CAPTURE
precise tracking at its best

GUI DESCRIPTION

Capture Systems Ltd

Revision 2.0.2

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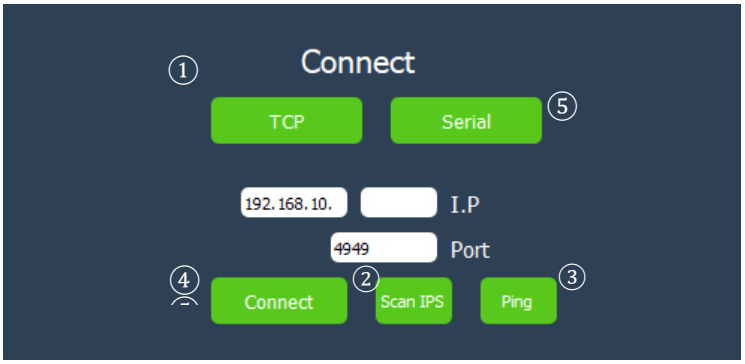
Open Communication Channel

By default, the application opens the communication window. By using the communication window, you let the application locