
- height: 0.5-0.8 m.

4.2.2 Parachute system

The parachute system consists of a parachute compartment and a parachute. The folded parachute is placed in a specialized compartment (Figure 9).

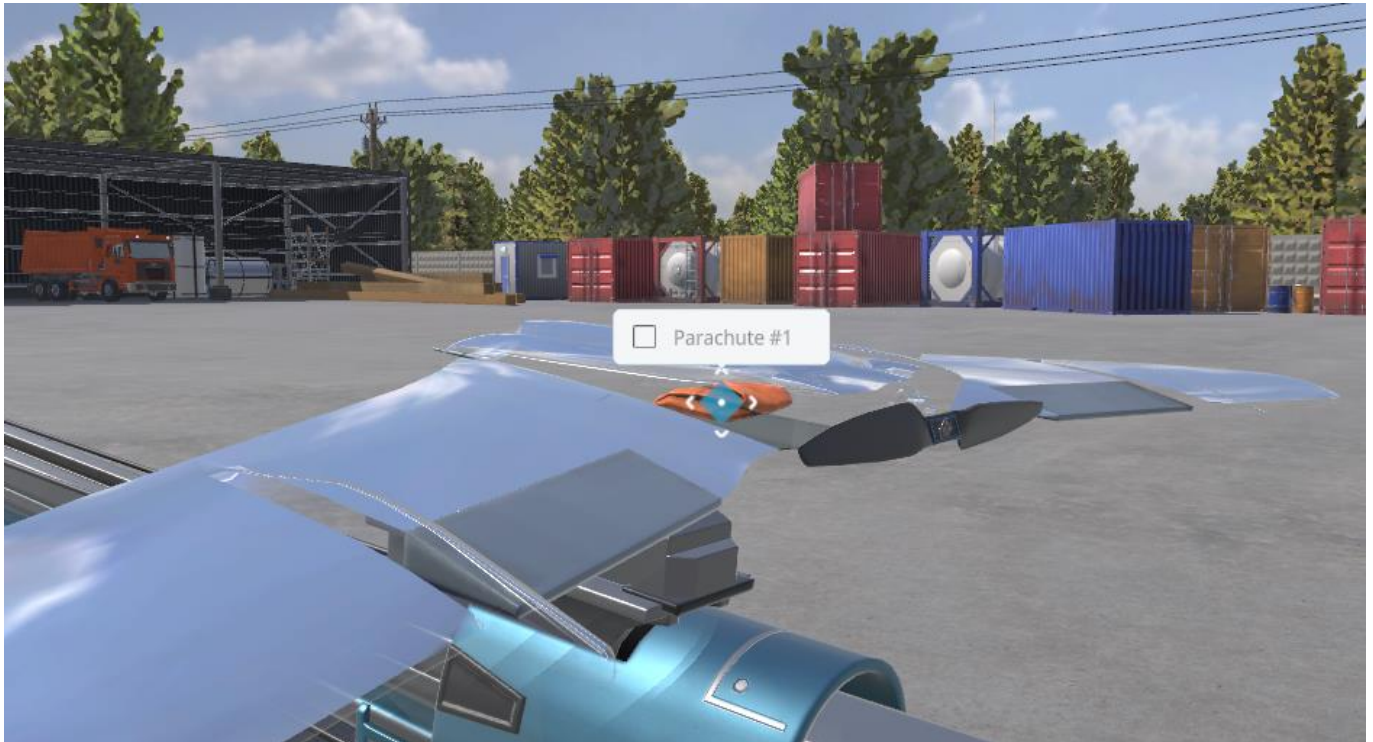


Figure 9 – Parachute system

4.3 Hybrid-type UAV

UAV of hybrid type Hybrid 1 (Figure 10) — it is a UAV with the ability to take off and land vertically, as well as hover over a selected point. The UAV is controlled in both manual and autonomous mode, which allows you to automatically take off, move along a set trajectory and land.

Hybrids are not used in a closed range due to their high speed, size and maneuverability.



Figure 10 – Hybrid 1

5 Camera

Outside of the piloting state (when selecting a scene, UAV, pre-flight preparation, in the scene constructor), the user can use the mouse to inspect the UAV from all sides, namely:

- to bring the camera closer to the UAV, you should rotate the mouse wheel away from you, to move it away — towards you;
- to rotate the camera around the UAV (up to full all-round view), raise it above the floor or lower it, hold down the right mouse button and move the mouse in the desired direction.

In piloting condition the Simulator has four camera modes that can be switched sequentially using the keys and buttons that are defined for the "Switch Camera Mode" field (see 3 «Control devices»):

- Tracking mode — the camera is not tied to the UAV, but follows it. A third-person user watches a UAV (Figure 11).



Figure 11 – Tracking mode – the camera is not tied to the UAV, but follows it

- Operator Mode — camera is not tied to the UAV. The user watches the UAV like an operator standing at a specific point in a range (LOS — Line of Sight). The camera is located at the height of the person (Figure 12).



Figure 12 – Operator's mode — the camera is fixed at one point of the range

- "Rear camera" mode — the camera is fixed behind the UAV (as if on a boom) and moves with the UAV (Figure 13).



Figure 13 – "Rear camera" mode — the camera is fixed behind the UAV

- The camera was recorded in front of the UAV. The user observes everything that happens on the range from the first First Person View (FPV) (Figure 14).



Figure 14 – FPV mode – camera fixed in front of the UAV

In the cell FPV has the ability to adjust the settings (see [8.2.2 «FPV System Unit»](#)).

6 Main Menu

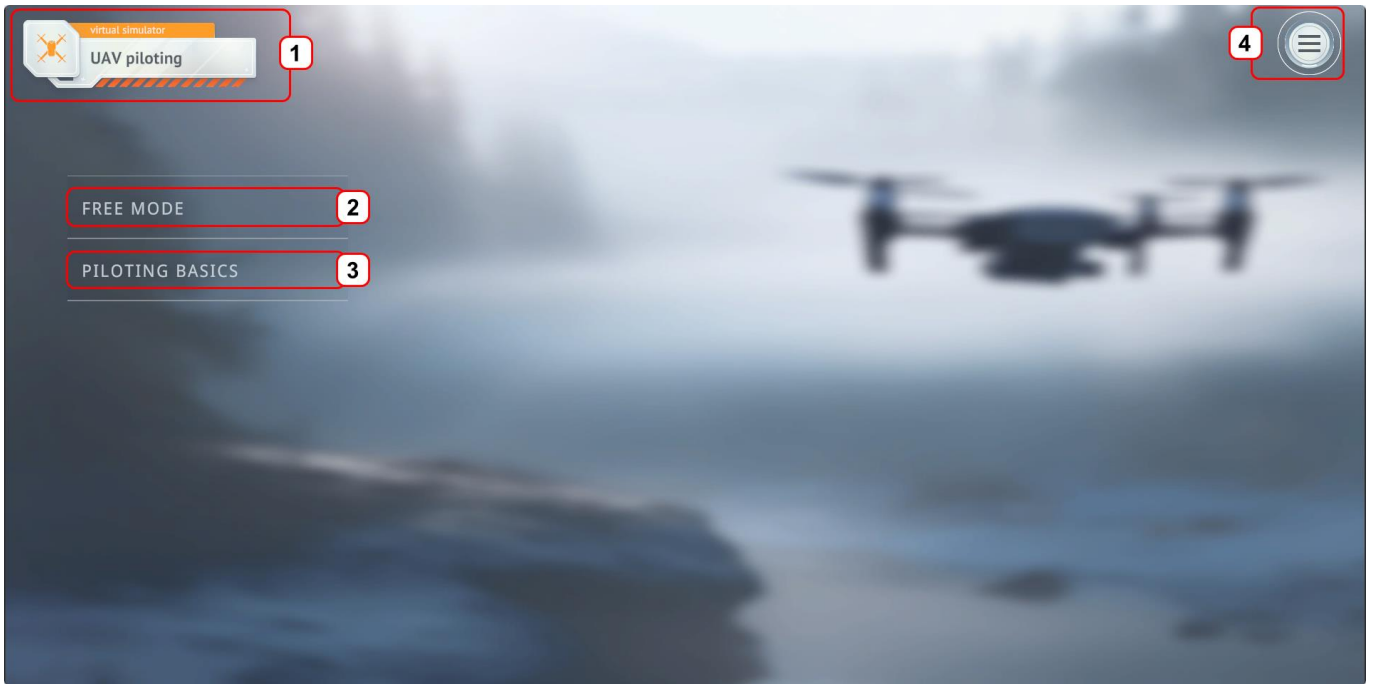


Figure 15 – Main screen

The main screen includes (Figure 15):

- application logo (1);
- "Free Mode" button (2) to go to the free mode selection menu (see 3 «["Free Mode" Selection Menu](#)»);
- "Piloting Basics" button (3) to go to the scenario mode selection menu (see 11 «["Piloting Basics" selection menu](#)»);
- button to call the "Scene Menu" (4) (see 7 «[Scene menu](#)»).

7 Scene menu

The scene menu contains a set of function buttons (Figure 16):



Figure 16 – Scene menu

- a button to call up instructions for working with the Simulator ;
- button "Collapse/expand" to enable/disable full-screen mode  (see [7.2 «Full-screen mode»](#)).

To go to instructions or full-screen mode, go to the menu Stage work (4 in the Figure 15) and select a button to perform the desired action (Figure 16). Button "Menu" will change its appearance: .

To close the scene menu, click the  or anywhere in the scene outside the menu.

7.1 Instructions

To select an instruction to view, click the "Instructions" toggle button  in the scene menu (see [7 «Scene menu»](#)). A menu will open where you can select a video tutorial or a user guide (Figure 17).

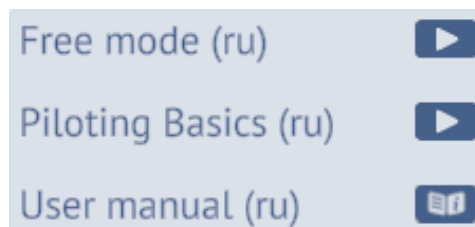


Figure 17 – Instruction selection menu

Video instructions "Free mode" and "Piloting Basics" allow you to get an idea of the main modes of operation of the Simulator. Video instructions play in a window that opens on top of the scene. Control playback with the built-in player (Figure 18).



Figure 18 – Player controls

To close the playback screen, click the "Close" button  in the upper right corner of the screen. The user manual opens in PDF format in a new browser tab.

7.2 Full-screen mode

To enable full-screen mode, press the "Collapse/expand»  in the scene menu (see [7 «Scene menu»](#)). Simulator will be deployed full screen, all other elements of your device's browser and desktop will be hidden. To exit full-screen mode, press the  or the Esc key on your keyboard.

8 "Free Mode" Selection Menu

To access the "Free Mode" selection menu:

- click the "Free mode" button,
- in the window that appears, click the "Start" button (Figure 19).

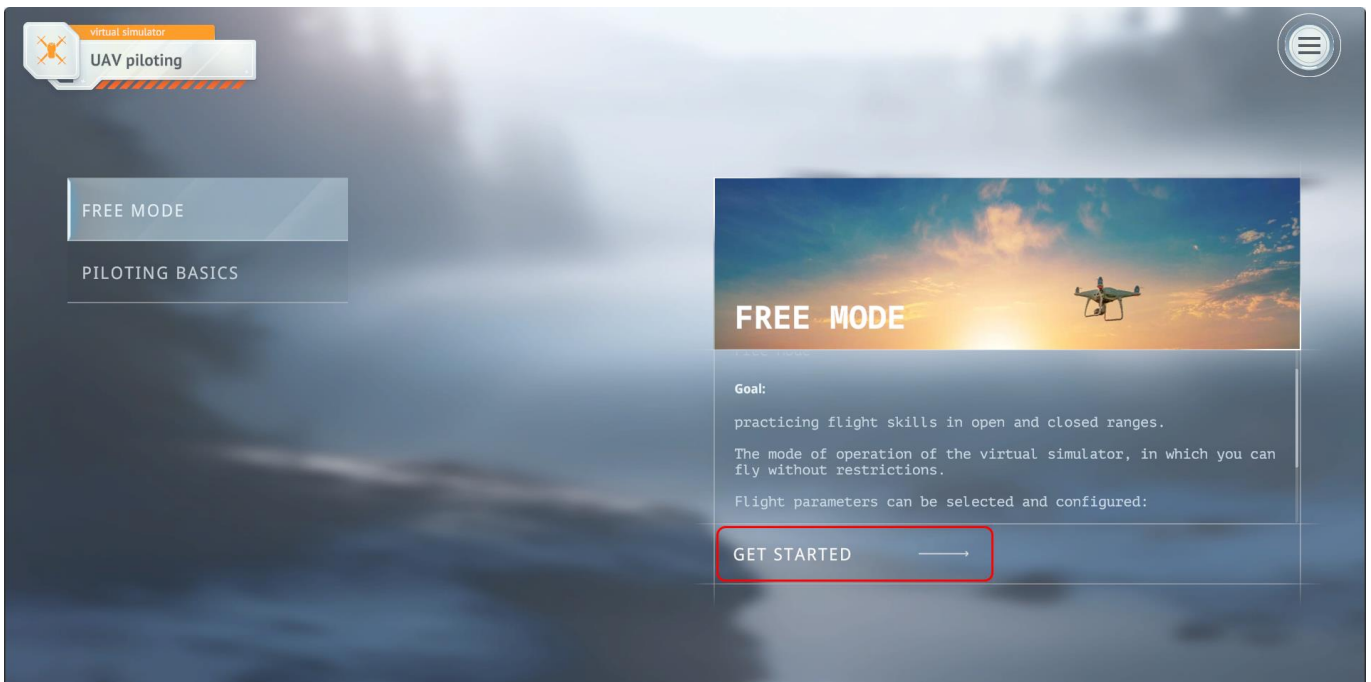


Figure 19 – Switching to "Free Mode"

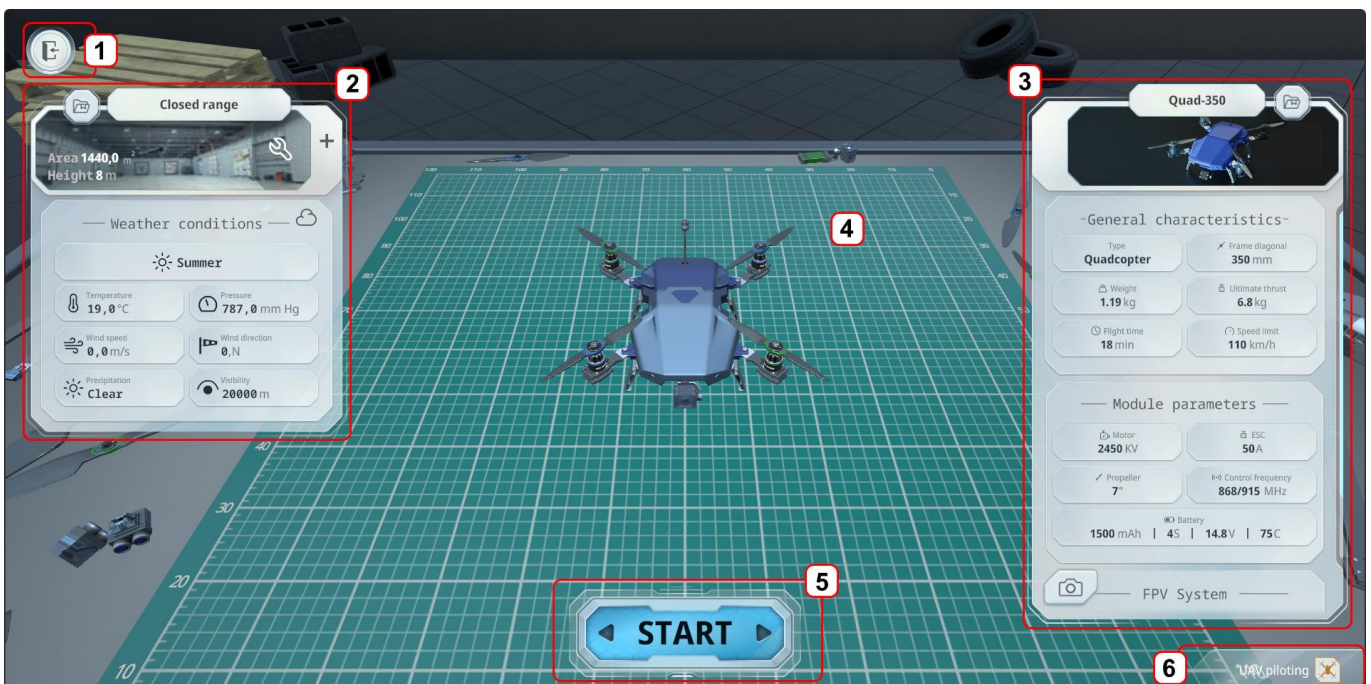


Figure 20 – Elements of the "Free Mode" screen

The interface of the "Free Mode" screen (Figure 20) includes the following elements:

- the "Back" button (1), when clicked, returns to the previous page;
- scene selection and adjustment unit (2) (see [8.1 «Scene selection and settings block»](#));
- UAV selection and configuration unit (3) (see [8.2 «UAV selection and configuration unit»](#));
- the working area centered on the UAV model (4);

- the "Start" button (5, see [8.3 «Start button»](#));
- App logo (6).

8.1 Scene selection and settings block

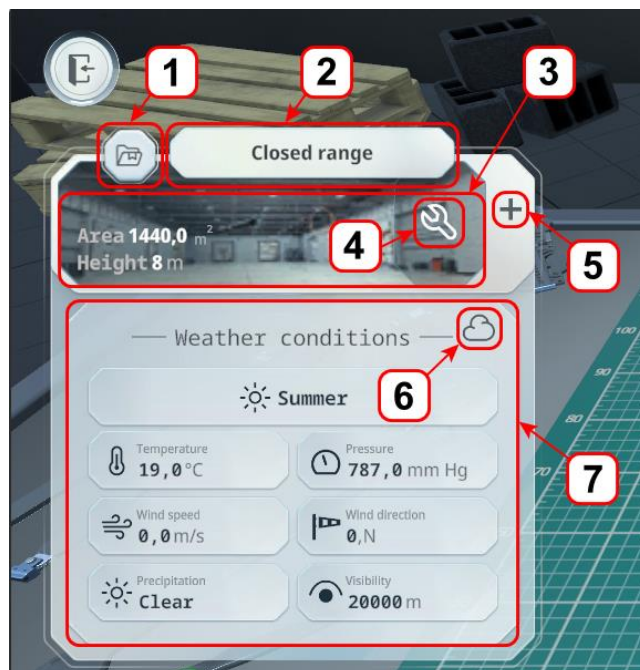


Figure 21 – Elements of the scene selection and settings block

Scene selection and settings block (Figure 21) includes:

- button to go to scene selection (1, see [8.1.1 «Scene selection block»](#));
- the name of the scene (2) and its visual representation (3) with the area and height of the working area;
- button transition to the constructor of the selected scene (4, see [9 «Closed range constructor»](#)) is displayed only for a closed range;
- button transition to a new closed range scene (5, see [9 «Closed range constructor»](#)); in free mode is always available;
- the weather conditions display unit (7) and the button to switch to weather settings (6, see [8.1.2 «Weather Conditions Block»](#)); the button is available only for an open range.

8.1.1 Scene selection block

To select a scene, press the Go to Scene Selection button (1, Figure 21).

The scene selection block contains two tabs:

- "Presets" — with preset scenes (Figure 22).

These scenes are divided into two groups:

- "Closed" — scenes in a closed range;
- "Open" — scenes on an open range.

- "Saved" — with scenes created in Scene constructor mode (Figure 23, see [9 «Closed range constructor»](#)).



Figure 22 – Scene selection block, "Preset" tab

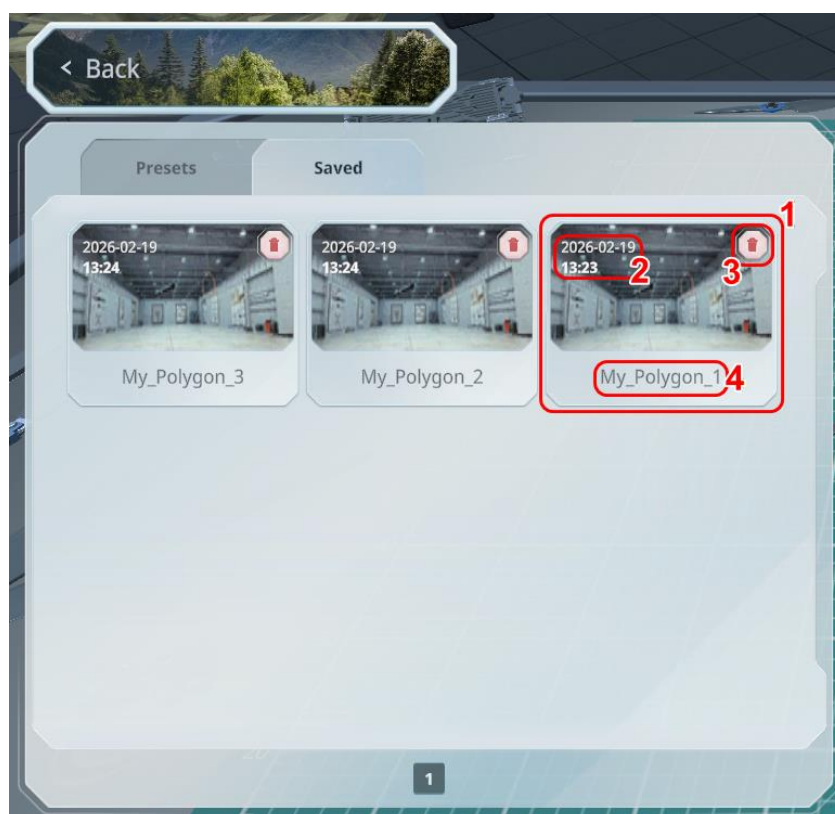


Figure 23 – Scene selection block, "Saved" tab

The scene card on the "Saved" tab (1, Figure 23) includes:

- Scene Title (4)
- the date and time of the last saving of the scene (2);
- button to delete the scene.

Select the desired scene, click on the card and its name will be displayed in the field (2) in the Figure 21.

8.1.2 Weather Conditions Block

To change the weather settings on an open range, click button to go to weather settings (6, Figure 21).

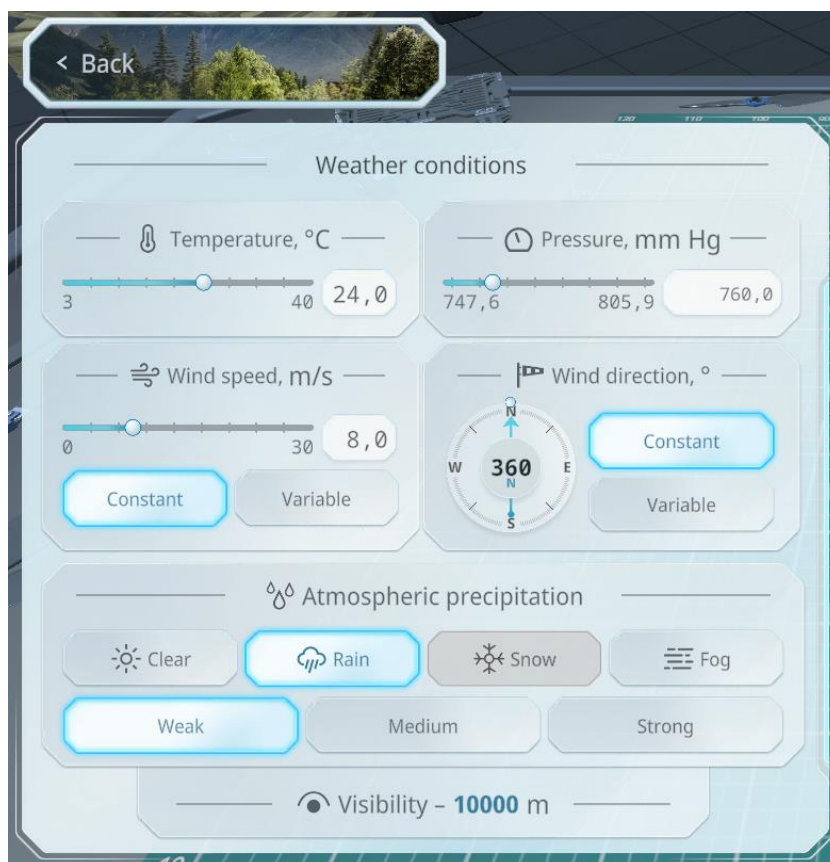


Figure 24 – Elements of the weather conditions block

Weather conditions block (Figure 24) includes the following settings:

- temperature: from +3 to +40°C;
- atmospheric pressure: from 747.6 to 805.9 mm Hg st.;
- wind speed: from 0 to 30 m/s; can be constant and variable.

Fluctuations in speed (gusts and lulls) from the established (average) occur in the following ranges:

- ± 0.5 m/s at an average speed of 1-4 m/s;
- ± 1.5 m/s at an average speed of 5-10 m/s;
- ± 3 m/s at an average speed of 11-30 m/s;

- wind direction (available at wind speed >0): measured in degrees (°), can be constant and variable (smooth change of direction by 180° relative to the set one occurs 1 time in 5-7 minutes);
- Precipitation (only one type of precipitation can be selected):
 - "Clear" (without precipitation) (Figure 25);
 - "Rain" (Figure 26);
 - "Snow" is available at a set temperature of up to +10°C (Figure 27);
 - "Fog" (Figure 28);
 - Precipitation: weak/medium/strong (not available for "Clear");
- Visibility: varies depending on the type and level of precipitation from 800 m to 20000 m.



Figure 25 – Weather conditions without precipitation and wind



Figure 26 – Weather conditions with rain and wind



Figure 27 – Weather conditions with snow and without wind



Figure 28 – Weather conditions with fog and wind

8.2 UAV selection and configuration unit

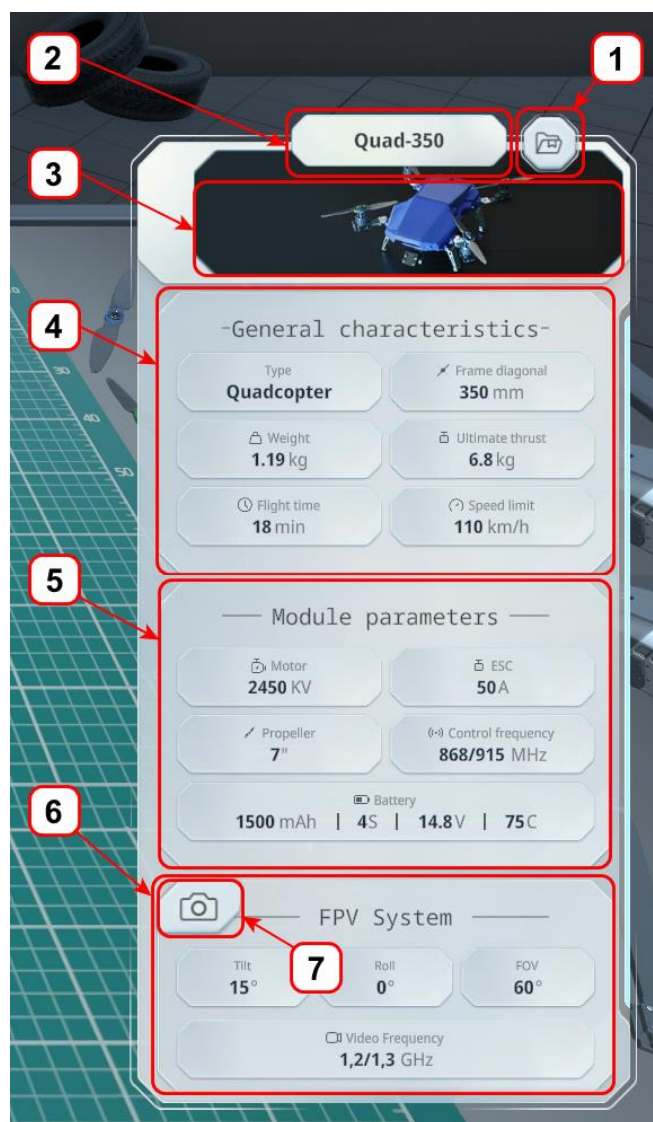


Figure 29 – UAV selection and settings panel

UAV selection and configuration unit (Figure 29) includes:

- the button to go to the UAV selection (1, see [8.2.1 «UAV Selection Unit»](#));
- UAV name (2);
- UAV image (3);
- general characteristics of the UAV (4):
 - UAV type;
 - UAV weight;
 - UAV flight time;
 - frame diagonal (for multi-rotor UAVs)/wingspan (for aircraft and hybrid UAVs);
 - maximum thrust of the UAV;
 - the maximum speed of the UAV;
- module parameters (5):
 - type of motor;

- ESC – Electronic Stability Control, used only for multi-rotor UAVs;
 - propeller diameter;
 - control frequency;
 - battery capacity (only for multi-rotor UAVs);
- FPV system data (6), the button to proceed to FPV system configuration (7) (see [8.2.2 «FPV System Unit»](#)) and the frequency of the video signal.

To scroll vertically through the item list, click and drag the section area up or down, or use the scroll bar on the right.

8.2.1 UAV Selection Unit

To go to the UAV selection unit, press the button to go to UAV selection (1, Figure 29).



Figure 30 – UAV Selection Unit

In the UAV selection unit (Figure 30) presents UAV cards (Figure 31). Only multi-rotor UAVs can be used in a closed test site, so aircraft and hybrid UAVs are not represented for this space. To navigate between pages, use the page number buttons at the bottom of the window.



Figure 31 – UAV card

UAV card (Figure 31) includes:

- UAV model name;
- panel with UAV characteristics:
 - frame diagonal  (for multi-rotor UAVs)/wingspan (for aircraft and hybrid UAVs);
 - UAV weight ;
 - propeller diagonal ;
 - motor power ;
 - battery capacity  (only for multi-rotor type UAVs).

Select the desired UAV model, click on the card and its name will be displayed in field (2) in the Figure 29.

Click the Back button (Figure 30) or to any location outside the UAV Selection Unit to return to the UAV Selection and Configuration Unit (Figure 29).

8.2.2 FPV System Unit

"FPV system" is a system installed on the UAV that provides a live broadcast of video from the camera.

Block "FPV System" (6, Figure 29) includes the following settings:

- Tilt – rotate the camera relative to the horizon – down/up,
- Roll — rotate the camera clockwise/counterclockwise,
- FOV (Field of View), which determines the width of the area that the camera can cover. A wider angle of view provides a more immersive effect, but can lead to significant image distortion.
- the frequency of the video signal.

Tilt, Roll, FOV settings can be set in the settings FPV systems. Click the "Go to Setup" button (7, Figure 29) to navigate to the FPV system configuration unit (Figure 32).

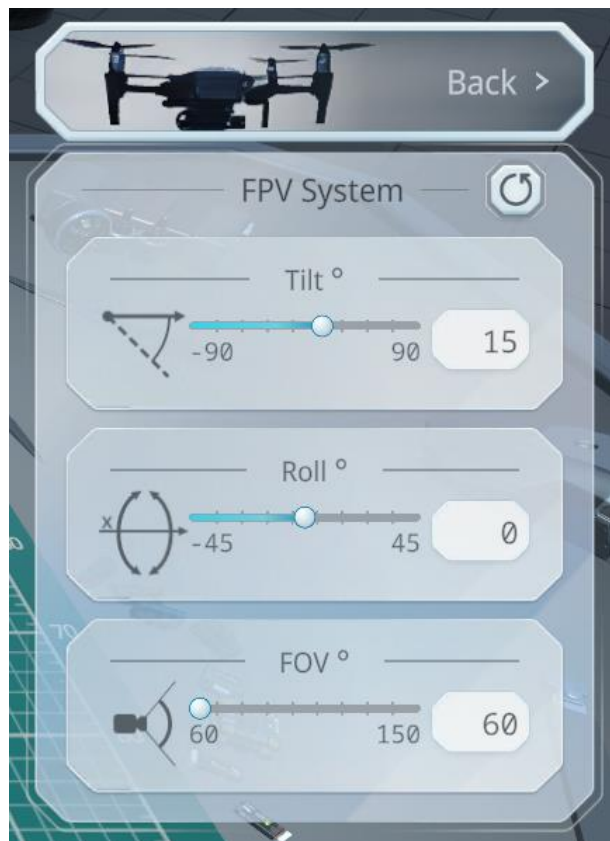


Figure 32 – The setting unit "FPV Systems"

Use the keyboard to set the exact parameter values or use the slider and slider.

Camera view examples FPV systems with different settings are shown in the Figures 33-39.



Figure 33 – View from the camera "FPV Systems" (Tilt=15°, Roll=0°, FOV=60°)



Figure 34 – View from the camera "FPV Systems" (Tilt=90°, Roll=0°, FOV=60°)



Figure 35 – View from the camera "FPV Systems" (Tilt=-90°, Roll=0°, FOV=60°)



Figure 36 – View from the camera "FPV Systems" (Tilt=15°, Roll=45°, FOV=60°)



Figure 37 – View from the camera "FPV Systems" (Tilt=15°, Roll=-45°, FOV=60°)



Figure 38 – View from the camera "FPV Systems" (Tilt=15°, Roll=0°, FOV=100°)



Figure 39 – View from the camera "FPV Systems" (Tilt=15°, Roll=0°, FOV=150°)

To return to the preset settings, click the "Update" button  (Figure 32).

To return to the UAV selection and configuration unit, press the "Back" button (Figure 32) or anywhere outside the "FPV Systems".

8.3 Start button

Start button (5, Figure 20) allows you to jump to the simulation with the scene and UAV selected.

9 Closed range constructor

9.1 General information



Figure 40 – Closed range

A closed range, within which you can control the UAV and monitor its flight using a camera, is shown in the Figure 40. A hangar is used as a range with an area of 24×60 m, 8 m high.

The range can be filled with landmarks (see 9.4 «Targets/Goals») and obstacle structures of varying complexity (see 9.5 «Obstacles»), so you can create your own alignment. To do this, in the scene selection block (see 8.1.1 «Scene selection block») set the "Closed range" scene and click the "Scene constructor" button (4, Figure 21) or click the button transition to a new closed range scene (5, Figure 21).

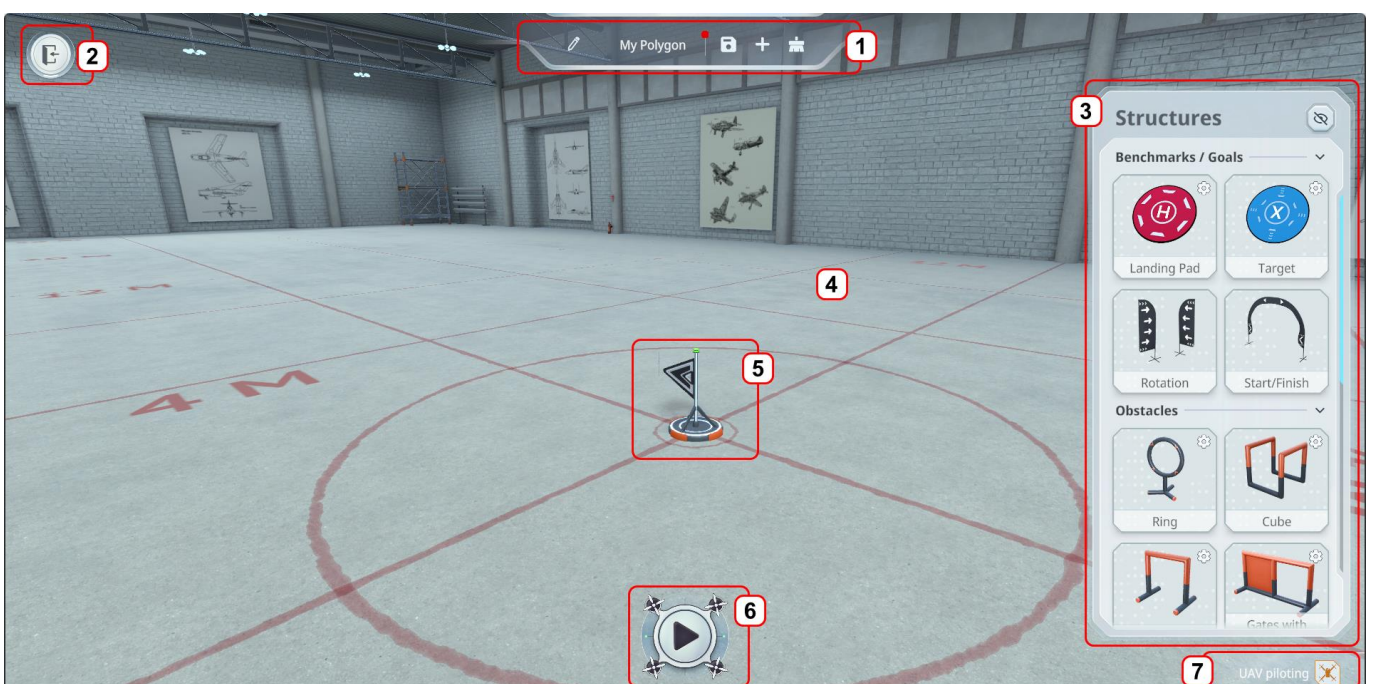


Figure 41 – "Scene constructor" UI elements

"Scene constructor" screen interface (Figure 41) includes:

- scene panel (1, see [9.8 «Scene panel»](#));
- button to exit the mode (2, see [9.11 «Exiting the Closed Range Designer»](#));
- constructs panel (3, see [9.2 «"Structures" panel»](#));
- the work area (4, see [9.3 «Workspace»](#));
- the "Starting point" construction (5, see [9.6 «Starting point»](#));
- button to go to the simulation in the current scene (6, see [6.9 «Go to the simulation in the current scene»](#));
- App logo (7).

9.2 "Structures" panel

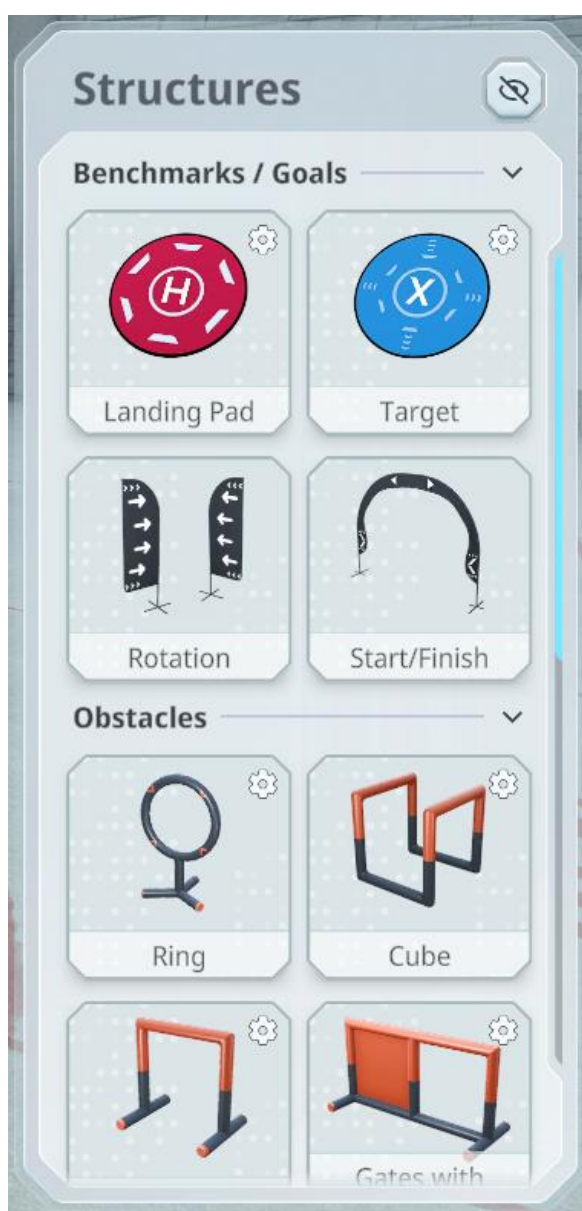


Figure 42 – "Structures" panel

In the "Structures" panel (Figure 42) presents cards of objects available to the user for filling the closed range: landmarks (see [9.4 «Targets/Goals»](#)) and obstacle structures of varying complexity (see [9.5](#)

«Obstacles»)). Each card contains an image and the name of the structure. The cards of some objects are marked with the , such objects can be configured using the object constructor (see 9.7.4.1 «Object constructor»).

When clicking on the object card (3 in the Figure 43) the card is activated: a panel with a description of the selected object (1) is displayed on the screen, and if a constructor is provided for the object, the designer panel is also displayed on the screen (2, see 9.7.4.1 «Object constructor»).

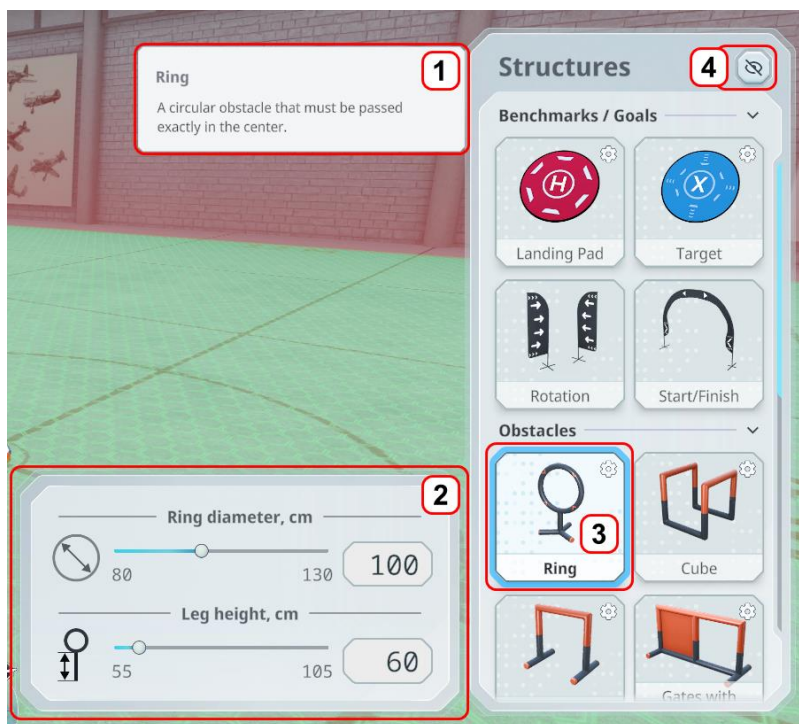


Figure 43 – Activate the object card

To hide the panel, press the  button (4). The button will remain on the screen , when you click on it, the panel will open again.

9.3 Workspace

In the workspace, you can place features in a closed range. It is highlighted in green:

- when clicking on the object card;
- when you move an object from a card to a workspace.
- when you click on an object in the workspace.

The workspace is conditionally divided into the main and additional zones.

The main area of the workspace is located on the floor surface of the closed range (Figure 44).

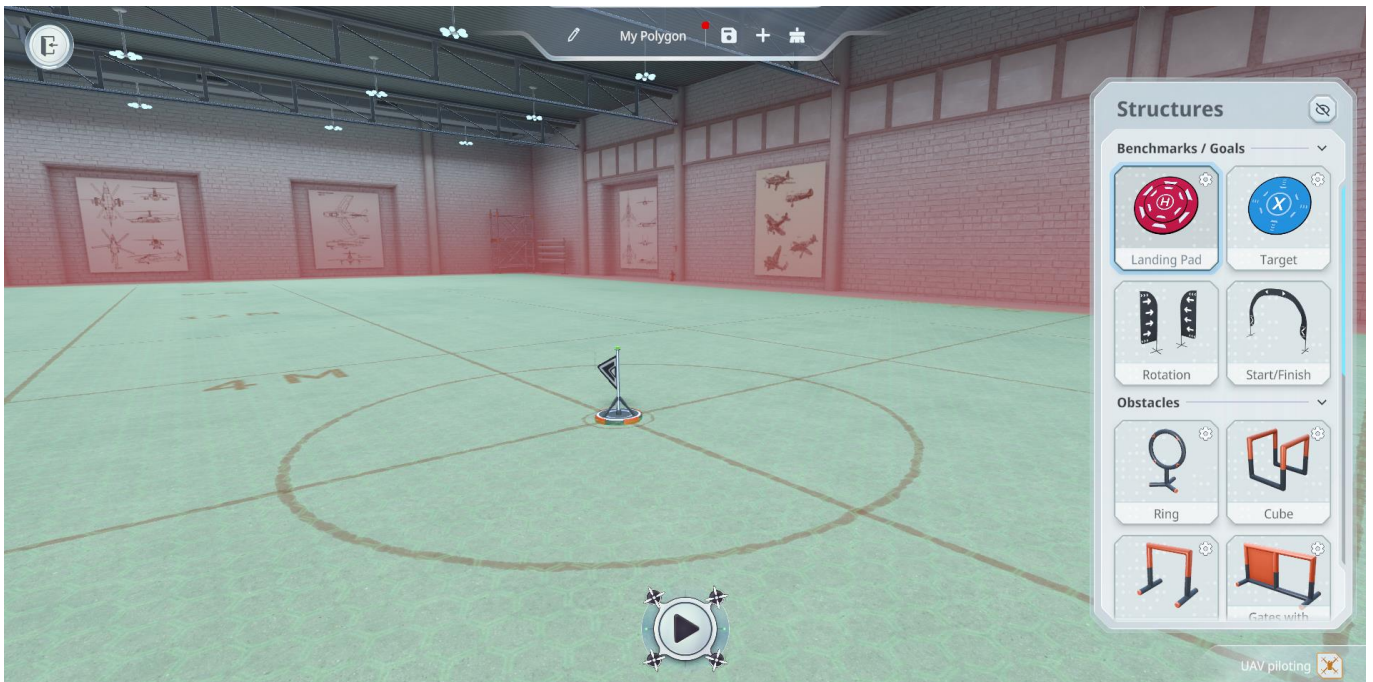


Figure 44 – Main area of the workspace (highlighted in green)

The additional zone is located on the surface of six ceiling beams (Figure 45). This zone contains objects that belong to the suspended structures. Such objects include "Pipe" and "Hoop" when the "Hanging structure».

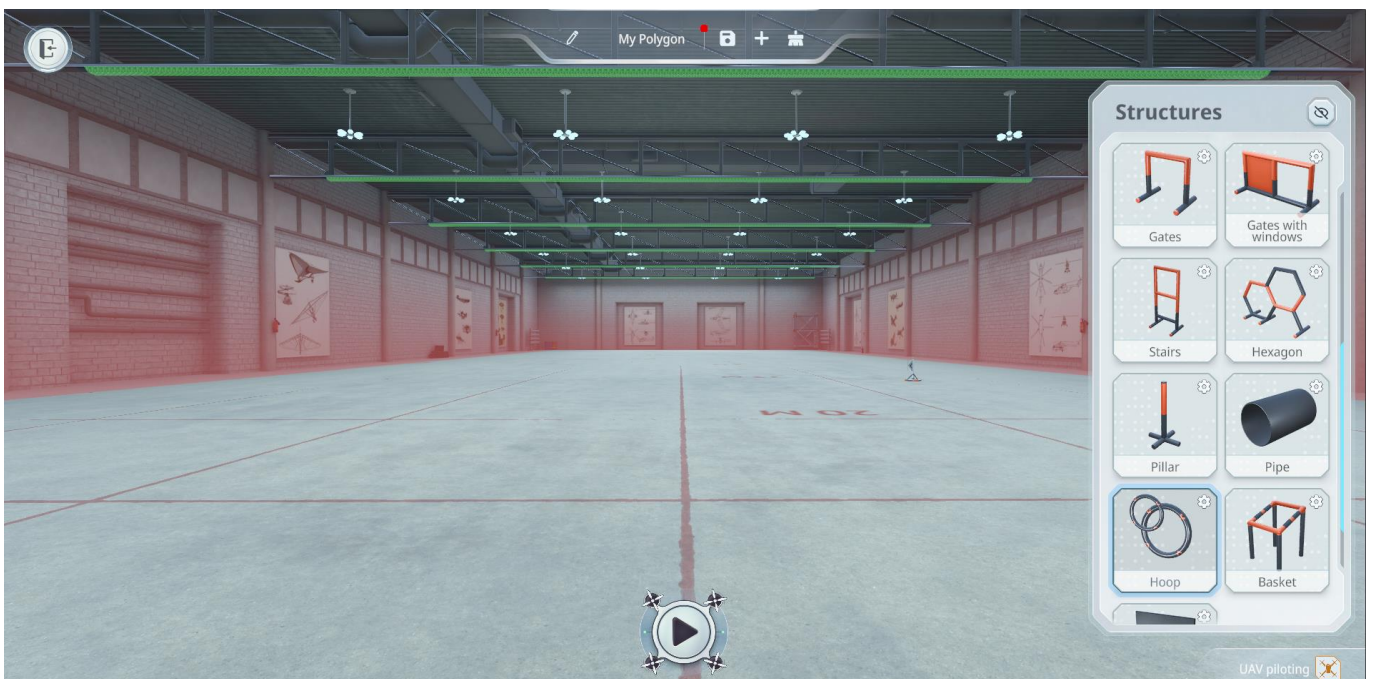


Figure 45 – Additional workspace area (highlighted in green)

9.4 Targets/Goals

9.4.1 Landing Pad

A Landing Pad is an area for performing special tasks, such as taking off, landing, or turning 360° (Figure 46).



Figure 46 – Landing Pad

The diameter of the Landing Pad is adjustable from 80 cm to 130 cm, the color is red or orange.

To select settings, open the object constructor (see [9.7.4.1 «Object constructor»](#)) and set the desired values (Figure 47).

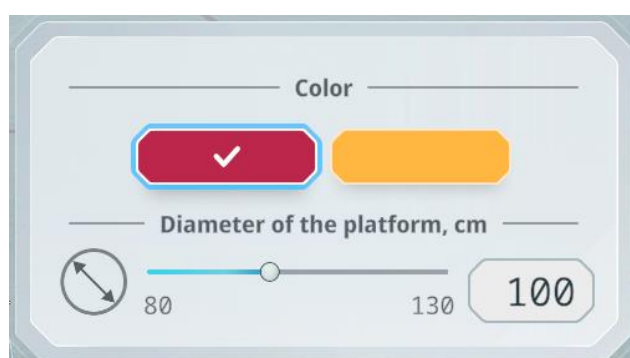


Figure 47 – Landing Pad constructor

9.4.2 Target

A target is an object for accurate landing, touching, and placing a load (Figure 48).



Figure 48 – Target

The color of the target can be blue or green.

The diameter of the target is 80 cm.

To select a color, open the object constructor (see [9.7.4.1 «Object constructor»](#)) and set the desired value (Figure 49).



Figure 49 – Target constructor

9.4.3 Rotation

Rotation is a flag to indicate an abrupt change in the flight path (Figure 50).



Figure 50 – Rotation

9.4.4 Start/Finish

Start/Finish is a flag to mark the start and end points of the course (Figure 51).

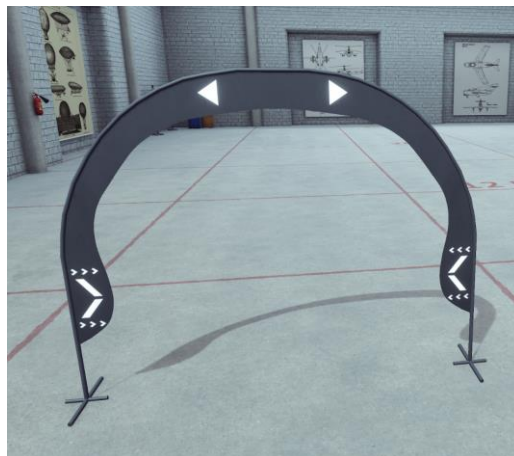


Figure 51 – Start/Finish

9.5 Obstacles

9.5.1 Ring

A ring is a round obstacle that must be passed exactly in the center (Figure 52). The task is to fly inside the ring.



Figure 52 – Ring

The inner diameter of the ring is adjustable from 80 to 130 cm. The dimensions of the outer diameter vary accordingly from 110 to 160 cm.

The height of the leg is adjustable from 55 to 105 cm.

To select settings, open the object constructor (see 9.7.4.1 «Object constructor») and set the desired values (Figure 53).



Figure 53 – Ring constructor

9.5.2 Cube

A cube is a volumetric obstacle in the form of a cube that needs to be circled along a given trajectory (Figure 54).



Figure 54 – Cube

The height of the opening is adjustable from 95 to 145 cm, the height of the structure varies accordingly from 110 to 160 cm.

The width of the opening is adjustable from 80 to 130 cm, the width of the structure varies accordingly from 110 to 160 cm.

To select the dimensions of the opening, open the object constructor (see [9.7.4.1 «Object constructor»](#)) and set the desired parameter values (Figure 55).



Figure 55 – Cube constructor

9.5.3 Gates

Gate — a structure requiring a straight-line flight of the UAV through its center (Figure 56).



Figure 56 – Gates

There are 2 types of gates: "Open" and "Closed".

For each type, the following parameters are adjusted:

- window height:
 - for "Open" it varies from 95 to 145 cm, the height of the gate varies from 110 to 160 cm;
 - for "Closed" it varies from 80 to 130 cm, the height of the gate varies from 150 to 200 cm.
- the width of the window is adjustable from 80 to 130 cm, the width of the gate varies from 110 to 160 cm for open type and closed type.

To select settings, open the object constructor (see 9.7.4.1 «Object constructor») and set the desired parameter values (Figure 57).

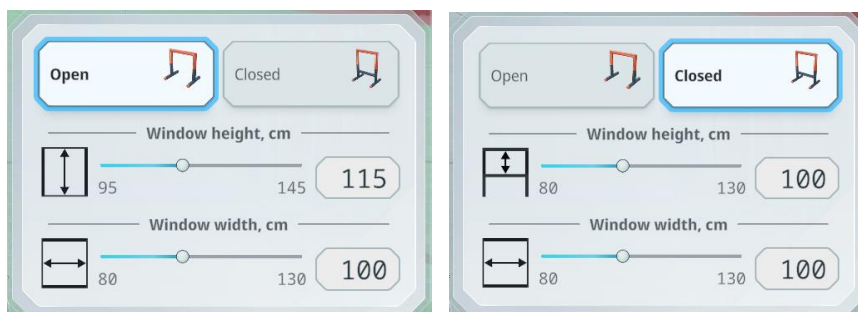


Figure 57 – Gate constructor

9.5.4 Gates with windows

Gates with windows are complicated gates with additional openings (Figure 58). The pilot's task is to fly through a certain "window".

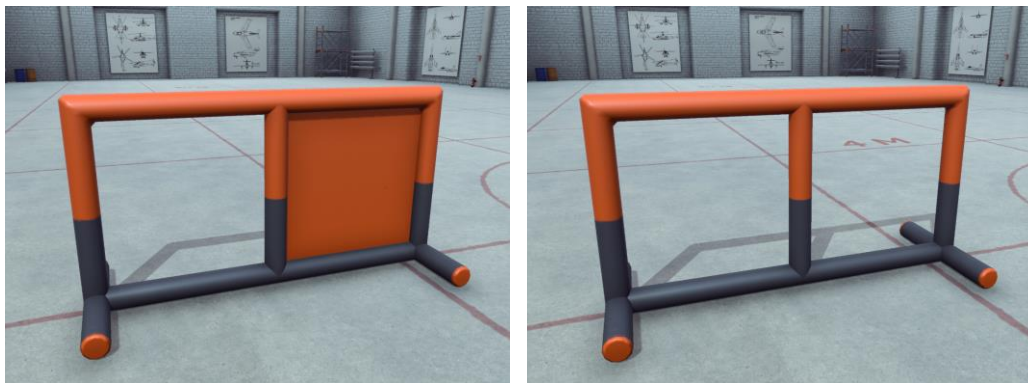


Figure 58 – Gate with window

There are 2 types of gates with windows: "Single" (with one window) and "Double" (with two windows). For each type, the following parameters are adjusted:

- the height of the window varies from 80 to 130 cm; the height of the gate varies from 110 to 160 cm.
- the width of the window varies from 80 to 130 cm; the width of the gate varies from 205 to 305 cm.

To select settings, open the object constructor (see [9.7.4.1 «Object constructor»](#)) and set the desired parameter values (Figure 59).

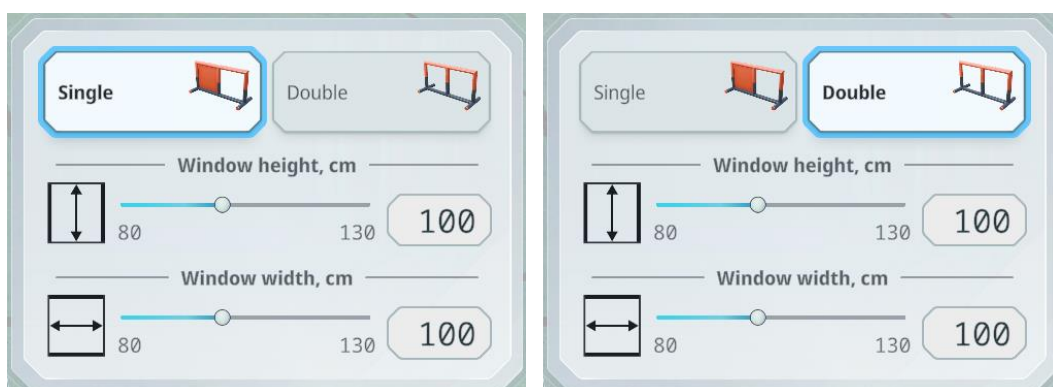


Figure 59 – Gate constructor with a window

9.5.5 Stairs

A staircase is a vertical structure that resembles a figure of eight (Figure 60). It flies in a "step" — a sequential movement up or down with a pause at each "flight". The pilot's task is to fly through one hole and after turning around the stairs — the second hole (make a figure eight).



Figure 60 – Stairs

In the staircase, you can change the size of the window:

- the height of the window is adjustable from 80 to 130 cm, the height of the structure varies from 245 to 345 cm;
- The width of the window is adjustable from 80 to 130 cm, the width of the structure varies from 110 to 160 cm.

To select settings, open the object constructor (see [9.7.4.1 «Object constructor»](#)) and set the desired parameter values (Figure 61).



Figure 61 – Staircase Constructor

9.5.6 Hexagon

Hexagon is a volumetric obstacle in the shape of a hexagon (Figure 62), you need to fly through several tunnels in a row, to create a carousel, you will need at least three hexagons with 1 window, which are placed at a short distance from each other. If the figures include more than two windows, the pilot needs to fly through all the constituent parts of the figure (fly inside each hexagon).

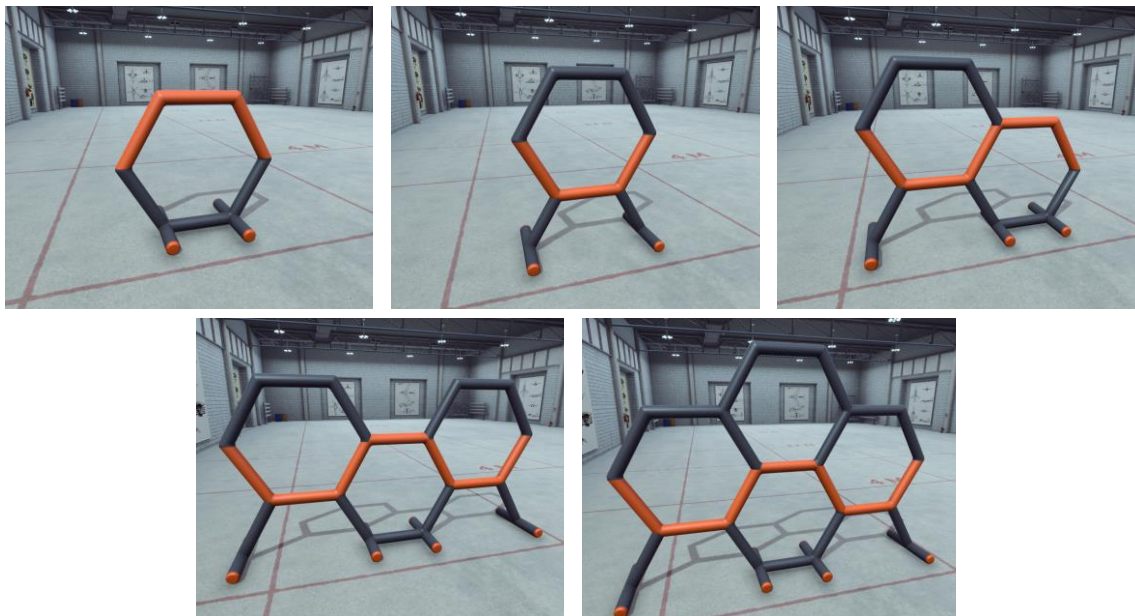


Figure 62 – Hexagon

Hexagon is available in 4 types: 1 window, 2 windows, 3 windows, 4 windows.

For the "1 window" type, you can choose the window size:

- standard (on legs);
- small (without legs).

The height of one window is 160 cm, the length of the legs is 50 cm, the diameter of the supports is 15 cm.

To select settings, open the object constructor (see [9.7.4.1 «Object constructor»](#)) and set the desired parameter values (Figure 63).

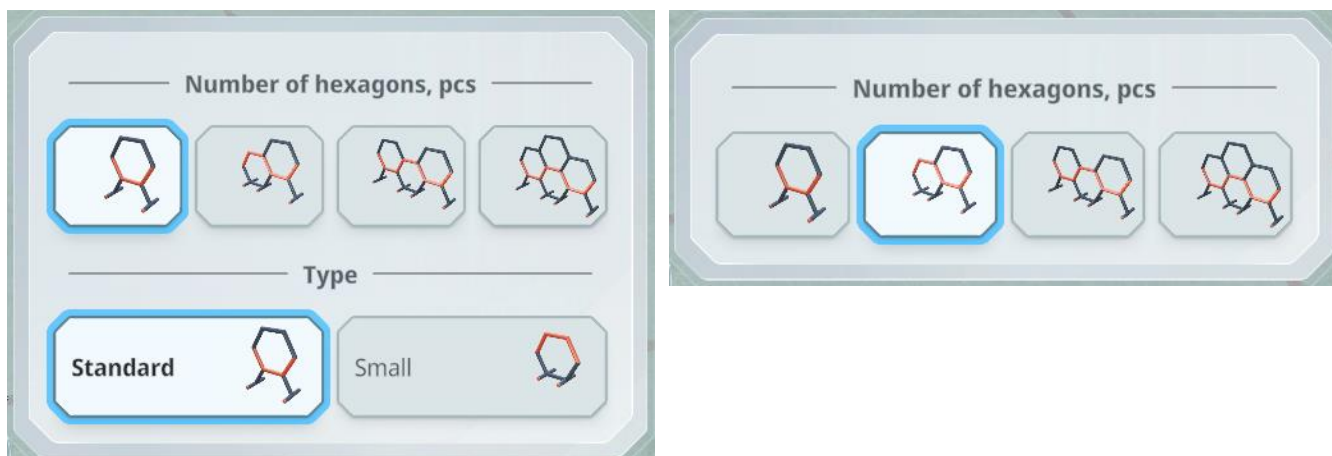


Figure 63 – Hexagon constructor

9.5.7 Pillar

A pillar is a vertical post that must be flown around a given radius (Figure 64). The pilot's task is to turn 180 ° and fly in the opposite direction. The pillar is also used to pass the "Slalom" point, where the pilot needs to fly in a zigzag through the pillars.



Figure 64 – Pillar

The height of the pillar leg is adjustable from 150 to 200 cm.

To select settings, open the object constructor (see [9.7.4.1 «Object constructor»](#)) and set the desired parameter values (Figure 65).



Figure 65 – Pillar constructor

9.5.8 Pipe

A pipe is a horizontal tunnel through which it is necessary to fly without touching its surface (Figure 66).

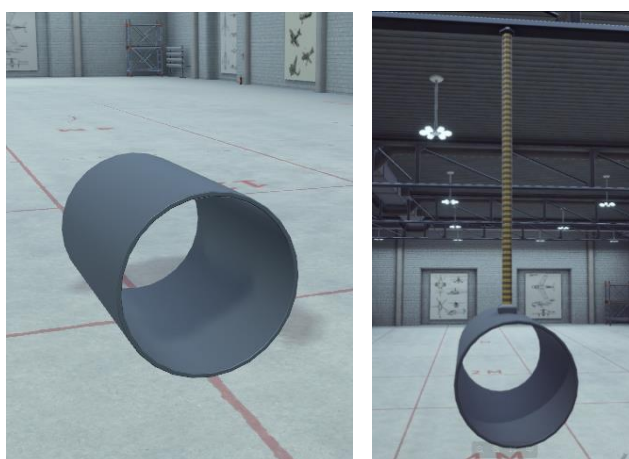


Figure 66 – Pipe

The pipe can be suspended (suspended from the hangar beams on the floor using a special mechanism) and non-suspended (floor, placed on the floor). To create a suspended structure in the object constructor, select the "Hanging structure" parameter in the checkbox. In the context menu constructor, this checkbox is blocked. The height of the lock can be changed by the user as moving the object along the up-

down axis (the limitation is other objects in the scene and the hangar floor, see [9.7.2 «Moving and rotating an object»](#)).

The size of the inner diameter is adjustable from 80 to 130 cm, the size of the outer diameter varies from 86 to 136 cm.

The length of the pipe is adjustable from 150 to 200 cm.

To select settings, open the object constructor (see [9.7.4.1 «Object constructor»](#)) and set the desired parameter values (Figure 67).

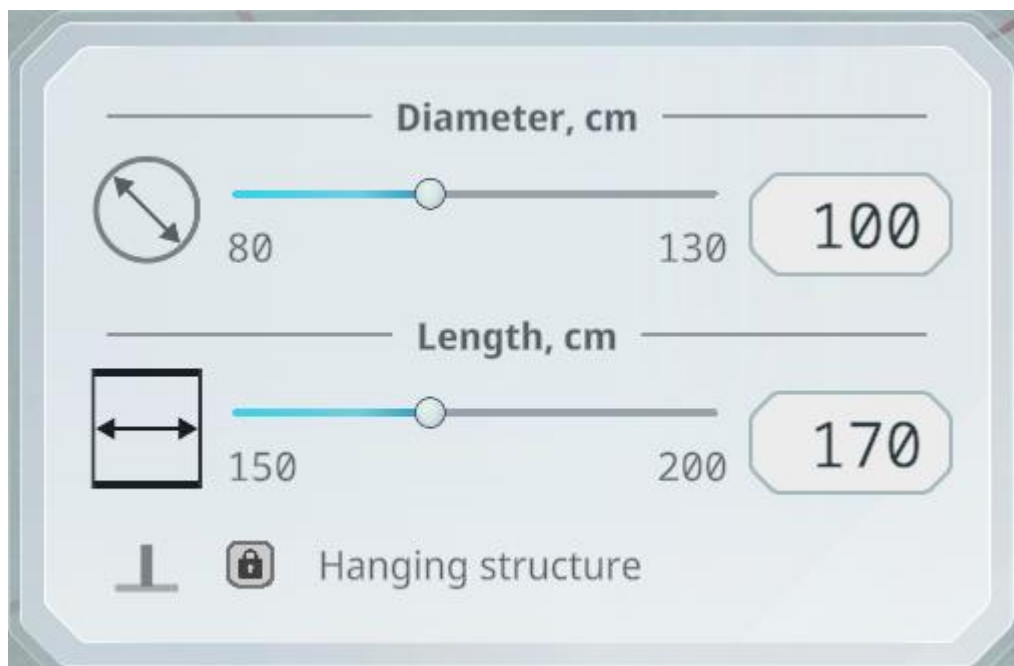


Figure 67 – Pipe constructor

9.5.9 Hoop

A hoop is a round obstacle similar to a ring (Figure 68). The pilot's task is to fly inside the ring.

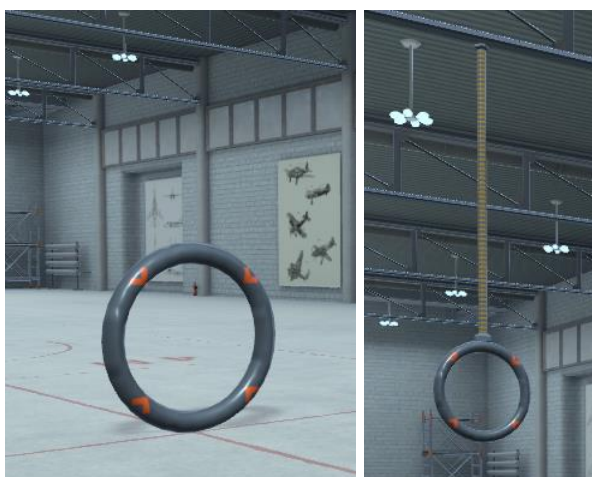


Figure 68 – Hoop

The hoop can be hanging (hanging from the hangar beams using a special mechanism) or non-hanging (floor-mounted, placed on the floor). To create a hanging structure in the object constructor, select the "Hanging structure" parameter in the checkbox. In the context menu builder, this checkbox is blocked.

The height of the lock can be changed by the user as moving the object along the up-down axis (the limitation is other objects in the scene and the hangar floor, see [9.7.2 «Moving and rotating an object»](#)).

The size of the inner diameter of the hoop is adjustable from 80 to 130 cm, respectively, the size of the outer diameter varies from 110 to 160 cm.

To select settings, open the object constructor (see [9.7.4.1 «Object constructor»](#)) and set the desired parameter values (Figure 69).

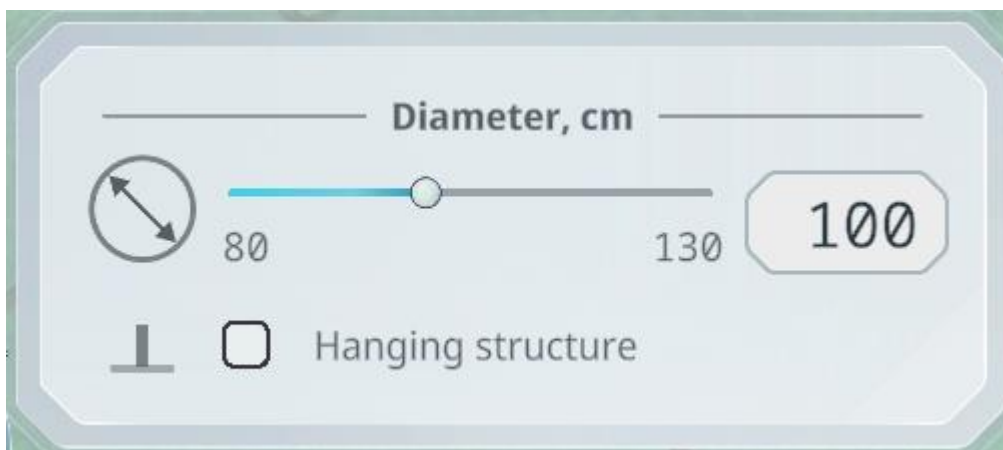


Figure 69 – Hoop constructor

9.5.10 Basket

A basket is a shape for organizing a track (Figure 70). The pilot's task is to fly inside the basket window without touching the edges of the structure.

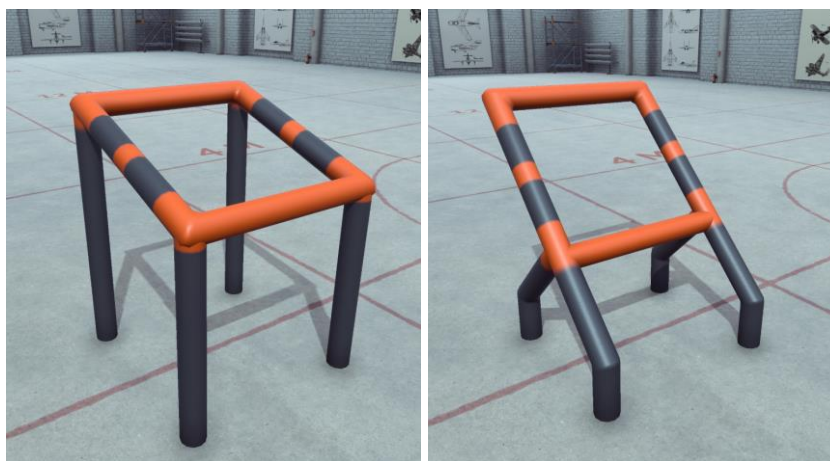


Figure 70 – Baskets vertical and corner

The basket is presented in 2 types: "Vertical" and "Corner".

Parameters for the "Vertical" type:

- window height, adjustable from 80 to 130 cm;
- window width, adjustable from 80 to 130 cm;
- the height of the basket, adjustable from 150 to 200 cm. The height of the legs of both faces is changed (measuring the height from the base of the leg to the highest point of the structure).

Parameters for the "Corner" type:

- window height, adjustable from 80 to 130 cm;

- window width, adjustable from 80 to 130 cm.

To select settings, open the object constructor (see 9.7.4.1 «Object constructor») and set the desired parameter values (Figure 71).

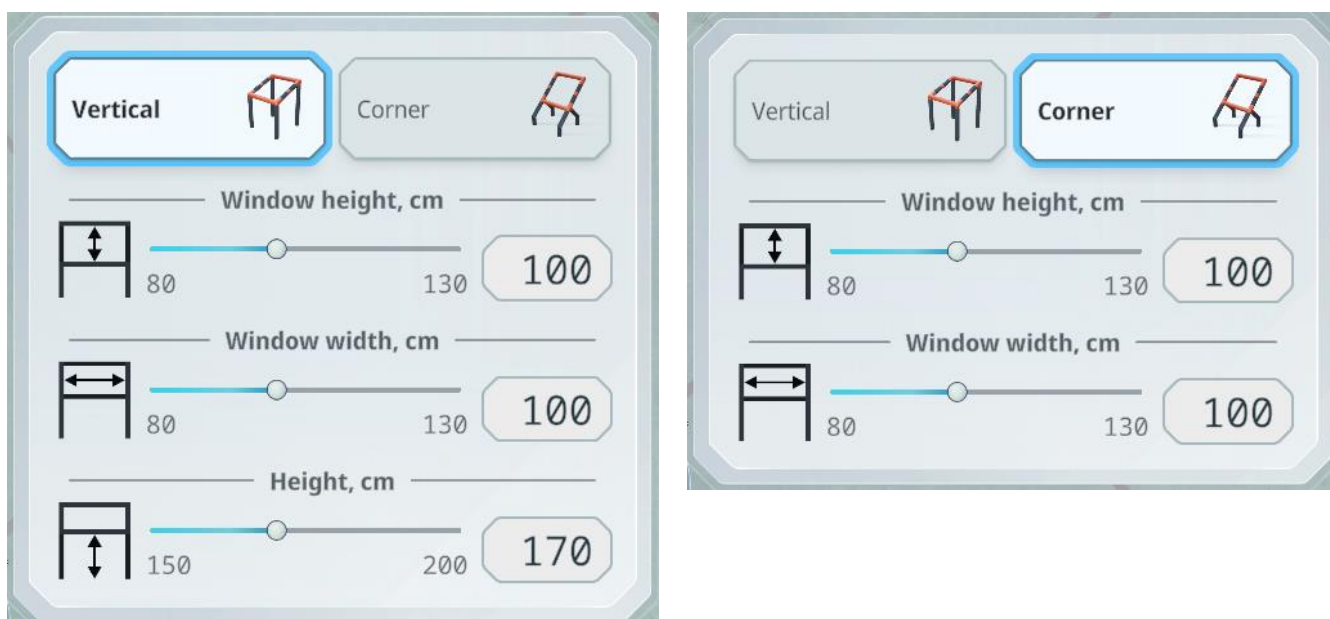


Figure 71 – Basket constructor

9.5.11 Wall

A wall is a wide vertical obstacle (Figure 72). It is installed to limit space and construct labyrinths. The pilot's task is not to collide with a wall.

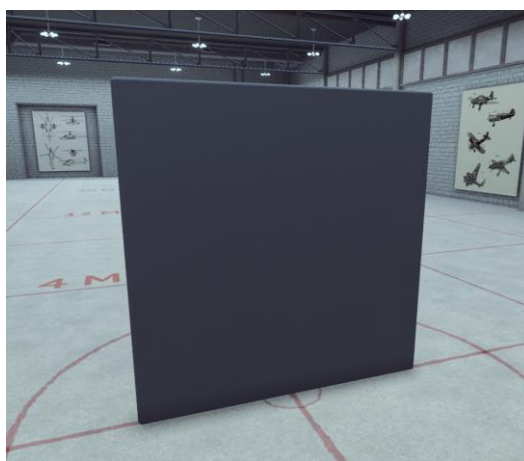


Figure 72 – Wall

In the construction set, the height of the wall is adjustable from 250 to 500 cm, the width is from 250 to 500 cm.

To select settings, open the object constructor (see 9.7.4.1 «Object constructor») and set the desired parameter values (Figure 73).



Figure 73 – Wall constructor

9.6 Starting point

Object "Starting point" (Figure 74) represents the starting position for completing the simulation. Displayed only in Scene constructor mode. In simulation mode, the UAV is placed at the position of the starting point, replacing this object.



Figure 74 – Starting point

The starting point cannot be deleted or its size can be changed (the buttons to go to the object constructor, view information and delete are not active, Figure 75), but can be moved or rotated like other structures (see [9.7.2 «Moving and rotating an object»](#)). The start point is set on the "Landing Pad" object and is used as the starting point in the route.



Figure 75 – Start point context menu

9.7 Interacting with Objects

9.7.1 Creating an Object

To create an object, drag the object card to an empty space on the workspace (Figure 76). If the object you are creating has become red, then you cannot place it in this place on the workspace — find an empty space for the object (Figure 77).

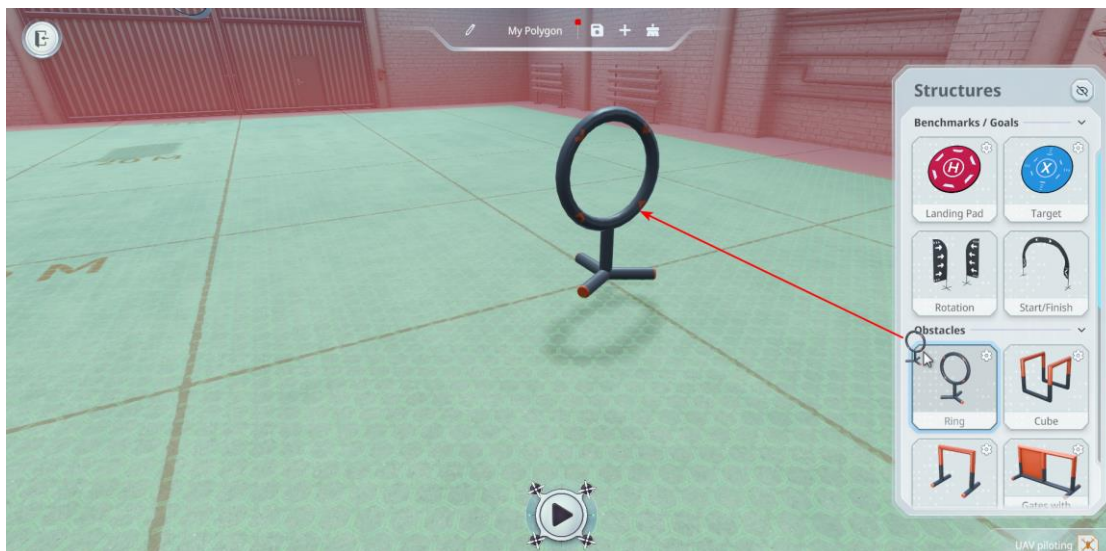


Figure 76 – Creating an object

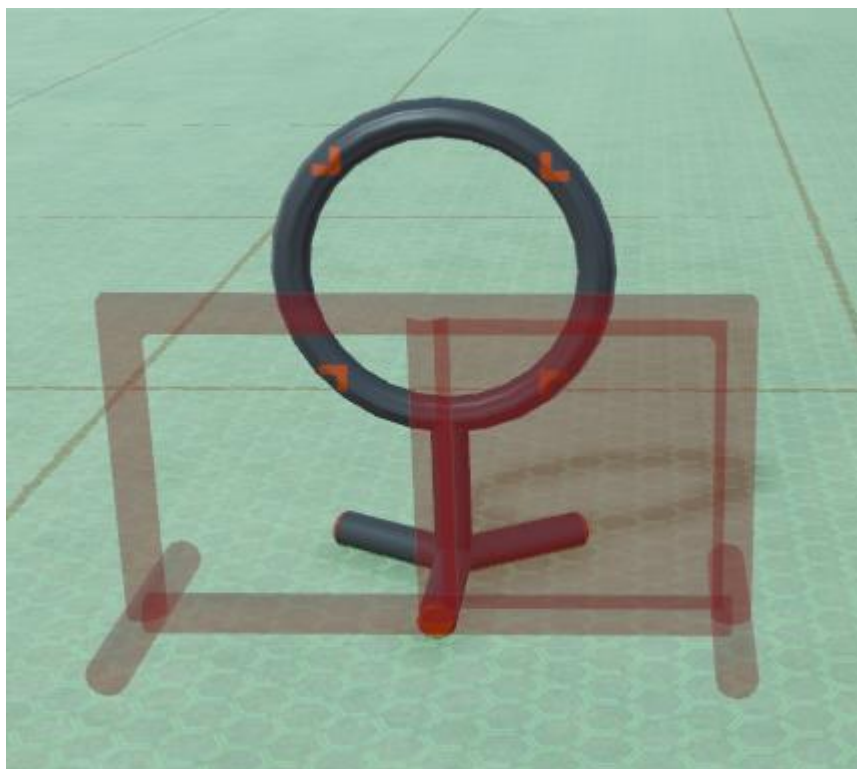


Figure 77 – Object in an inaccessible area

9.7.1.1 Object context menu

For each object, a context menu is provided, which contains all available actions with the object. To open the context menu, click on the object in the workspace.

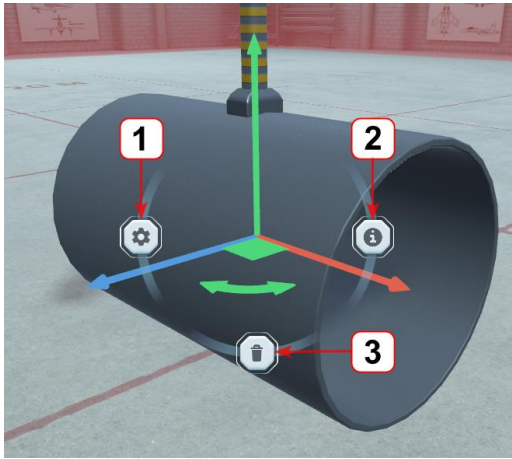


Figure 78 – Context menu of "Structures" objects (buttons)

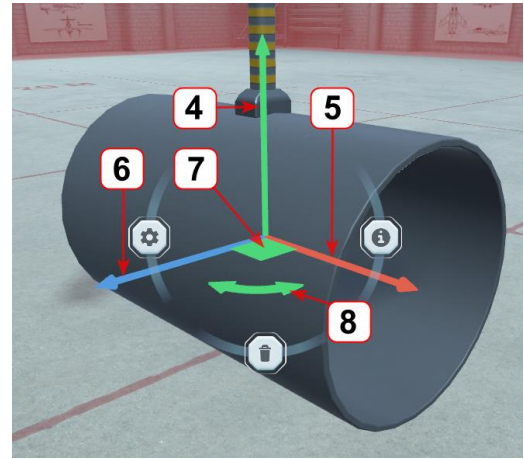


Figure 79 – Context menu of "Structures" objects (manipulators)

Object context menu (Figure 78, Figure 79) includes the following elements:

- **Settings button** (1) navigates to the constructor of the selected object (see [9.7.4 «Editing an Object»](#)).
- **Info button** (2) allows you to view information about the selected object (see [9.7.3 «View property information»](#)).
- **Delete button** (3) is designed to remove an object from the scene (see [9.7.5«Deleting an object»](#)).
- **Movement manipulators** allow you to move the object along the axes (4, 5, 6) and along the plane (7) — simultaneously along axes 5 and 6 (see [9.7.2 «Moving and rotating an object»](#)). Manipulator 4 is absent in floor objects. Manipulator 7 is absent in suspended objects.
- **Rotation manipulator** (8) allows the object to rotate around its axis 4 (see section 1). [9.7.2 «Moving and rotating an object»](#)).

9.7.2 Moving and rotating an object

To **move** an object in the workspace, open the context menu (see [9.7.1.1 «Object context menu»](#)), then:

- to move along one of the axes, press the manipulator (4, 5 or 6, Figure 79) and drag it along the appropriate axis until the object is in the desired location; in suspended structures, movement along the blue axis (6) occurs along the beam, movement along the green axis (7) changes the length of the suspension cable, and movement along the red axis (5) causes the object to be hung from the beam to the one closest to the user indicator; In floor structures, there is no manipulator (4) and movement along it.
- to move along two axes at once (5 and 6, Figure 79) select the manipulator (7) and pull it until the object is in the desired place; In suspended structures, there is no manipulator (7) and movement simultaneously along axes 5 and 6.

To **rotate** an object around its axis in the workspace, open the context menu (see [9.7.1.1 «Object context menu»](#)), then:

- press the manipulator (8, Figure 79),
- drag the handle around the circular scale that appears until the object rotates to the desired angle (Figure 80).

The object is rotated around an axis perpendicular to the floor plane and passing through the intersection point of the axes in the context menu.

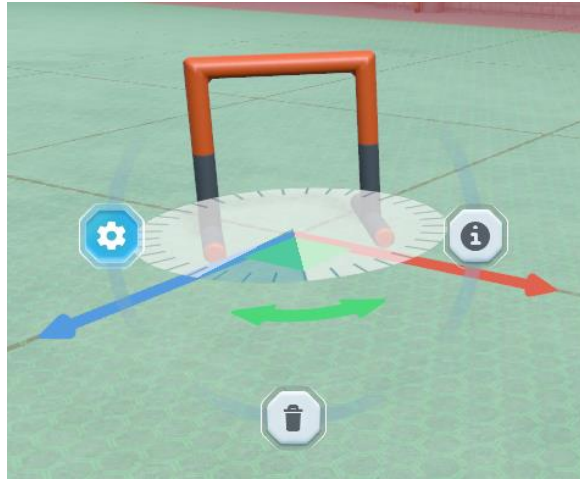


Figure 80 – Structure rotation

9.7.3 View property information

To get acquainted with information about the object:

- before creating an object, click on its card (3 in the Figure 43) and the panel (1 in the Figure 43);
- in the workspace, open the context menu (see 9.7.1.1 «Object context menu»), click the info

button  (Figure 81).

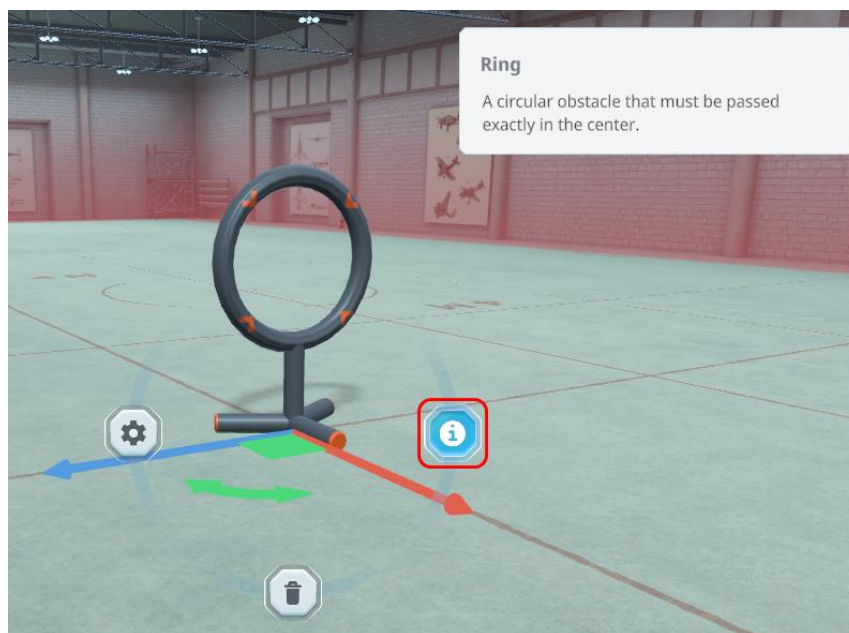


Figure 81 – Info button

9.7.4 Editing an Object

For editing **settings** use the Object constructor (see 9.7.4.1 «Object constructor»).

9.7.4.1 Object constructor

The object constructor (Figure 83) is used to configure the settings of an object before placing it in the workspace and to modify the settings of objects that have already been placed. Depending on the object, you can select a color in the Constructor, set the diameter, height, width, length of the object or its structural elements, and the type of object. For objects that cannot be modified, the Object constructor is not provided.

To open the object constructor:

- before creating an object, click on the object card; if you want to change the object settings, the object designer appears next to the "Structures" panel (Figure 43);
- after creating an object, open the context menu (see 9.7.1.1 «Object context menu»), click the settings button  (1, Figure 78), the object constructor appears in the upper-left corner (Figure 82). If the selected object does not contain settings that can be edited, the settings button will be grayed out.



Figure 82 – Object constructor in the workspace

Constructor parameters (Figure 83) depends on the selected object:

- Color options (1) and object types (4) have a fixed set of options. You need to choose one of the options offered.
- Some parameters have a range of values (2, 5). For each parameter, there is a panel displaying the current value (6), a slider (7), and a slider (8). You can set a new parameter value in one of the following ways:
 - click on the slider area;
 - drag the slider slider.
- If the parameter has a fixed value of "Yes/No" ("Hanging structure"), then its value is set using the checkbox (3). This setting cannot be changed after the object has been created.

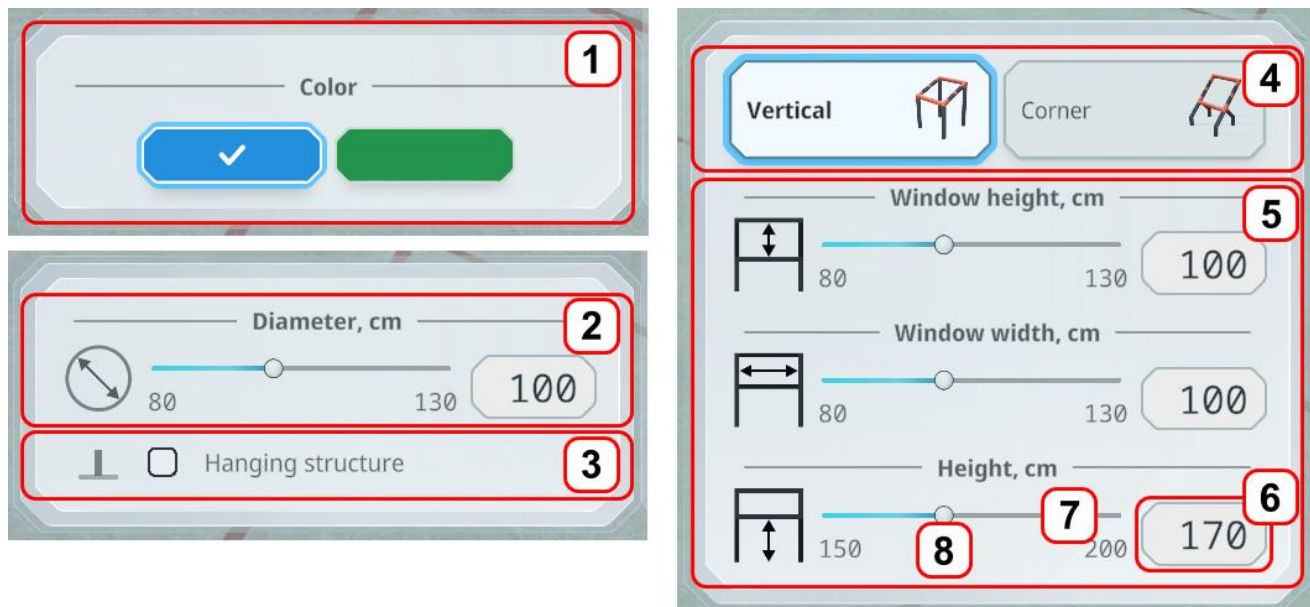


Figure 83 – Object constructor parameters

To close the constructor opened through the "Structures" panel, click on the object card. To close the designer in the workspace, click the  in the context menu (1, Figure 78) or any point on the screen outside of the design and assembly panels, as well as outside the context menu.

9.7.5 Deleting an object

To delete an object, open the context menu (see 9.7.1.1 «Object context menu»), click the delete button  .

9.8 Scene panel



Figure 84 – Stage Control Panel

Scene control panel (Figure 84) includes:

- A field for entering the name of the scene (1). The title can be up to 36 characters.
- A mark (2) indicating that the scene has not been saved. after saving, the red mark disappears;
- "Saving a scene" button (3) (see 9.8.1 «Saving a scene»);
- "Creating a new scene" button (4) (see 9.8.2 «Creating a new scene»);
- "Clearing the scene" button (5) (see 9.8.3 «Clearing the scene»).

9.8.1 Saving a scene

To save a scene, click the "Saving a scene" button (3) in the menu working with scenes (Figure 84).

If the scene has already been saved, the application will overwrite the contents of the scene. If the "Scene name" field was previously filled, the application will save this record. If the scene is saved for the first time, the save form (Figure 85).



Figure 85 – Scene Save Form

Enter the **name** of the scene you want to save (up to 36 characters) in the corresponding field and click the "Save" button. If the field with the name of the scene was previously filled in in the row directly in the Scenes panel, then this entry will be displayed when saving the scene; this entry can be changed.

To cancel saving a scene, click the "Cancel" button.

To exit the closed range constructor, click the  in the upper left corner (see [9.11 «Exiting the Closed Range Designer»](#)).

Saved scenes can be selected for simulation in the scene selection block on the "Saved" tab (see [8.1.1 «Scene selection block»](#)).

9.8.2 Creating a new scene

To create a new scene, click the "Creating a new scene" (4, Figure 84) in the scene panel. If the scene has unsaved data, the "Saving a draft" window opens (Figure 85).

To avoid losing the current data, click the "Save" button and save the scene. After that, a new scene will open.

If you decide not to create a new scene yet or change the current one, then click the "Cancel" button and you will return to the current unsaved scene.

You can also create a new scene in the scene selection and settings block (see [8.1 «Scene selection and settings block»](#)). To do this, click button 5 in the Figure 21.

9.8.3 Clearing the scene

To clear the scene of all structures (except for the Starting point), click the "Clearing the scene" button (5, Figure 84). A confirmation window opens (Figure 86).

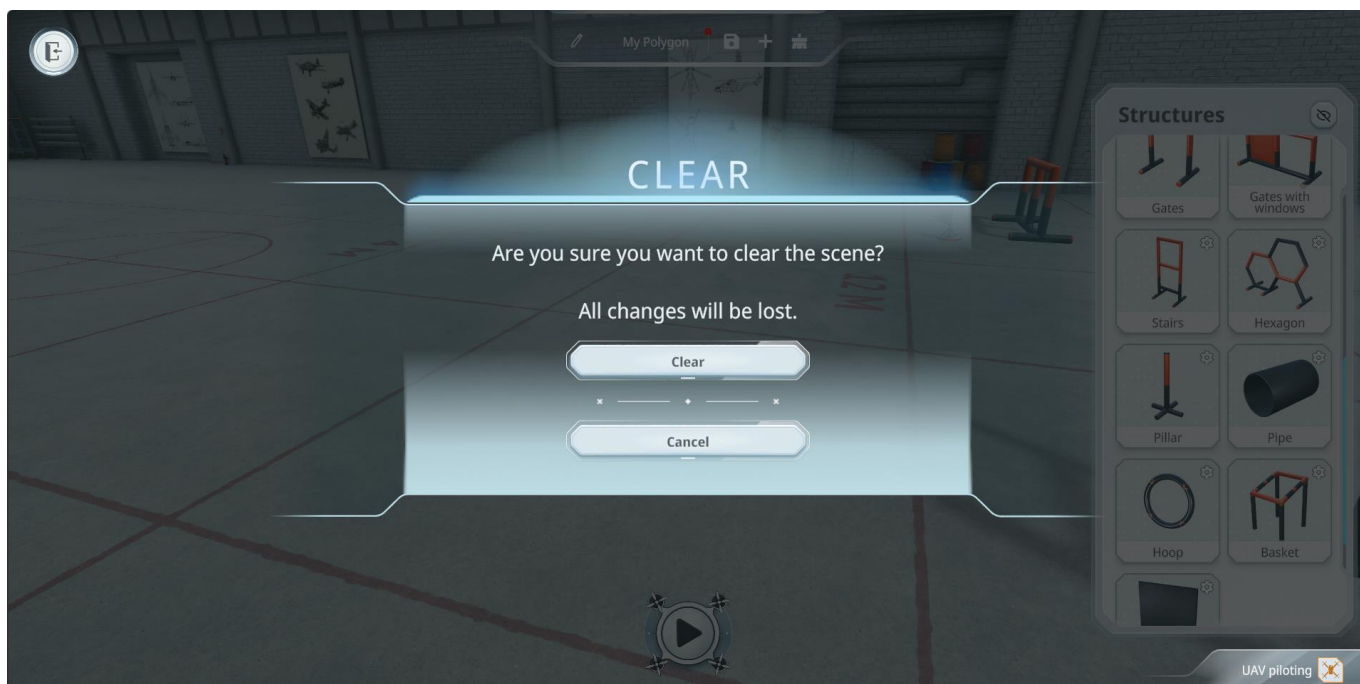


Figure 86 – Scene clearing confirmation window

Click the "Clear" button to clear the scene or the "Cancel" button to abandon the action.

To exit the closed range constructor, click the  in the upper left corner (see [9.11 «Exiting the Closed Range Designer»](#)).

9.9 Go to the simulation in the current scene

To go to the simulation in the current scene, press the go to simulation button (6, Figure 41). If the scene has not been saved, a window will first appear prompting you to save the scene (see [9.8.1 «Saving a scene»](#)). For the following, see [10 «Simulation in Free Mode»](#).

9.10 Deleting a scene

To delete a scene, go to the scene selection block, select the required scene in the "Saved" tab and delete it (see [5.1.1 «Scene selection block»](#)).

9.11 Exiting the Closed Range Designer

To exit the closed range constructor, click the exit mode button (2, Figure 41). If the scene has not been saved, a save window (Figure 87).

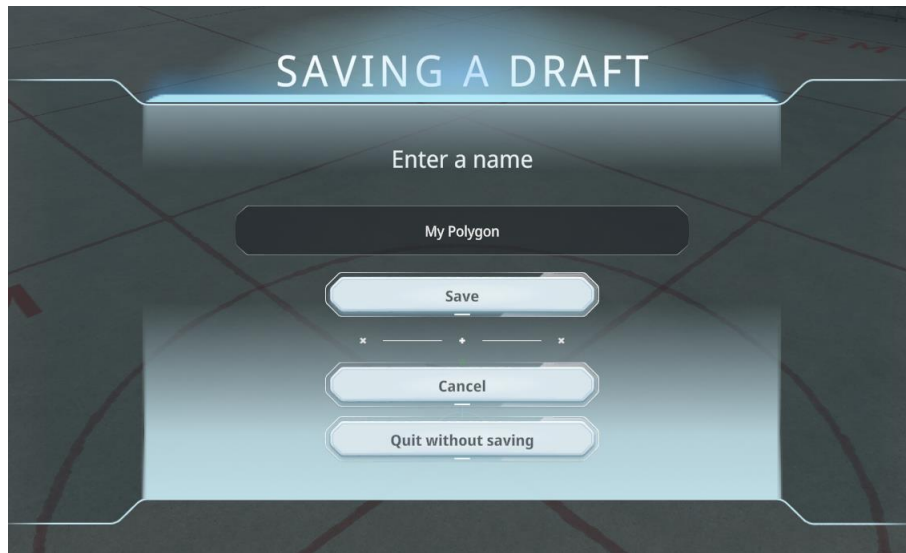


Figure 87 – Saving the scene when exiting Scene constructor mode

Enter the **name** of the scene you want to save (up to 36 characters) in the corresponding field and click the "Save" button. If the field with the name of the scene was previously filled in in the line directly in the Scenes panel, then this entry will be displayed when saving the scene, and this entry can also be changed at your discretion.

To cancel the exit of the mode and go back to the currently unsaved scene, click the "Cancel" button.

To exit without saving the current scene, click the "Quit without saving" button.

10 Simulation in Free Mode

To go to the simulation, press the "Start" button 5 (Figure 20) or 6 (Figure 41). First, it is necessary to perform pre-flight preparation (see [10.1 «Pre-flight preparation»](#)), then turn on the UAV to switch to direct piloting ([10.2 «Piloting»](#)).

10.1 Pre-flight preparation

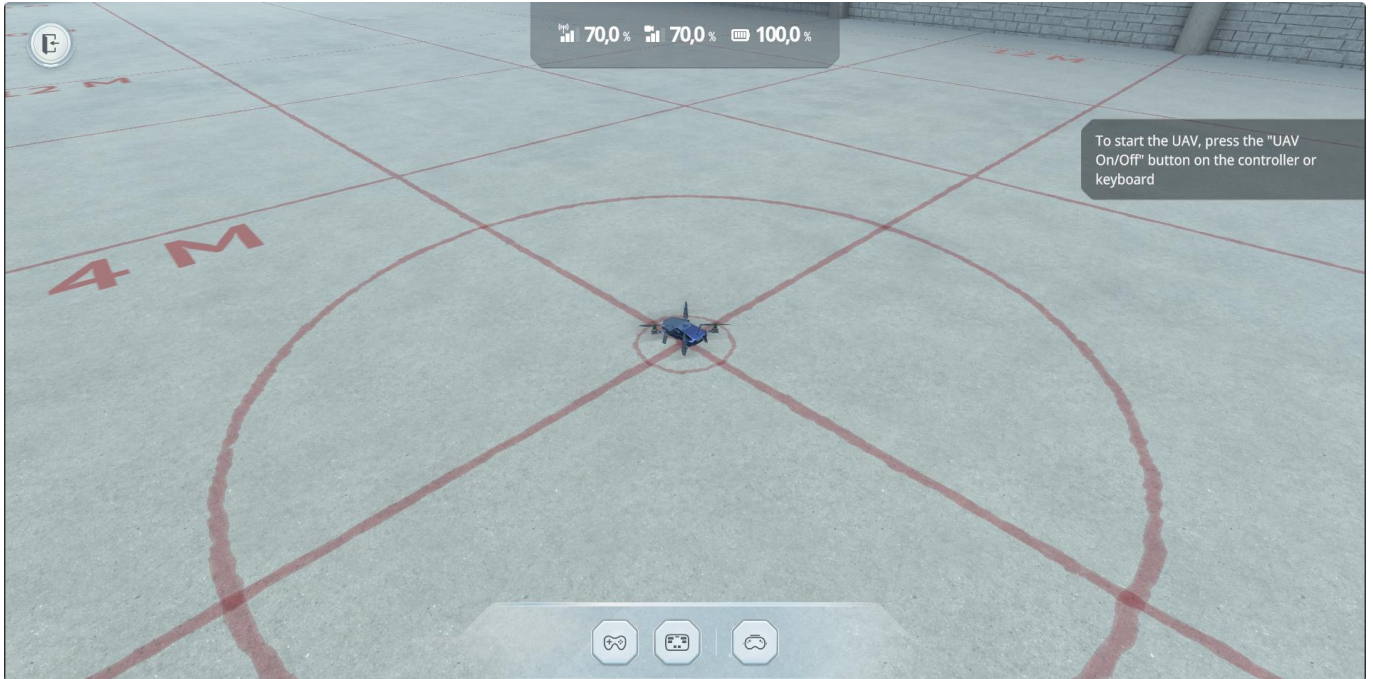


Figure 88 – Pre-flight preparation ("Free mode", closed range)



Figure 89 – Pre-flight preparation ("Free mode", open range)

The interface of the pre-flight preparation screen (Figure 88, Figure 89) includes:

- the "Return to previous menu" button (1), which returns to the selection menu (see [8 «"Free Mode" Selection Menu»](#)) or Scene constructor (see [9 «Closed range constructor»](#));

- options panel:
 - control station signal level (2);
 - video signal level (3);
 - battery charge (4);
- toolbar (5);
- a working area centered on a UAV model (6);
- quick access panel to settings:
 - control (7, see [10.1.1 «Control Settings»](#));
 - interface (8, see [10.1.2 «UI Settings»](#));
 - weather (9, see [10.1.3 «Adjusting weather conditions»](#)); button (9) is missing in a closed range;
 - FPV systems (10, see [10.1.4 «FPV System Unit»](#)).

10.1.1 Control Settings

To go to the control settings, press button 7 (Figure 89).

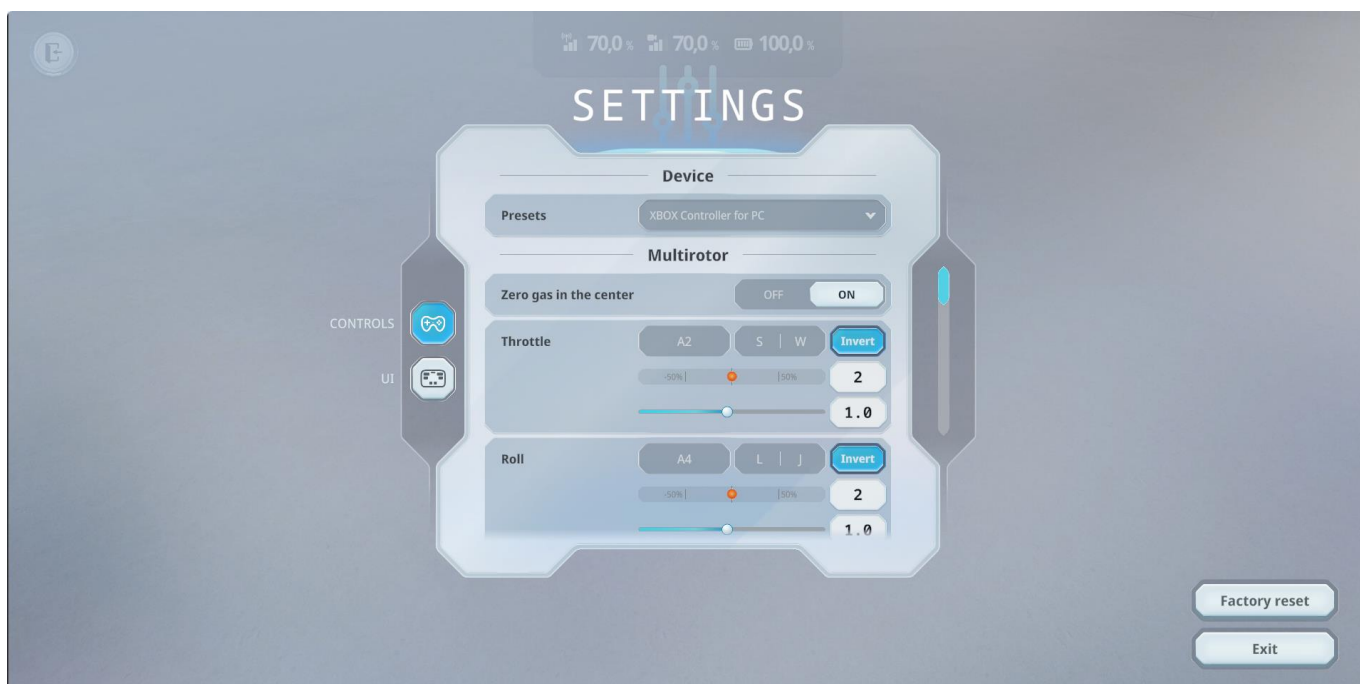


Figure 90 – Control settings

The management settings consist of the following sections:

- Device,
- Multirotor,
- Aircraft,
- Controls,
- Hybrid,
- Airplane.

To return to the preset settings, click the "Factory reset" button. To exit the control settings, press the "Exit" button.

10.1.1.1 Device

In the "Device" section, in the drop-down field, select the control device you are using, the settings (presets) for it will be displayed in the following sections. You can change the settings of the control device for different types of UAVs and they will be saved in the current session of the Simulator.

Devices for selection:

- DualSense PS Controller (see [3.2 «PS DualSense control»](#));
- XBOX Controller for PC (see [3.3 «XBOX Wireless Controller Control »](#));
- Radiomaster pocket (see [3.4 «Professional Remote Control»](#)).

10.1.1.2 Multirotor

The Multirotor and Airplane sections include:

- Zero gas in the center (Off/On) moves the zero throttle value to the neutral position of the stick. It is used for gamepads, because, unlike the UAV control equipment, the sticks are not fixed in the extreme position and return to neutral.



Note: OFF is ignored in ANGLV mode (Angle with height stabilization, default mode is ON), there are no changes to the settings.

For each UAV control channel (Throttle, Roll, Pitch, Yaw) are configured (Figure 91):

- control (1),
- dead zone (2),
- sensitivity (3).

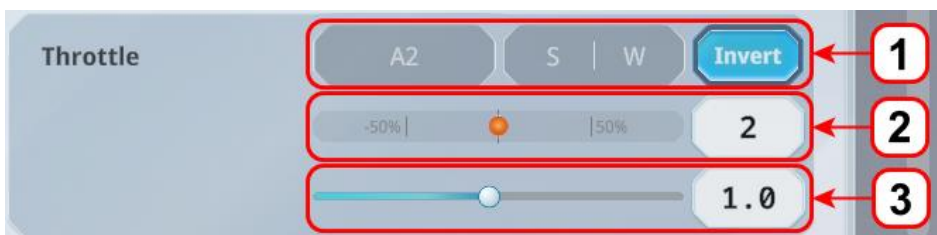


Figure 91 – Settings of UAV control channels

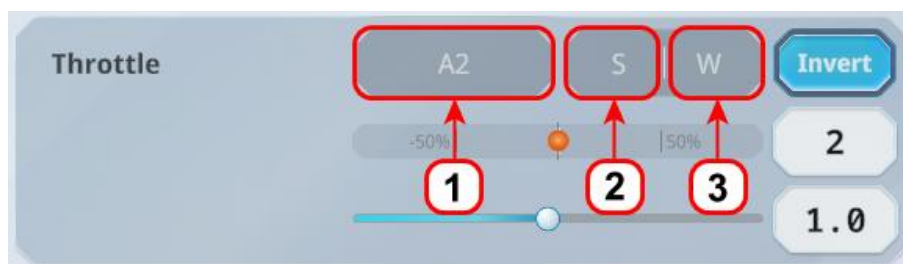


Figure 92 – Settings of buttons and keys for UAV control

For **Control channel settings** (Figure 92) of the selected **devices**:

- press the "1" button, a circular rotating arrow will appear;
- select the stick that will be responsible for the channel and the direction of its movement;

- move the stick along the selected axis (up/down, right/left).

The "1" button will display the name of the selected axis for your device.

To change the direction by 180° (invert), press the "Invert" button. This button applies only to the control channel of the professional console (Radiomaster pocket).

To **adjust the keypad control channel** and the direction of its movement along the **negative part of the axis** (down/left/counterclockwise):

- press the "2" button, a circular rotating arrow will appear;
- select and press the key on the keyboard that will be responsible for the channel and the direction of its movement (down/left/counterclockwise).

The "2" button displays the name of the selected key.

To **adjust the keypad control channel** and the direction of its movement along the **positive part of the axis** (up/right/clockwise):

- press the "3" button, a circular rotating arrow will appear;
- select and press the key on the keyboard that is responsible for the channel and its direction of movement (up/right/clockwise).

The "3" button will display the name of the selected key.

Invert is a change in direction. For example, the input signal from the axis/key is inverted (example: physical stick up, emulator down).

Dead zone (2) — specifies an axis segment with the middle in the neutral position of the sticks to avoid interference.

Sensitivity (3) — depending on the factor selected for the axis, the transmitted value is increased or decreased. Setting range: from 0.1 to 2, with an accuracy of 0.1. The lower the control sensitivity, the slower the UAV will be controlled.

10.1.1.3 Aircraft

See. [10.1.1.2 «Multirotor»](#).

10.1.1.4 Controls

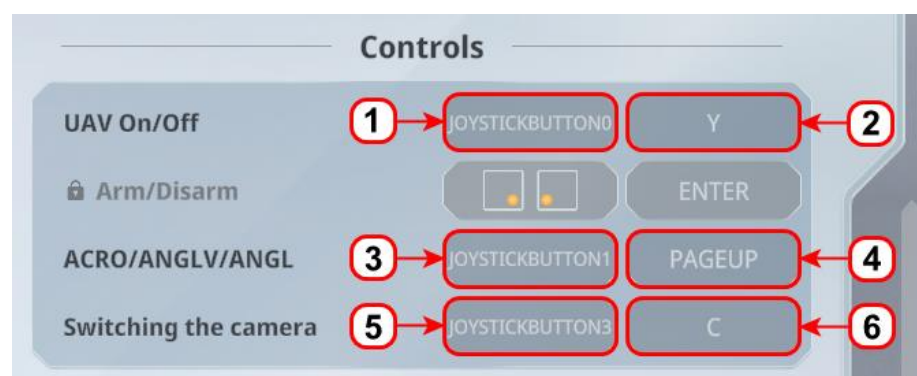


Figure 93 – UAV control settings

To set buttons turning on and off the UAV, switching ACRO/ANGLV/ ANGL, switch camera **on the device of your choice** (Figure 93):

- press the "1", "3" or "5" button, a circular rotating arrow will appear;
- select and click the button responsible for the corresponding functionality.

The "1", "3" or "5" button will display the name of the selected key.

To set the UAV power on and off **key**, toggle ACRO/ANGLV/ ANGL, switch the camera **on the keyboard**:

- press the "2", "4" or "6" button, a circular rotating arrow will appear;
- select and press the key on the keyboard responsible for the corresponding functionality.

The "2", "4" or "6" button will display the name of the selected key.

10.1.1.5 Hybrid

The installation of a button and a key to switch between aircraft and copter modes in a hybrid -type UAV is similar to [10.1.1.4 «Controls»](#).

10.1.1.6 Airplane

The installation of buttons and keys for launching from the installation and release of the parachute for aircraft-type UAVs and hybrid -type UAVs in the aircraft mode is similar to [10.1.1.4 «Controls»](#).

10.1.1.7 Go to interface settings

To go to the interface settings, click the "UI" button  (Figure 90).

10.1.1.8 Factory reset

To return to the preset settings, click the "Factory reset" button (Figure 90).

10.1.1.9 Exiting settings

To exit the settings, click the "Exit" button (Figure 90).

10.1.2 UI Settings

To go to the interface settings, click the  (8, Figure 89) or the "UI" button  (Figure 94).

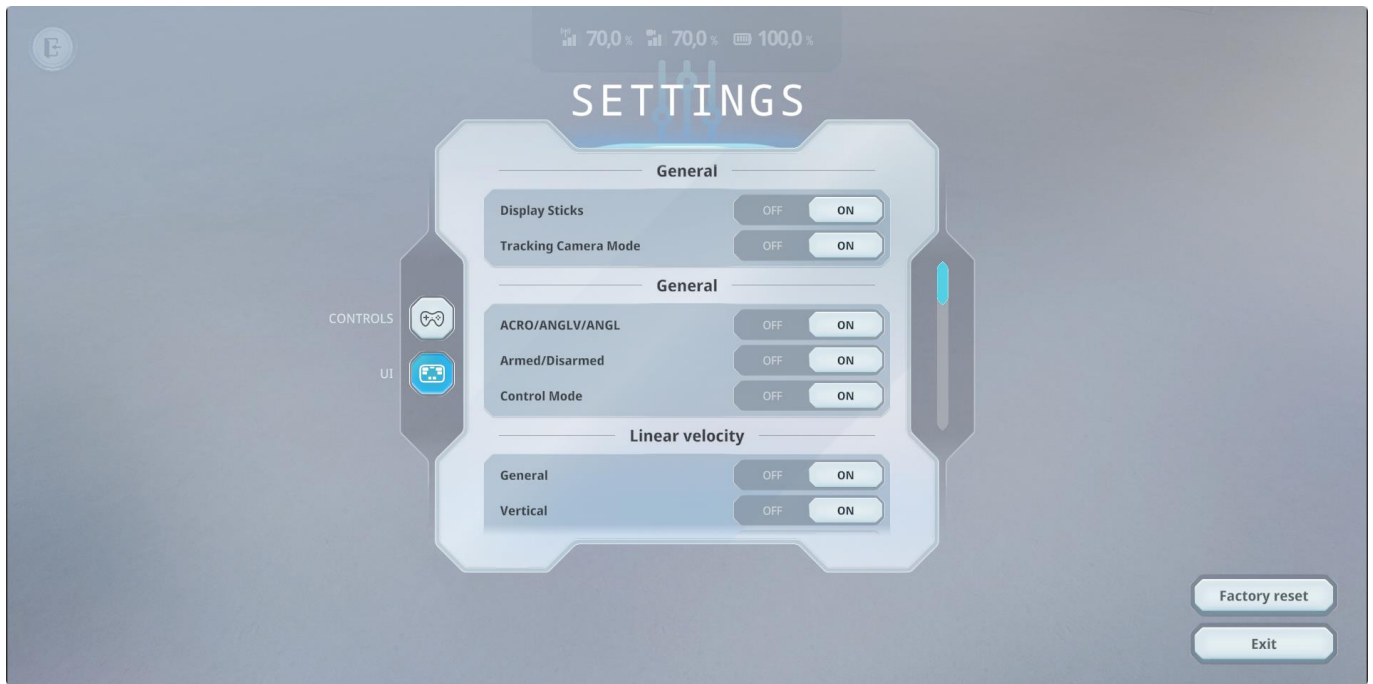


Figure 94 – Interface settings

In the "Interface" section, you can turn off and turn back on the display of dashboard settings on the screen (Figure 95, 10.2.2.1 «Dashboard») and the camera's "Tracking" mode (see 5 «Camera»). In the Figure 95 the options displayed in the interface are indicated.

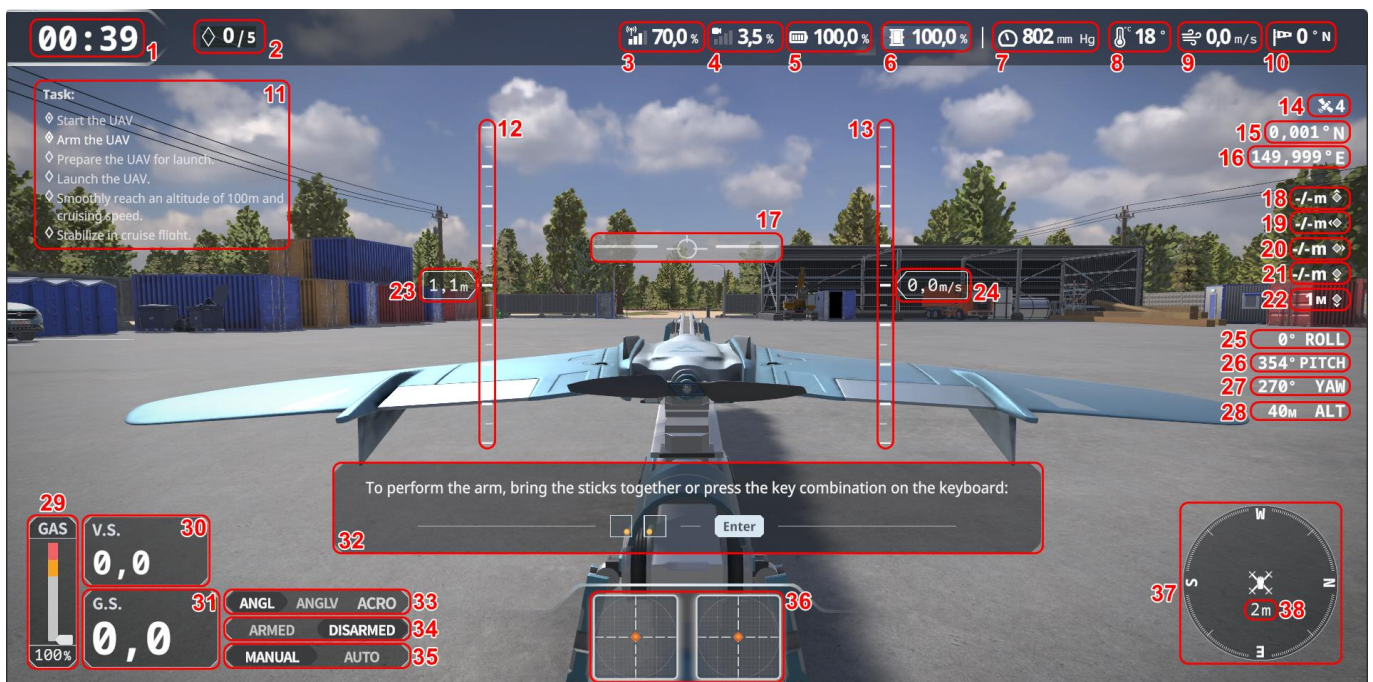


Figure 95 – Dashboard

10.1.2.1 Settings

The "General" section includes:

- Display Sticks (36),
- Tracking Camera Mode.

The "General" section includes:

- ACRO/ANGLV/ANGL (33),

- Armed/Disarmed (34),
- Control Mode (35).

The "**Linear velocity**" section includes:

- General (24, 13),
- Vertical (30),
- Horizontal (31).

The "**Angular Velocity**" section includes:

- Roll (25),
- Pitch (26),
- Yaw (27),
- Course (37),
- Artificial horizon (17),
- Flight Timer (1),
- Throttle position (29).

The "**Navigation**" section includes:

- Altitude (28),
- Height above ground (24, 13),
- Distance to the operator (38),
- Distance to obstacles (18 – in front, 19 – left, 20 – right, 21 – behind, 22 – down).

The "**GPS coordinates**" section includes:

- GPS coordinates (15, 16),
- GPS signal strength (14).

The "**System Status**" section includes:

- Battery charge (5),
- Fuel level (6),
- Control Signal Strength (3),
- Video Transmitter Signal Strength (4).

The "**Meteorological data**" section includes:

- Atmospheric pressure (1),
- Temperature (8),
- Wind speed (9),
- Wind direction (10).

Options 2, 11, 32 are not disabled through the interface settings.

10.1.2.2 Go to control settings

To go to the control settings, click the "Control" button  (Figure 90).

10.1.2.3 Factory reset

To return to the preset settings, click the "Factory reset" button (Figure 90).

10.1.2.4 Exiting settings

To exit the settings, click the "Exit" button (Figure 90).

10.1.3 Adjusting weather conditions

To switch to the weather settings, press the  (9, Figure 89).

The weather conditions are adjusted in a similar way to [Ошибка! Источник ссылки не найден.](#)
[«Weather Conditions Block»](#).

10.1.4 FPV System Setup

To go to the FPV system settings, press the  (10, Figure 89).

The FPV system is configured in the same way as in [8.2.2 «FPV System Unit»](#).

10.2 Piloting

When switching to the "Piloting" state:

- the timer starts;
- the mouse cursor becomes inactive.
- the controls are completely switchable to the control device (gamepad or professional remote control) and the keyboard.

To return to the "Pre-flight preparation" from the state "Piloting" go to the "Pause" menu (press the **Esc** on the keyboard, see [7.3 «"Pause" menu»](#) and click the "Restart" button.

To return to the "Free Mode" selection menu, go to the "Pause" menu (using the **Esc** on the keyboard, see [7.3 «"Pause" menu»](#)) and click the "Complete the simulation" button.

10.2.1 Launch of piloting

To switch to piloting, it is necessary to turn on the UAV. To start the UAV engines, press the "UAV On/Off" button on the control device or keyboard (see [3 «Control devices»](#)).

10.2.2 Piloting Screen Interface

When the UAV enters the piloting state, the screen of the selected range opens (Figure 96, Figure 97). the screen displays the parameters to be monitored when operating the UAV (see [10.2.2.1 «Dashboard»](#)).



Figure 96 – Piloting screen in a closed range



Figure 97 – Piloting screen at an open range

10.2.2.1 Dashboard

The dashboard (telemetry panel) is a layer of flight and system information displayed in simulation mode.

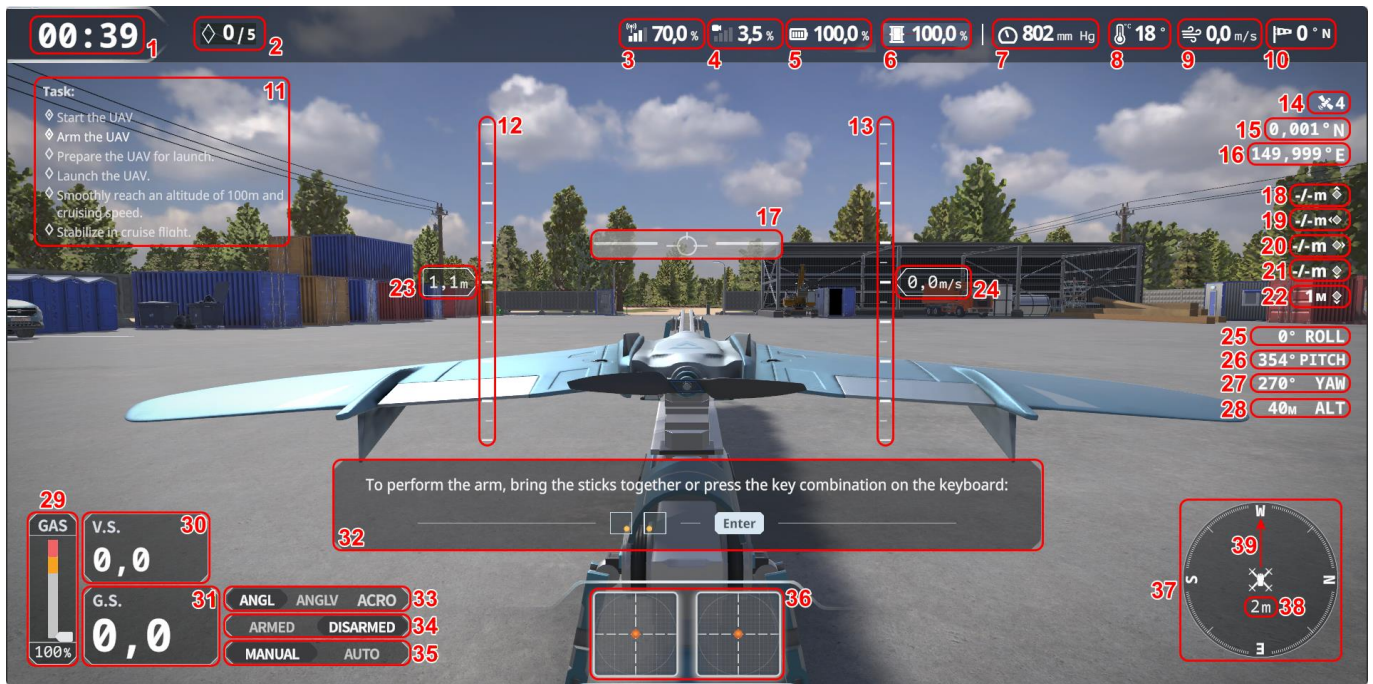


Figure 98 – Telemetry panels on the simulation screen

Dashboard (Figure 98) includes:

- **System status panel:**

- Flight timer (1) — real-time timer in MM:SS format, starts at the moment of UAV launch ("UAV on/off"), pauses when you go to the Pause Menu, stops when the simulation ends. The total value is used in the session statistics if necessary (for example, the completion of the scenario).

- **System status:**

- Control station signal level (3) — depending on the weather conditions (see [Ошибка! Источник ссылки не найден. «Weather Conditions Block»](#)) and external influences, the signal indicator displays the percentage value and the corresponding number of ticks.
- Video level (4) — depending on weather conditions and environmental influences, the video indicator displays the percentage and the corresponding number of tick marks.
- Battery charge (5) — the charge level as a percentage for the entire battery. It is used for UAVs with electric motor(s) and Hybrid-1 with hybrid engine.
- Fuel level (6) — the remaining fuel level. It is used for UAVs with an internal combustion engine and Hybrid 1 with a hybrid engine.

- **Weather data:**

- Atmospheric pressure (7) is the actual pressure at the altitude of the UAV, in mm Hg;
- Ambient temperature (8) is the actual temperature at the UAV flight altitude, in °C;
- Wind speed (9) is the actual wind speed at the UAV flight altitude, in m/s;
- Wind direction (10) is the actual wind direction at the UAV flight altitude, in degrees (°), with an indication of the direction.

– **Navigation and speed:**

- Altitude above ground (AGL) (23) – in meters, rounded to the nearest 0.1, is defined as the vertical distance from the UAV to the ground or water surface at the range, if the distance to the ground is outside the operating range, the value is replaced with "-/-".
- Linear speed, in m/s, corresponds to the speed of movement of the UAV (24);
- Artificial horizon (for FPV camera mode) consists of a sight (17), which is displayed stationary in the center of the screen, side panels (12, 13) — vertical lines equidistant from the sight, which simplify the perception of the angle of inclination of the horizon, Accordingly, roll - tilt around the sight at an angle opposite to the angle of inclination of the UAV, from a horizontal position (horizon), pitch — movement of the artificial horizon vertically in the opposite direction from the inclination of the UAV, commensurate with the inclination of the UAV.
- GPS signal strength (14) — the indicator depends on the surroundings and the number and relative location of connected satellites. To implement coordinate and time tracking, 4 satellites need to be connected.
- GPS coordinates (15, 16) — latitude and longitude in degrees (°), decimal format rounded in a thousandth to display position accuracy up to 1 m; If the signal is lost (insufficient number of satellites), the value is replaced with "-/-".

Position designations:

- N is northern latitude,
 - S is south latitude,
 - E is the east longitude,
 - W is the west longitude.
- Distance to obstacles (18-22) — in meters, determined as the distance from the UAV to the obstacle (building, tree, etc.) in the direction from the sensor; If no obstacle is detected/the distance to the obstacle is outside the operating range, the value is replaced with "-/-".

Sensor designations:

 — in front,  — left,  — right,  (21) — behind,  (22) — down.

- Orientation (25-27) is the angle of deviation from the neutral position, in degrees (°), for roll, pitch, yaw.
- Height above sea level (28), in m.
- Throttle position (29) is the value corresponding to the "throttle flow" taking into account the conversions, in percentage, scale with an indicator from 0 to 100 %.
- The vertical speed (30), in m/s, the vertical component of the speed (along the Oz axis), is the most informative during takeoff and landing.
- Horizontal velocity (31) — in m/s, horizontal component of velocity (in the xOy plane).

- Heading (37) — shows the direction of movement of the UAV similar to a compass. The element is a compass scale with divisions for directions:
 - letter designations N, S, W, E — North, South, West, East;
 - long strokes without a signature — North-West, South-West, North-East, South-West.

Principle of operation: a classic circular compass with a virtual fixed pointer (39) and a movable limb (circular scale).

Also on the compass is the distance to the operator (38), in meters.

– **Main flight parameters:**

- ANGL/ANGLV/ACRO (33) is the currently selected mode (see [10.2.2.2 «Flight modes»](#));
- ARMED/DISARMED (34) — currently selected mode (see [10.2.2.2 «Flight modes»](#));
- MANUAL/AUTO (35) — manual/autopilot control.

– **Stick position indicators (Emulator) (36, see [10.2.3.1 «Stick emulator»](#)).**

– **Information box (32) — displays warnings and prompts.**

– **Script enablers:**

- Task field for scenario (11) — a field containing a list of tasks for the scenario, the current task is highlighted. In some scenarios, a progress bar appears below the quest field, where the full scale is 100%.
- Counter (2) is a counter for the repetition of specified tasks in the script.

10.2.2.2 Flight modes

To switch between ACRO, ANGL, ANGLV modes during piloting, you need to press the buttons/keys responsible for performing this action (see [3 «Control devices»](#)).

At the start of the simulation (by default) the **ANGLV** mode is set.

ACRO (acrobatic) mode — the UAV does not stabilize automatically. The operator has full control over its behavior.

ANGL (angle) mode — there are restrictions on deviations in roll, yaw, pitch. Deviation restriction: 45°. Horizontal position is stabilized.

ANGLV mode (angle+ vertical stabilization) — and is equivalent to the **ANGL** mode, but with additional stabilization of the vertical position (height).

ARMED modes — engine on.

DISARMED modes — engine Off.

10.2.3 UAV control

The UAV is controlled during piloting using a keyboard, a gamepad or a professional remote control (see [3 «Control devices»](#)).

The UAV moves through space by rotating around three axes passing through the center of gravity of the UAV (Figure 99):

- Pitch axis is the transverse (or lateral) axis. Making rotational movements around this axis (pitch), the UAV tilts and flies forward/backward;
- Roll axis is the longitudinal axis. Making rotational movements around this axis (roll), the UAV tilts and flies to the right/left;
- Yaw axis is the vertical axis perpendicular to both the pitch axis and the roll axis. Making rotational movements around this axis of this axis (yaw), the UAV rotates clockwise/counterclockwise.

In addition to the three channels that control the rotation of the UAV around the three axes, there is a gas control channel (Throttle), since the speed at which the UAV will take off and land, as well as fly in the direction specified by the user, will depend on the power supplied to the UAV engines. Thus, there are 4 UAV control channels: Pitch, Throttle, Roll and Yaw.

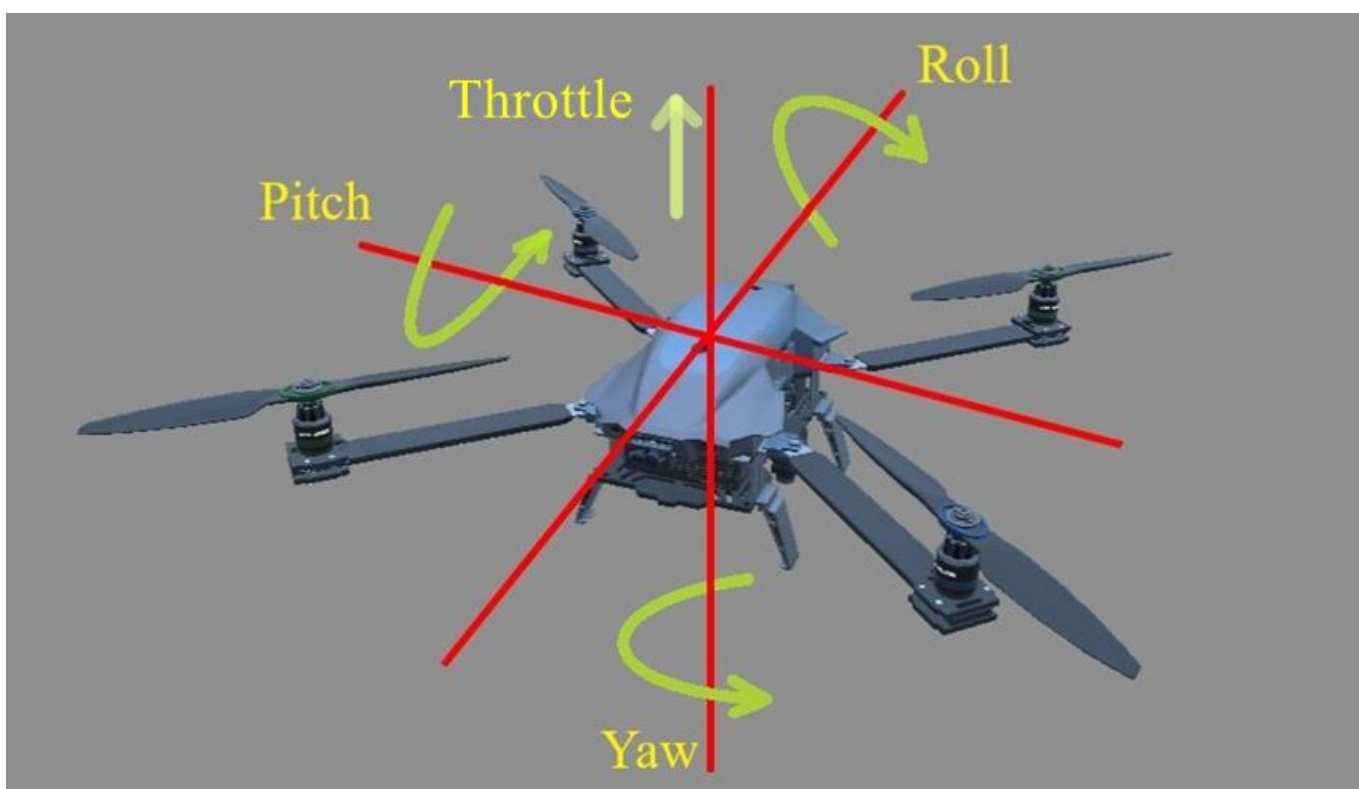


Figure 99 – UAV control channels

To start controlling the UAV, follow these steps:

- 1) Unlock the engines (perform Arm).
- 2) Using the buttons or keys of the control devices (see [3 «Control devices»](#)), control the UAV, avoiding turns, overcoming obstacles and completing tasks.

10.2.3.1 Stick emulator

The stick emulator (stick position indicators) is designed to visually represent the input of thumbstick commands.



Figure 100 – Stick Emulator

It consists of a left and right crosshairs with a vertical and horizontal axes and a stick position marker. The assignment of the emulator axes corresponds to the selected mode.

When you move the stick on the controller or press the corresponding keyboard keys, the stick marker in the emulator is displayed in the corresponding position based on the purpose of the axes.

The axes of movement of the controllers have segments of positive and negative values, a neutral position at zero. Purpose **without inversion** (Figure 101):

- +1 — up/forward/right/clockwise;
- -1 — down/backward/left/counterclockwise.

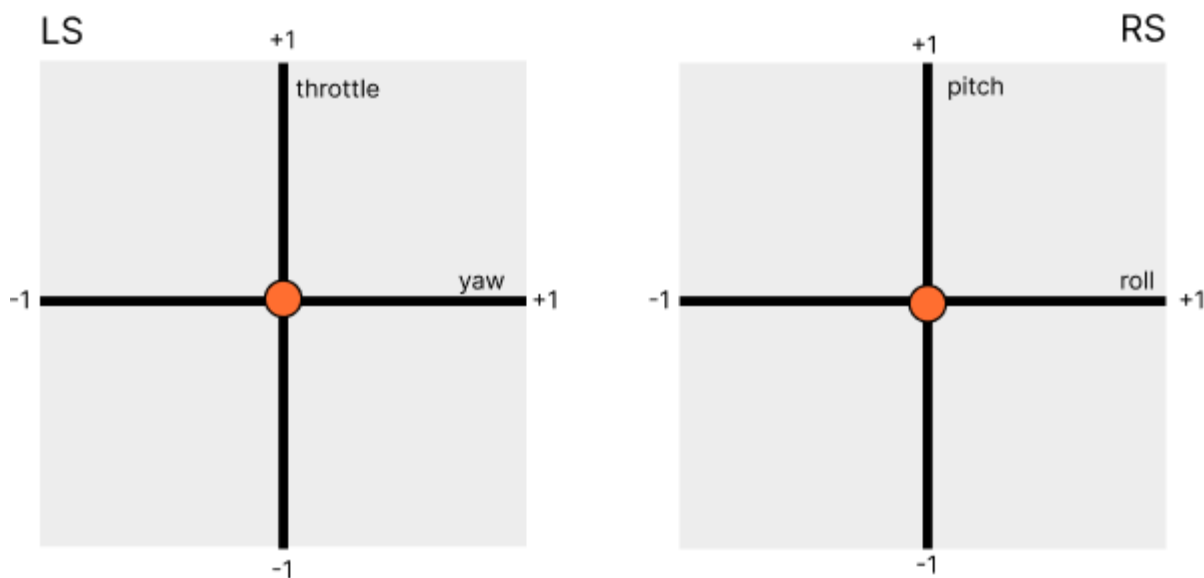


Figure 101 – Example of setting up UAV control channels on stick indicators



Note: displaying the stick position on the emulator takes into account not only the position of the physical stick, but also the dead zone and axis sensitivity settings, applying inversion to individual axes.

10.3 "Pause" menu

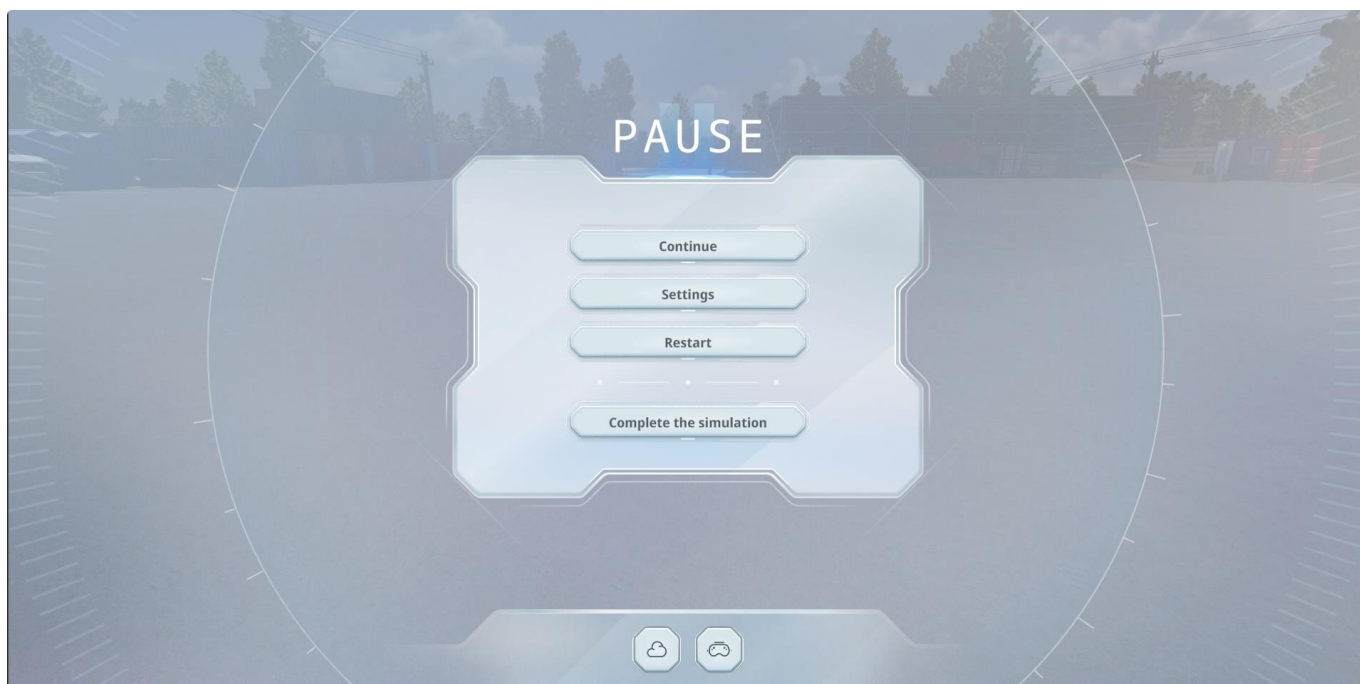


Figure 102 – Pause menu in free mode

If you want to pause the simulation, press the **Esc** and in the "Pause" menu that opens (Figure 102) click:

- the "Continue" button if you want to continue the flight simulation;
- the "Settings" button if you need to change the settings of the device and/or interface (see [10.1.1 «Control Settings»](#), [10.1.2 «UI Settings»](#));
- the "Restart" button if you want to start the flight from the beginning. The "Pre-flight preparation" status screen (Figure 88, Figure 89);
- the "Complete the simulation" button to exit the simulation mode and go to the "Free mode" selection menu;
- the "Weather" button  to switch to editing weather conditions (only for open ranges in free mode, see [Ошибка! Источник ссылки не найден. «Weather Conditions Block»](#));
- the "FPV System" button  to go to editing the settings "FPV Systems" (see [8.2.2 «FPV System Unit»](#)).

10.4 End the simulation

If during the flight there is a strong collision of the UAV with an obstacle and the engines are turned off, the simulation will end (Figure 103).



Figure 103 – Completion of the simulation

Press the "Restart" button to start a new flight, or the "Complete the simulation" button to go to the "Free Mode" selection menu (Figure 20).

11 "Piloting Basics" selection menu

To access the "Piloting Basics" mode selection menu:

- press the "Piloting Basics" button (3, Figure 15);
- select the type of UAV (Figure 104);
- select a specific scenario (Figure 105);
- in the scenario menu, select the option to complete — "Training" or "For evaluation" (Figure 106);
- click the "Get started" button (Figure 106).

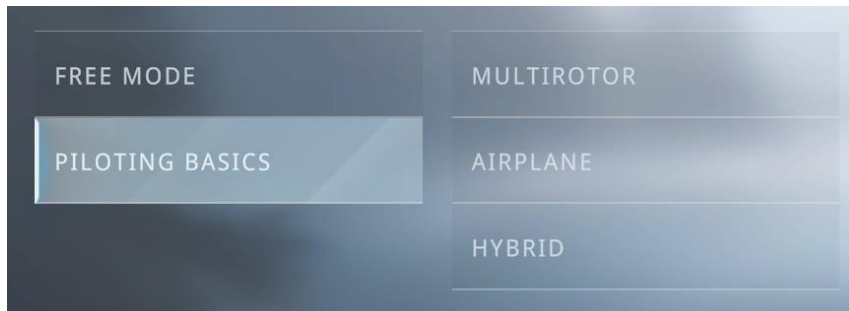


Figure 104 – Selection of the type of UAV



Figure 105 – Selection of a scenario for a specific type of UAV

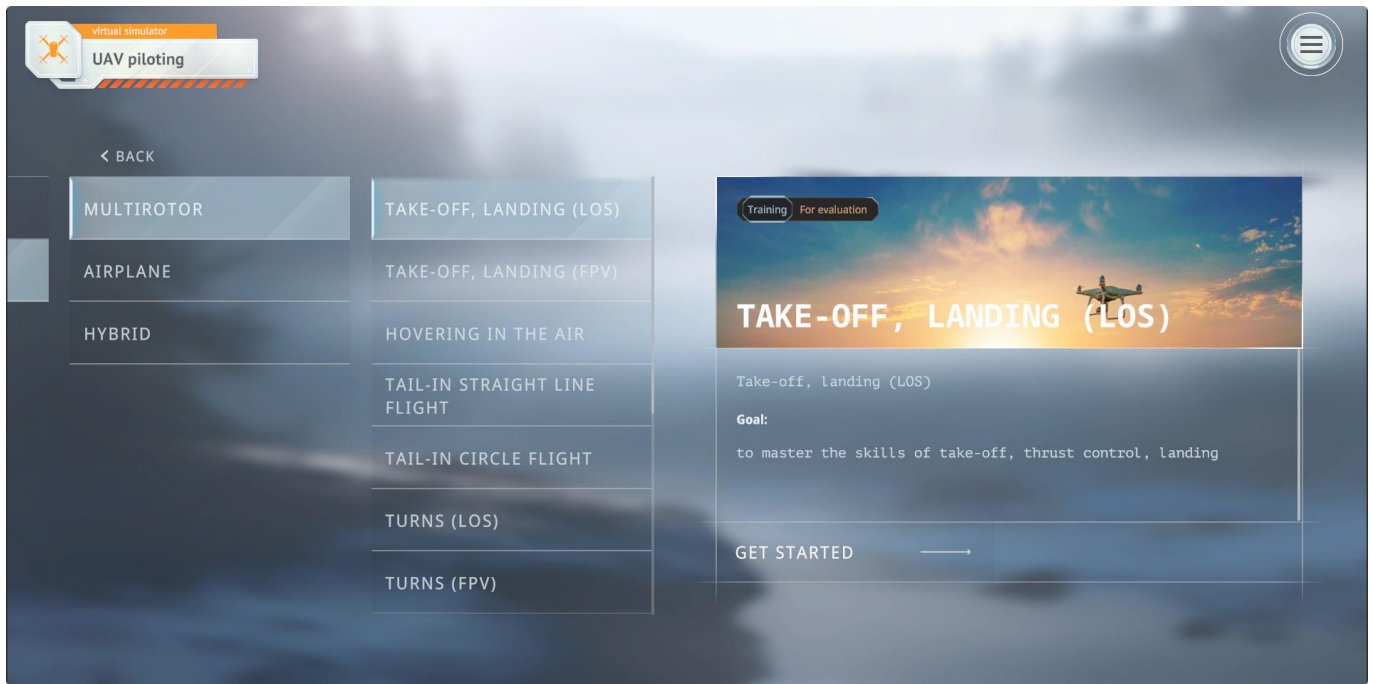


Figure 106 – Menu to go to the scenario for a specific type of UAV

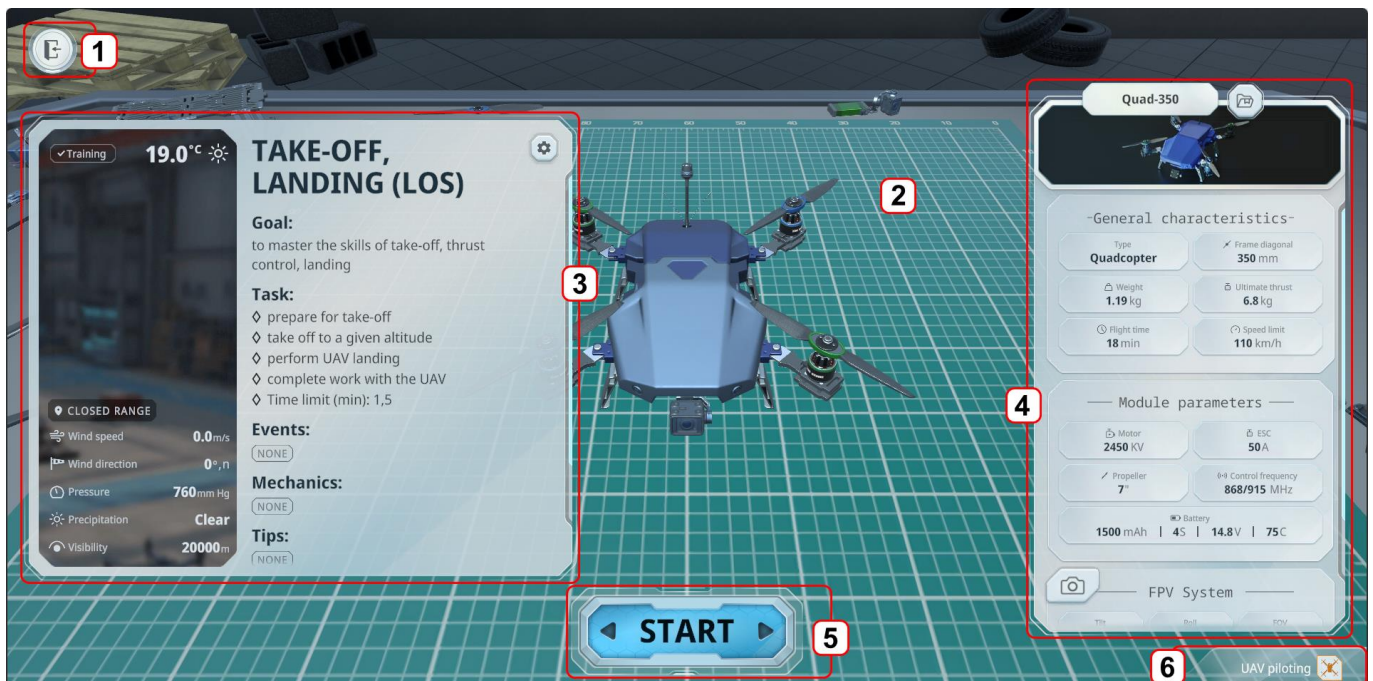


Figure 107 – Elements of the "Piloting Basics" mode window

The interface of the Piloting Basics screen (Figure 107) includes the following elements:

- button "Go to the main menu" (1), which returns to the main menu (see 6 «Main Menu»);
- work area and UAVs (2);
- scenario panel (3, see 11.1 «Scenario panel»);
- UAV selection and configuration unit (4, see 11.2 «UAV selection and configuration unit»);
- the "Start" button (5) to go to the simulation;
- App logo (6).

11.1 Scenario panel

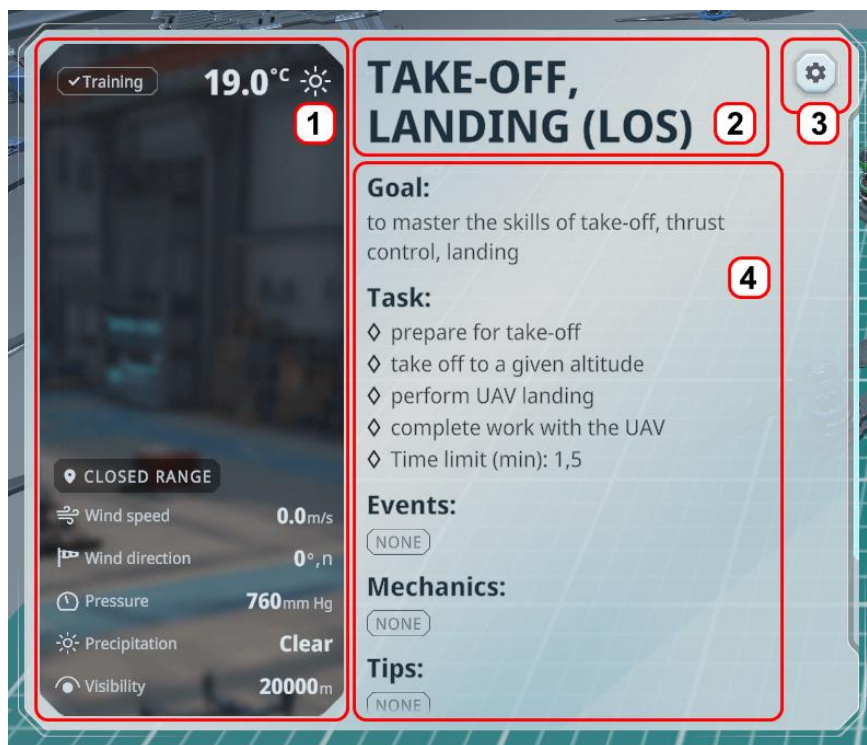


Figure 108 – Scenario panel

Scenario pane (Figure 108) includes:

- name of the scenario (2);
- scene information (1):
 - the option of passing (training, for evaluation);
 - scene type (open range |point of interest, closed range) Point of interest – a place to visit to photograph or destroy;
 - weather information (air temperature, wind speed, wind direction, pressure, precipitation, visibility);
- task information (4) — goal and objectives, as well as information about the presence of events, mechanics, hints, and gate/deviation settings;
- button "Settings" (3) (see [11.1.1 «Parameter display configuration block»](#)) is only present in "Training" mode.

11.1.1 Parameter display configuration block

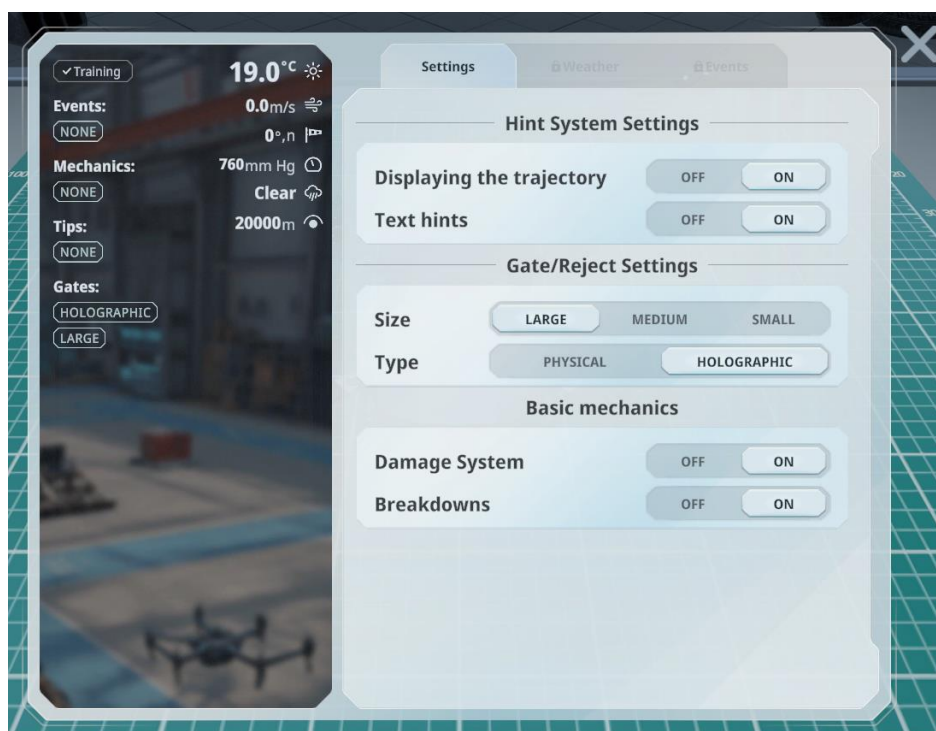


Figure 109 – Parameter display configuration unit

Before executing a script in the "Training" mode, you can edit the settings for displaying some parameters (the "Settings" tab, Figure 109):

- add or remove hints:
 - display the trajectory (see [11.1.1.1 «Trajectory»](#));
 - text hints (see [11.1.1.2 «Text hints»](#));
- select the gate/rejection settings (see [11.1.1.3 «Gates»](#)):
 - size;
 - type;
- add or remove the display of the main mechanics:
 - damage systems (falling, collision with environmental objects affect the level of integrity of the UAV and cargo);
 - breakdowns (there may be a defective part that is generated during pre-flight preparation, if breakdowns are disabled, the number of breakdowns during pre-flight preparation will always be 0).

Switching to the display settings when entering test mode is not available.

To close the block, click the "Close" button  or click anywhere outside the settings window.

The "Weather" and "Events" tabs are locked.

11.1.1.1 Trajectory

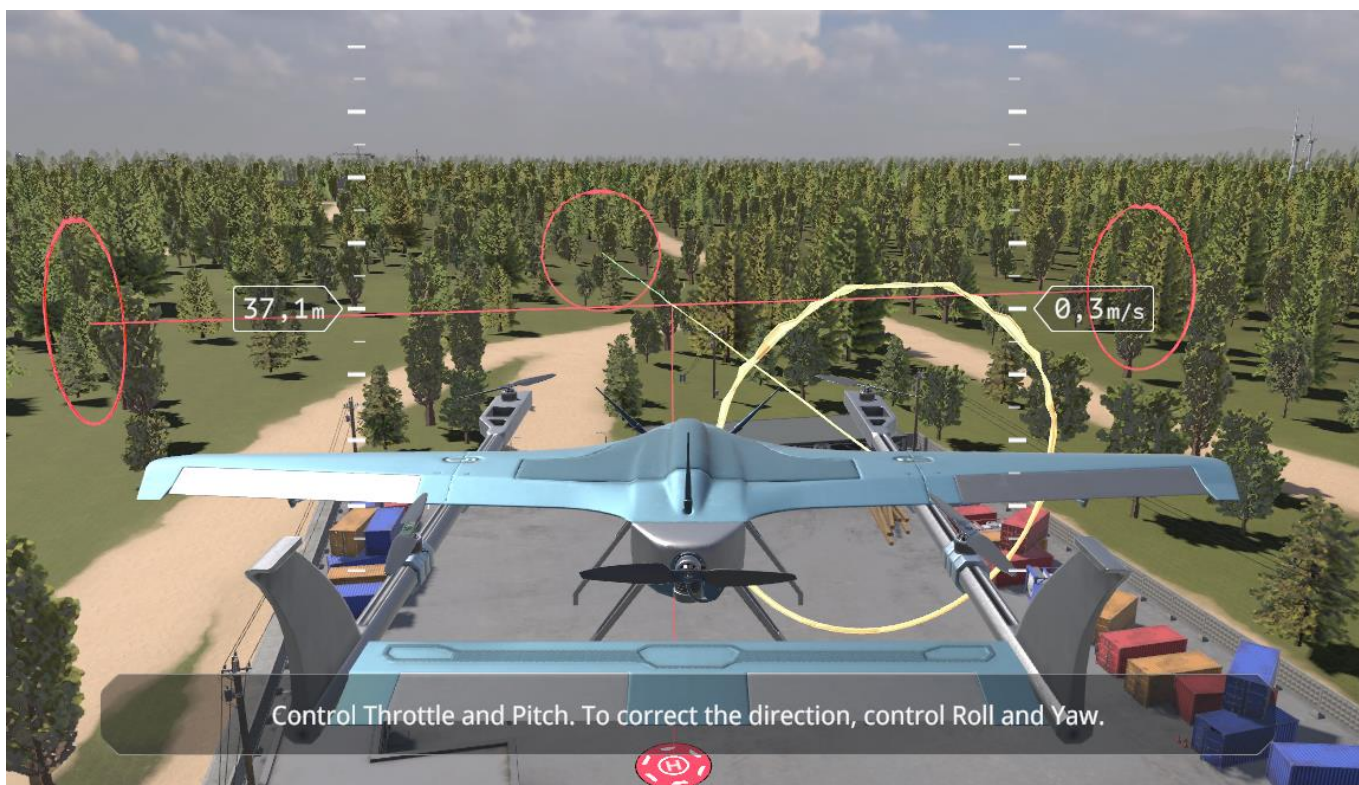


Figure 110 – Display of the trajectory (straight lines)

Trajectory is a hint to the task in the scenario, the path along which the UAV must fly to complete the task.

Yellow indicates the specified trajectory along which you need to fly, green indicates a successfully completed trajectory, and red indicates the rest of the trajectory in the current task.

Trajectories are segments that indicate the correct trajectory of the UAV to complete the task. There are two types:

- straight segments. for vertical movement, movement in a straight line;
- smoothed lines are the components of a circular path.

The path is displayed by default, but it can be turned off (see [11.1.1 «Parameter display configuration block»](#)).

11.1.1.2 Text hints

Text hints (Figure 111) help to control the aircraft in the "Free Mode" and the "Piloting Basics" mode (the option for passing is training).



Figure 111 – Displaying the hints

11.1.1.3 Gates

The gate is a ring through which the UAV must fly.

The gates are illuminated in the following colors:

- green — you need to pass at the moment in accordance with the current task;
- yellow — the gate successfully passed according to the task;
- red — all other gates in the current mission.

There are two types of gates:

- holographic (Figure 112) — collisions are not taken into account;
- physical (Figure 113) — collisions are counted.

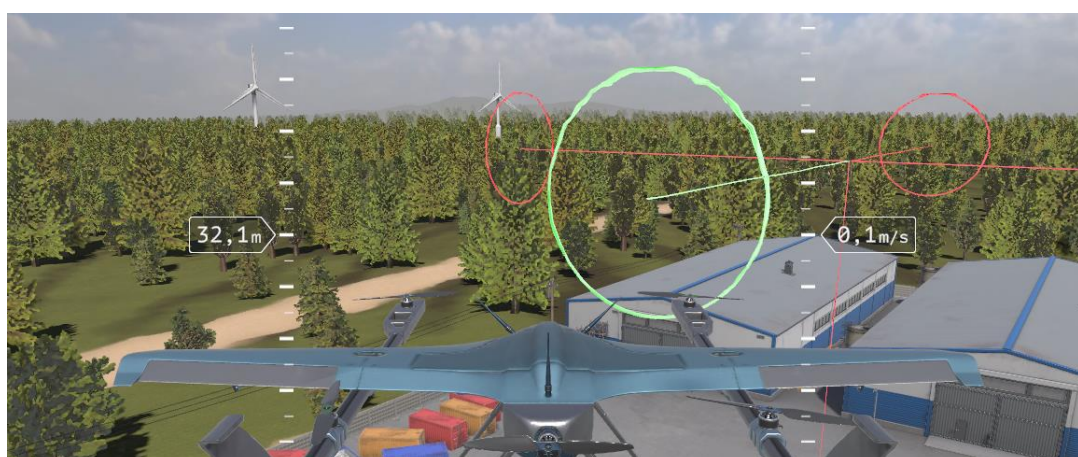


Figure 112 – Displaying the holographic gate

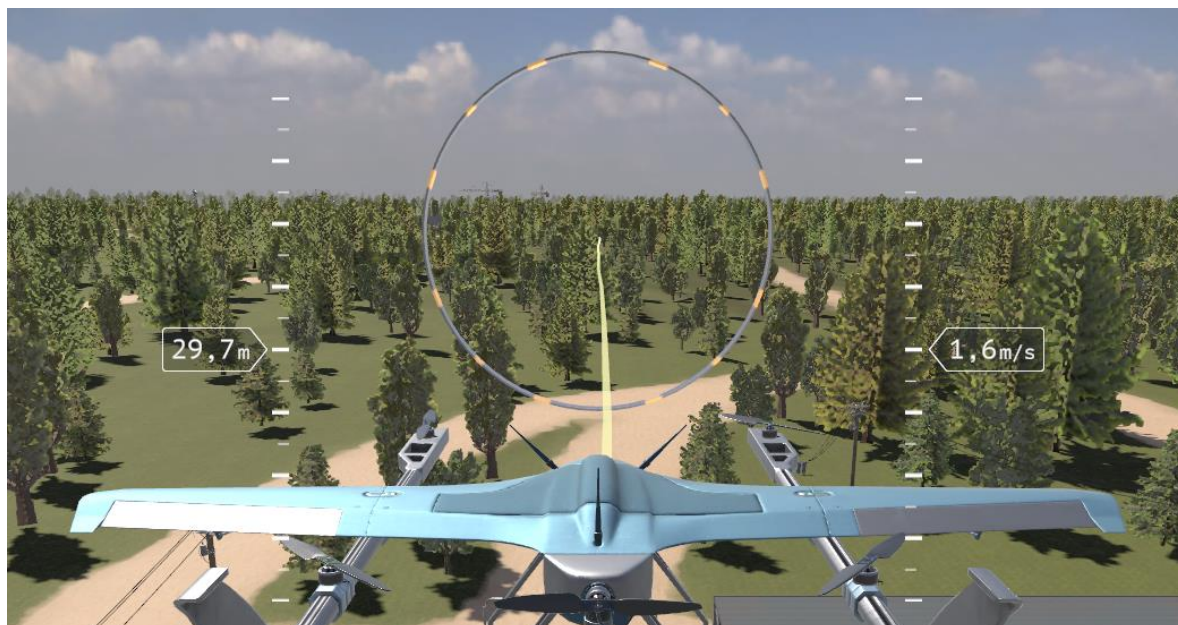


Figure 113 – Displaying the physical gate

You can choose the size of the gate:

- large;
- medium;
- small.

To select the type and size of the gate before executing the scenario, go to the parameter display block (see [11.1.1 «Parameter display configuration block»](#)) and under "Gate/Reject Settings" specify the desired parameters.

11.1.1.4 Starting position

Starting position is the vertical trajectory for takeoff/landing (Figure 114). Helps maintain the verticality of flight.



Figure 114 – Starting position

11.2 UAV selection and configuration unit

See. [8.2 «UAV selection and configuration unit»](#).

11.3 Start button

To switch to the simulation mode, press the "Start" button (5, Figure 107).

12 Simulation in Mode «Piloting Basics»

To switch to the simulation, press the "Start" button (5, Figure 107). First, it is necessary to perform pre-flight preparation, then turn on the UAV to proceed to direct piloting.

12.1 Pre-flight preparation

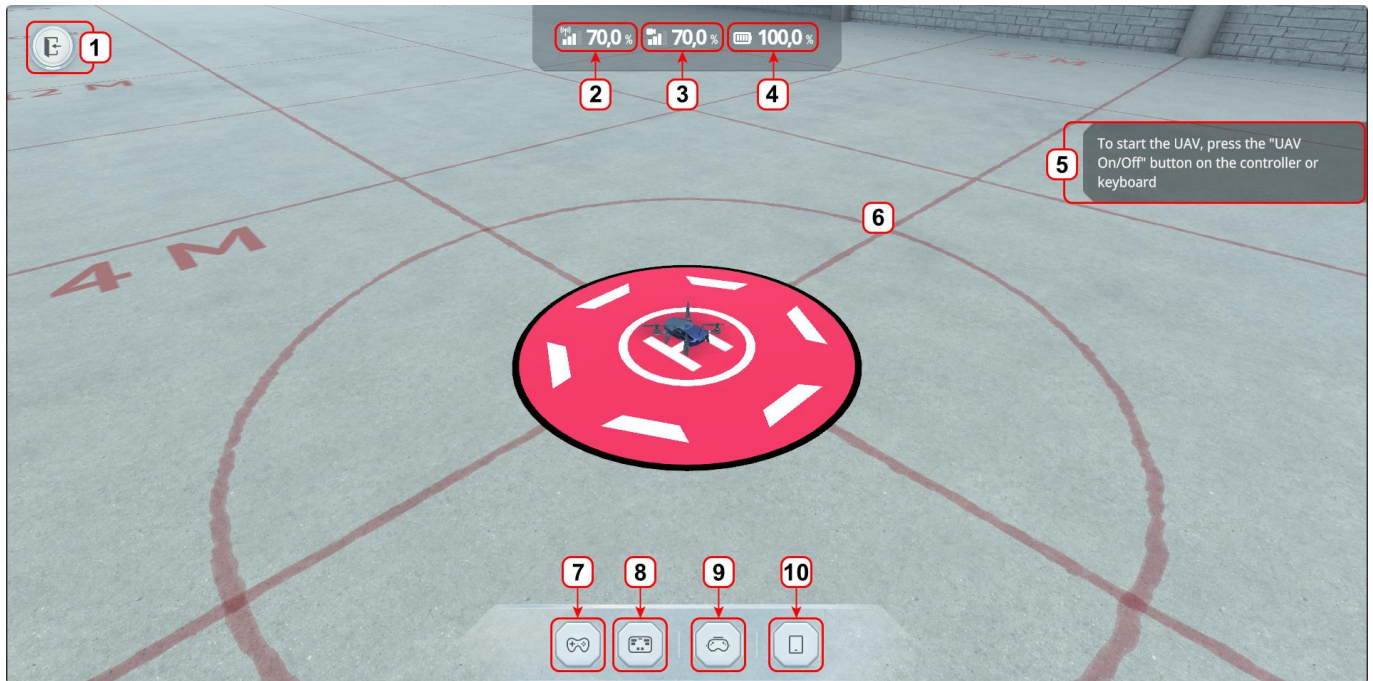


Figure 115 – Pre-flight preparation (Piloting Basics mode, closed training ground)

The interface of the pre-flight preparation screen (Figure 115) includes:

- the "Return to previous menu" button (1), which returns to the selection menu (see [11 «"Piloting Basics" selection menu»](#));
- options panel:
 - control station signal level (2);
 - video signal level (3);
 - battery charge (4);
- toolbar (5);
- a working area centered on a UAV model (6);
- quick access panel to settings:
 - control (7, see [12.1.1 «Control Settings»](#));
 - interface (8, see [12.1.2 «Interface Settings»](#));
 - FPV systems (9, see [12.1.3 «FPV System Setup»](#));
- button to call the "Checklist" (10, see [12.1.4 «Checking the UAV according to the checklist»](#)).

12.1.1 Control Settings

See. [10.1.1 «Control Settings»](#).

12.1.2 Interface Settings

See. [10.1.2 «UI Settings»](#).

12.1.3 FPV System Setup

See. [10.1.4 «FPV System Setup»](#).

12.1.4 Checking the UAV according to the checklist

In the "Piloting basics" mode, you can check the readiness of the UAV for flight. For each type of UAV, individual checklists are presented, containing a list of items for inspection and verification of the device at the pre-flight preparation stage. If you do not detect and replace the faulty part at this stage, the fault will persist and affect the behavior of the UAV in the simulation. At the end of the flight, the final report will record the presence of undetected errors.

The simulation results will also show the number of serviceable components that have been replaced. If you mistakenly replace a serviceable part (considering it defective), this fact will also be reflected in the flight results as an incorrect replacement.

The camera in checklist mode is centered on the UAV, giving the user the ability to zoom and rotate.

It is necessary to inspect the UAV for defects in the details specified in the checklist check points. A checklist check point is a specific, measurable, and verifiable record of a requirement for a UAV inspection.

The total number of checklist items depends on the model of the device or its type.

Press the switch button  to the right of the checklist check point, indicators will appear next to the checked parts of the UAV  and the names of the parts, and a repair panel will appear under the UAV (Figure 116).

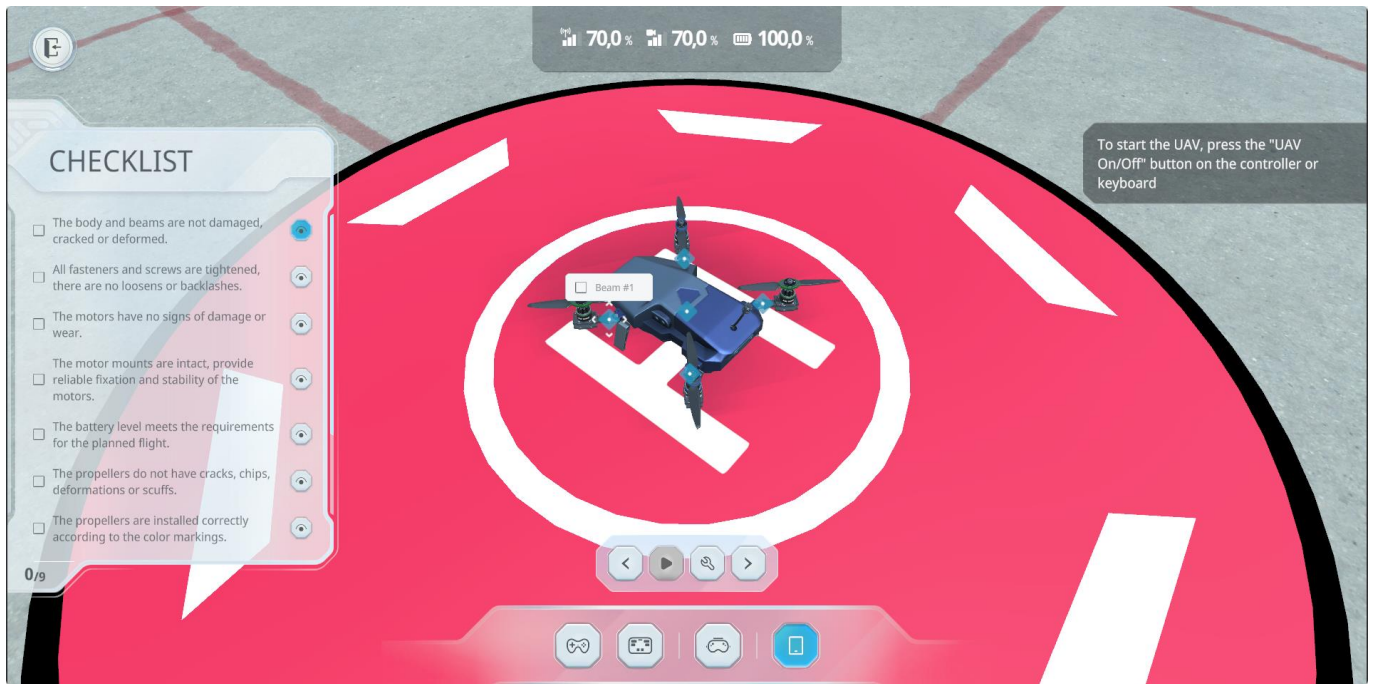


Figure 116 – Pre-flight preparation. Checklist check

To eliminate the defect:

- press the indicator  next to the defective part;
- click on the button  on the repair panel.

To switch between parts, use the arrows  on  the repair panel or press the indicators next to the parts to be inspected. To start the propellers, use the "Start" button .

Inspected and repaired parts can be marked in the checkbox next to the part name.

After checking and, if necessary, eliminating the defect, confirm that the condition is met, check the checkbox of the checklist check box, the text of the condition will become crossed out (Figure 117).

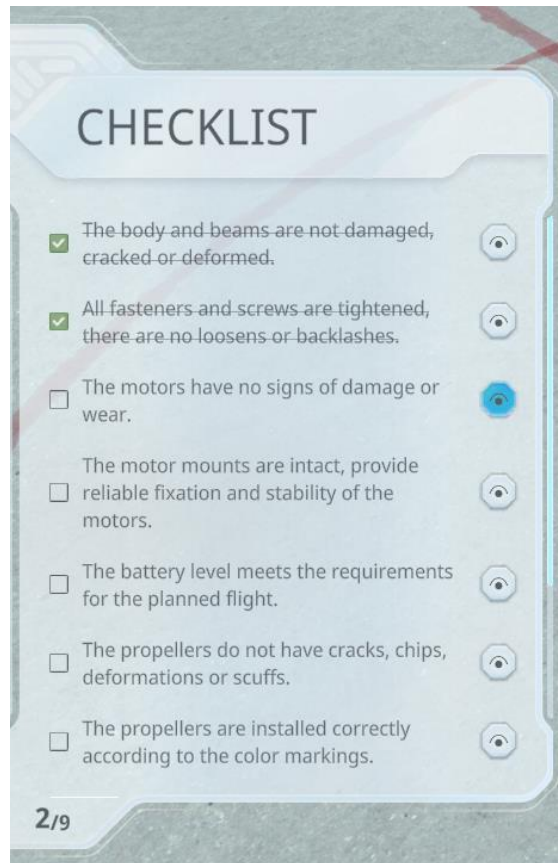


Figure 117 – Highlighting the completed items of the checklist

If the part is defective, it is replaced with a healthy one or returned to a standard state. When you do this, the message "The part has been successfully replaced" appears (Figure 118, Figure 119).



Figure 118 – Damaged part (antenna) detected



Figure 119 – The detected damaged part (antenna) is repaired

If the part is in good working order, replacement is not carried out, and a notification is displayed: "You are trying to replace a part that is working properly. Replacement has not been completed." (Figure 120).



Figure 120 – Notice of replacement of a defective part

12.1.4.1 Checklist of multi-rotor UAVs

Task	Number of Inspection Point Indicators	Actions	Link to the breakdown drawing
The body and beams are not damaged, cracked or deformed.	Quadcopters: beams (4 pcs.), body (1 pc.) Hexacopter beams (6 pcs.), body (1 pc.) Octopopter Beams (x8), Body (x1)	Integrity and condition are checked	
All fasteners and screws are tightened, there are no loosens or backlashes.	Body (1 pc.)	Integrity and condition are checked	
The motors have no signs of damage or wear.	Quadcopters: electric motors (4 pcs.) Hexacopters: electric motors (6 pcs.) Octocopters: electric motors (8 pcs.)	Integrity and condition are checked	
The motor mounts are intact, provide reliable fixation and stability of the motors.	Quadcopters: electric motors (4 pcs.) Hexacopters: electric motors (6 pcs.) Octocopters: electric motors (8 pcs.)	Integrity and fixation are checked	
The battery level meets the requirements for the planned flight.	1 piece	The battery charge level is checked	Figure 121
The propellers do not have cracks, chips, deformations or scuffs.	Quadcopters: (4 pcs.) Hexacopters: (6 pcs.) Octocopters: (8 pcs.)	Integrity and condition are checked	Figure 122
The propellers are installed correctly according to the color markings.	Quadcopters: (4 pcs.)	The order of placement of motors and propellers depending on the CW and CCW markings, color coding is checked 	Figure 125

Task	Number of Inspection Point Indicators	Actions	Link to the breakdown drawing
	Hexacopters: (6 pcs.)	Color coding is checked 	
	Octocopters: (8 pcs.)	Color coding is checked 	
The propellers are securely fastened and rotate freely, with no obstructions or backlash.	Quadcopters: (4 pcs.) Hexacopters: (6 pcs.) Octocopters: (8 pcs.)	Fixation and free movement are checked	
The antennas are in good condition, without damage or deformation.	2 pcs.	Integrity and condition without damage and deformation are checked	Figure 126

12.1.4.2 Aircraft-type UAV checklist

Task	Number of Inspection Point Indicators	Actions	Link to the breakdown drawing
Airplane 1			
The fuselage, wing consoles have no damage, cracks or corrosion.	Fuselage (1 pc.) Wing consoles (2 pcs.)	Integrity and condition are checked	
The fasteners of all elements, including the wings, tail and fuselage, are securely fixed.	1 piece	Integrity and fixation are checked	
The antennas are in good condition, without damage or deformation.	2 pcs.	Integrity and condition without damage and deformation are checked	Figure 127

Task	Number of Inspection Point Indicators	Actions	Link to the breakdown drawing
The motors have no signs of damage or wear.	Electric motor (1pc.)	Integrity and condition are checked	
The motor mounts are intact, provide reliable fixation and stability of the motor.	1 piece	Integrity and fixation are checked	
The propeller is securely fastened and rotates freely, with no obstructions or backlash.	1 piece	Fixation and free movement are checked	
The propeller has no cracks, chips, deformations or scuffs.	1 piece	Integrity and condition are checked	Figure 123
The parachute is located in a specialized compartment, has no visible damage and is securely fastened.	1 piece	The presence of the parachute in the compartment and its fixation are checked	Figure 129
Elevons move freely and without resistance.	2 pcs.	The free movement is checked	
The battery level meets the requirements for the planned flight.	1 piece	Battery level is checked	Figure 121
Airplane 2			
The fuselage, wing consoles have no damage, cracks or corrosion.	Fuselage (1 pc.) Wing consoles (2 pcs.)	Integrity and condition are checked	
The fasteners of all elements, including the wings, tail and fuselage, are securely fixed.	1 piece	Integrity and fixation are checked	
The antennas are in good condition, without damage or deformation.	2 pcs.	Integrity and condition without damage and deformation are checked	Figure 127
The motor has no signs of damage or wear.	Electric motors (1 pc.)	Integrity and condition are checked	
The motor mounts are intact, provide reliable fixation and stability of the motor.	1 piece	Integrity and fixation are checked	

Task	Number of Inspection Point Indicators	Actions	Link to the breakdown drawing
The propeller is securely fastened and rotates freely, with no obstructions or backlash.	1 piece	Fixation and free movement are checked	
The propeller has no cracks, chips, deformations or scuffs.	1 piece	Integrity and condition are checked	Figure 123
The parachute is located in a specialized compartment, has no visible damage and is securely fastened.	1 piece	The presence of the parachute in the compartment and its fixation are checked	Figure 129
Elevons move freely and without resistance.	4 pcs.	The free movement is checked	
The engine has no traces of fuel leakage.	1 piece	The absence of fuel leaks under the engine is checked	Figure 130
The volume of fuel meets the requirements for the planned flight.	1 piece	The volume of fuel in the engine is checked	Figure 132

12.1.4.3 Hybrid -type UAV checklist

Task	Number of Inspection Point Indicators	Actions	Link to the breakdown drawing
The fuselage, wing consoles have no damage, cracks or corrosion.	Fuselage (1 pc.) Wing consoles (2 pcs.)	Integrity and condition are checked	
The fasteners of all elements, including the wings, tail and fuselage, are securely fixed.	1 piece	Integrity and fixation are checked	
The antennas are in good condition, without damage or deformation.	3 pcs.	Integrity and condition without damage and deformation are checked	Figure 128
The motors have no signs of damage or wear.	5 pcs. Electric motors (4 pcs.) Internal combustion engine (1 pc.)	Integrity and condition are checked	
The motor mounts are intact, provide reliable fixation and stability of the motors.	5 pcs.	Integrity and fixation are checked	

Task	Number of Inspection Point Indicators	Actions	Link to the breakdown drawing
The propellers are securely fastened and rotate freely, with no obstructions or backlash.	5 pcs.	Fixation and free movement are checked	
The propellers do not have cracks, chips, deformations or scuffs.	5 pcs.	Integrity and condition are checked	Figure 124
Elevons move freely and without resistance.	4 pcs.	The free movement is checked	
The engine has no traces of fuel leakage.	Internal combustion engine (1 pc.)	The absence of fuel leaks under the engine is checked	Figure 131
The amount of fuel meets the requirements for the planned flight.	1 piece	The volume of fuel in the engine is checked	Figure 132

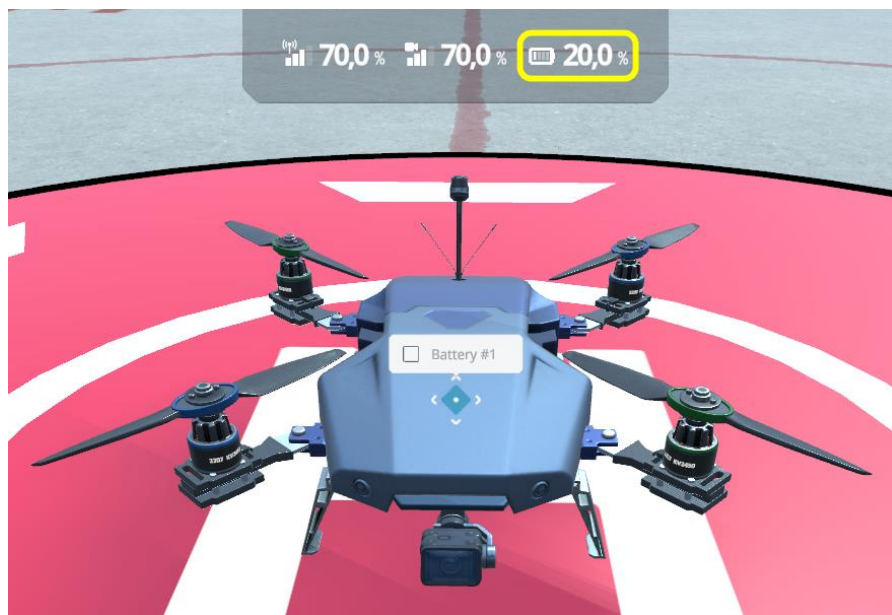


Figure 121 – Defect – battery is low



Figure 122 – Defect – chips on the propeller of a multirotor-type UAV



Figure 123 – Defect – chips on the propeller of an aircraft-type UAV

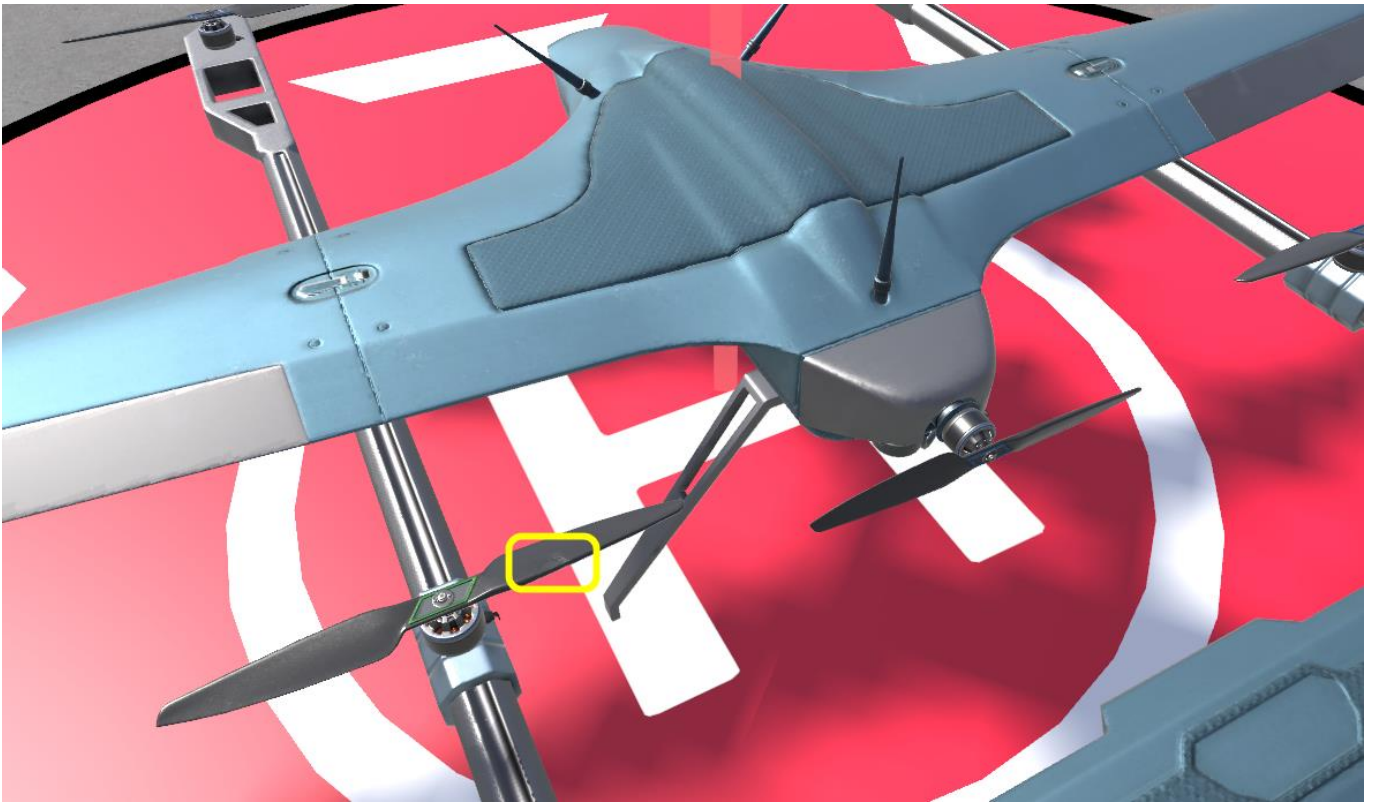


Figure 124 – Defect — chips on the propeller of a hybrid-type UAV



Figure 125 – Defect – incorrect installation of propellers

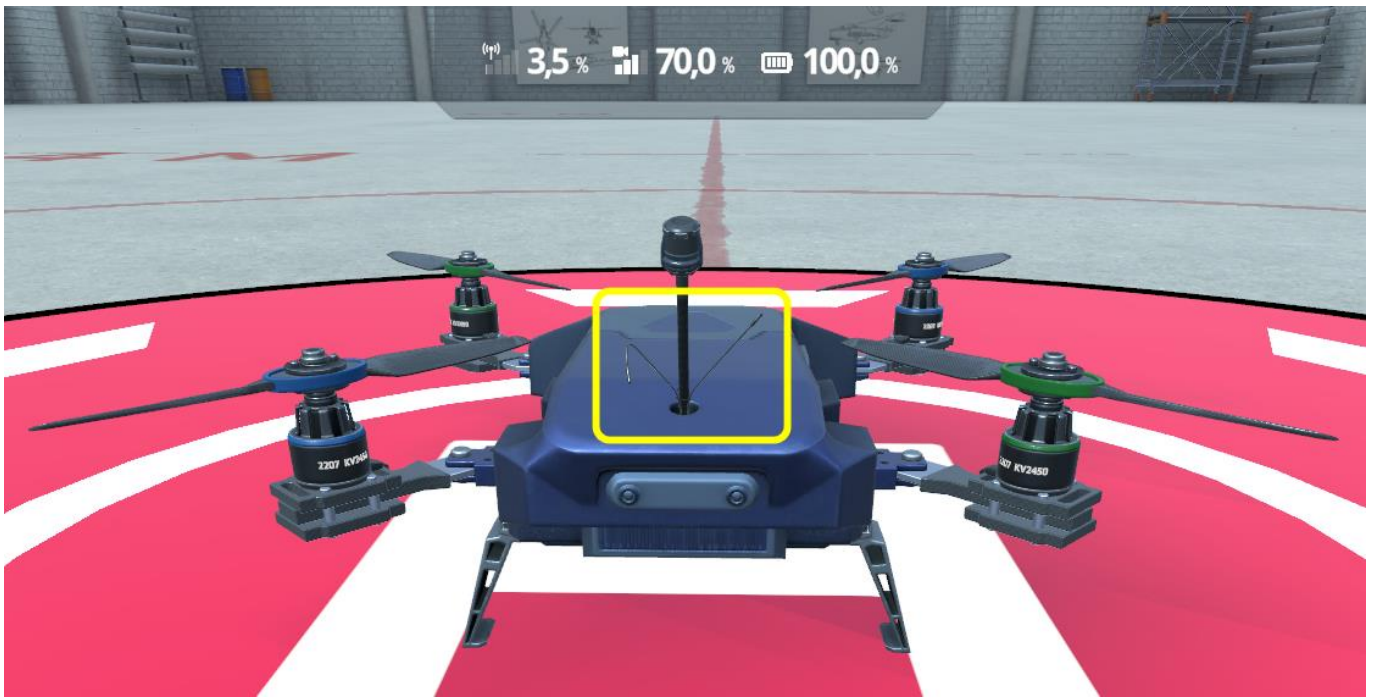


Figure 126 – Defect — antenna breakdown on a multi-rotor UAV



Figure 127 – Defect — antenna breakdown on an aircraft-type UAV



Figure 128 – Defect — breakdown of the antenna of a hybrid-type UAV



Figure 129 – Defect — parachute missing

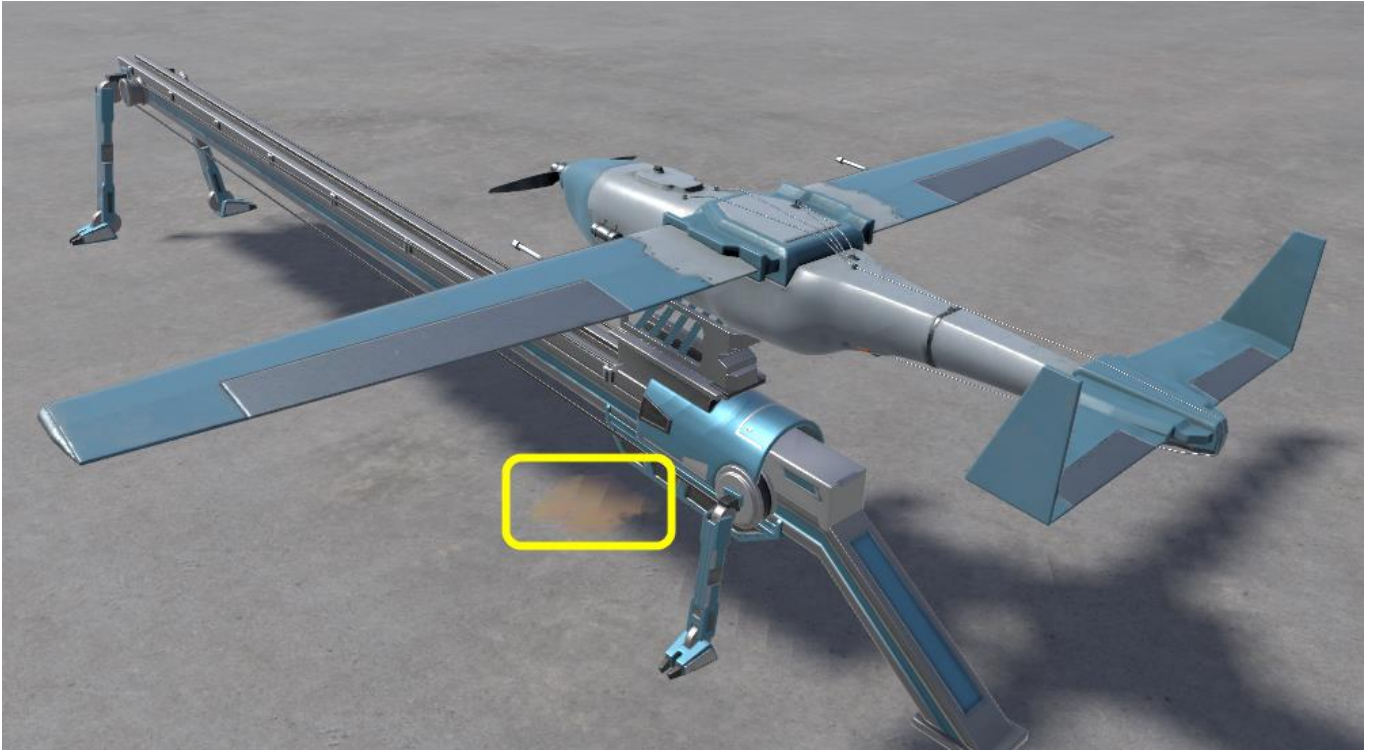


Figure 130 – Defect — fuel leakage of an aircraft-type UAV

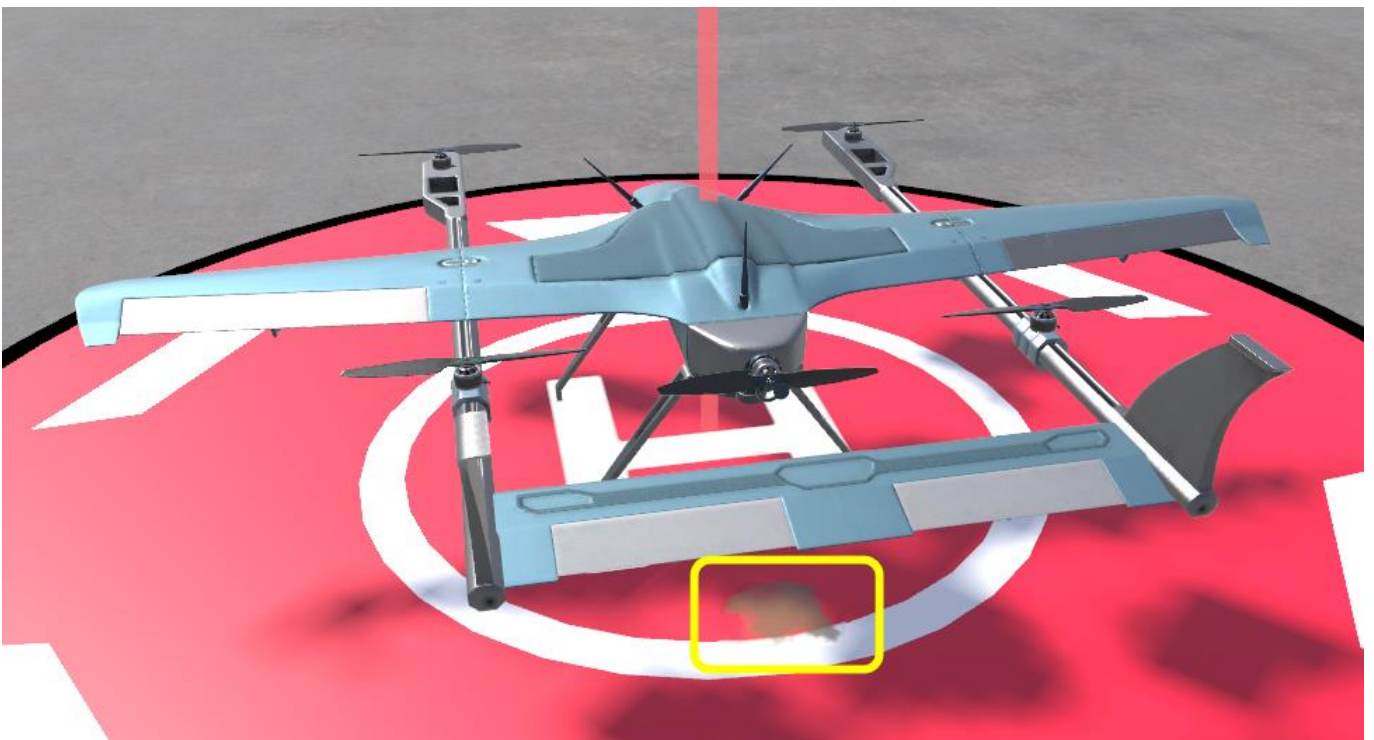


Figure 131 – Defect — fuel leak of a hybrid-type UAV



Figure 132 – Defect — insufficient fuel volume

12.1.4.4 Checklist statistics

In the "checklist" mode, the following indicators are calculated:

- **The total number of** defects generated by the system at the stage of entering simulation mode.
- **Fixed correctly** — the number of defects corrected correctly.
- **Fixed incorrect (erroneous replacement)** — the number of incorrect replacements. At the same time, the user can repair the same inspection point several times, and the counter takes into account each replacement attempt.
- **Not detected** — the number of items in the checklist that were not identified and defects were not corrected.

Checklist statistics are displayed in the simulation results.

12.2 Piloting

When switching to the "Piloting" state:

- the timer starts;
- the mouse cursor becomes inactive;
- the controls are completely switchable to the control device (gamepad or professional remote control) and the keyboard.

To return to the "Pre-flight preparation" from the state "Piloting" go to the "Pause" menu (press the **Esc** on the keyboard, see [12.3 «"Pause" menu»](#)) and click the Restart button.

To return to the "Piloting Basics" selection menu, go to the "Pause" menu (using the **Esc** on the keyboard, see [12.3 «"Pause" menu»](#)) and click the "Complete the simulation" button.

12.2.1 Launch of piloting

To switch to piloting, it is necessary to turn on the UAV. To start the UAV engines, press the "UAV On/Off" button on the control device or keyboard (see [3 «Control devices»](#)).

12.2.2 Piloting Screen Interface

When the UAV enters the piloting state, the screen of the selected range opens (Figure 133). the screen displays the parameters to be monitored when operating the UAV (see [12.2.2.1 «Dashboard»](#)).



Figure 133 – Piloting at an open range

12.2.2.1 Dashboard

See. [10.2.2.1 «Dashboard»](#).

12.2.3 UAV control

See. [10.2.3 «UAV control»](#).

12.2.4 Training mode Hints

Added hints for scenarios in training mode:

- trajectories are the lines along which the UAV needs to fly to perform the current and next tasks (see [11.1.1.1 «Trajectory»](#));
- textual information (see [11.1.1.2 «Text hints»](#)).

12.3 "Pause" menu

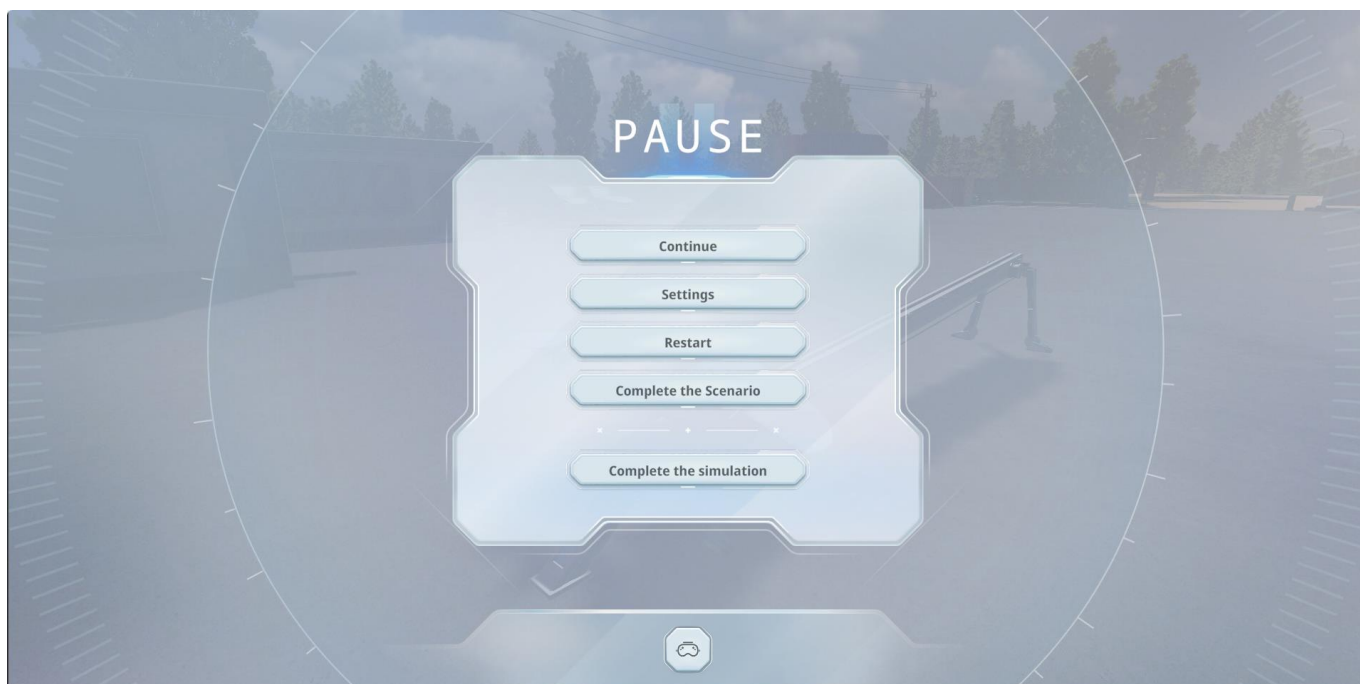


Figure 134 – "Pause" menu in "Piloting Basics" mode

If you want to pause the simulation, press the **Esc** and in the "Pause" menu that opens (Figure 134) click:

- the "Continue" button if you want to continue the flight simulation;
- the "Settings" button if you need to change the settings of the device and/or interface (see [12.1.1 «Control Settings»](#), [12.1.2 «Interface Settings»](#));
- the "Restart" button if you want to start the flight from the beginning. The "Pre-flight Preparation" status screen (Figure 115);
- the "Complete the Scenario" button to end the current scenario.
- the "Complete the simulation" button to exit the simulation mode and go to the "Piloting Basics" selection menu;
- button "FPV System»  to go to editing the settings "FPV Systems" (see [12.1.3 «FPV System Setup»](#)).

12.4 End the simulation

In "Piloting Basics" mode, the simulation can end for three reasons:

- all tasks of the script have been completed;
- during the flight, there was a strong collision of the UAV with an obstacle and the engines turned off;
- the UAV flew out of the permissible space.

If all the tasks of the script are completed, the simulation stops, a window appears with the inscription "The task is completed" (Figure 135). Press any keyboard key to go to the results of the flight check according to the scenario, they can be both positive (Figure 136) and negative (Figure 137).



Figure 135 – Reporting the completion of all tasks in the scenario



Figure 136 – Positive test results



Figure 137 – Negative test results

If during the flight there was a strong collision of the UAV with an obstacle and the engines turned off, then the simulation ends and a window appears with the inscription "Failed" (Figure 138).



Figure 138 – Script failure message

13 Simulation Requirements

13.1 Space

13.1.1 Closed range

The closed range is intended only for multi-rotor UAVs.

The space constraints in the closed range are the floor, walls, ceiling, beams. In the event of a collision with these objects, depending on the force and location of the impact, the UAV will be damaged or the simulation will cease (see [13.4 «Collision system»](#)).

In free mode, a closed range can be filled with structures at your discretion (see [9 «Closed range constructor»](#)) and train, overcoming obstacles.

13.1.2 Open range

The open range is designed for UAVs of all types.

An open range is an open space with such a natural environment as vegetation (trees, shrubs, grasses), reservoirs (rivers, lakes), different types of surface (grassy, sandy, stone).

An open range has several large "points of interest" (warehouse, construction site), as well as other objects of the environment: a water pumping station, a construction crane, poles to support electrical wires, a construction crane, a metal production container, a tank container, a container car, a vertical tank, a drilling rig, a radio transmission tower, a wind turbine, transport and other smaller elements.

Total area of the open range is a square of 8x8 km. The area accessible to UAVs is limited by a square with a side of 5 km, the altitude accessible to UAVs is 3 km (Figure 139).

When leaving the available area, noise appears and the signal is lost (see [13.3.3 «Leaving the permissible flight area»](#)).

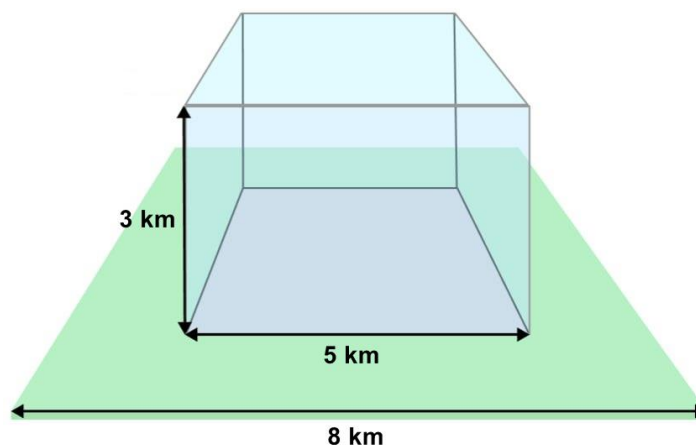


Figure 139 – Open range access area

13.2 Starting point

For free-mode closed range scenes, the starting point is selected or edited in Scene constructor mode. By default, when creating a new scene, the start point is set at the center of the range (see [9.6 «Starting point»](#)).

For "Piloting Basics" mode closed range scenes and all open range scenes, the start point is set automatically. You cannot select or edit the start point position.

13.3 Flight restrictions

13.3.1 Weather conditions

For open range scenes, you can change the weather parameters in free mode: seasonality (summer/winter), air temperature, atmospheric pressure, wind strength and direction, precipitation (see [8.1.2 «Weather Conditions Block»](#)), and, accordingly, visibility is the distance at which objects (landmarks) are seen and identified.

For all other scenes, weather conditions are assigned automatically and you need to pay attention to the weather parameters in the corresponding panels (see [8.1.2 «Weather Conditions Block»](#), [5.2.2.1 «Dashboard»](#)).

13.3.2 Environment Objects

Environment objects are vegetation, buildings, and structures on the range. When colliding with them, depending on the force and place of the impact and the parameters of the "health", the UAV is damaged or completely fails.

13.3.3 Leaving the permissible flight area

When going beyond the permissible flight zone (Figure 139) on the screen interference appears (for FPV first-person mode, Figure 140), the signal of the control station is not immediately turned off, within 15 seconds you need to return to the permissible zone. In the upper left corner under the timer, a countdown counter appears (Figure 141). If you are outside the boundary for more than 15 seconds, you are forced to exit the simulation mode.



Figure 140 – Interference when leaving the permissible zone



Figure 141 – Open range countdown counter

13.4 Collision system

13.4.1 Collision mechanics

To determine damage from collisions with environmental objects, the concept of UAV "health" is used. At the beginning of the simulation, it is assumed to be equal to 100 units. At each collision, the "health" loses its units, depending on the force and location of the impact. Collisions are taken into account for the following parts of the UAV: propellers, body, legs. A blow to the propeller blades leads to more serious damage. legs leads to less damage. The enclosure includes cameras, sensors, and all external components.

The fall of the UAV occurs when any part of the UAV receives critical damage.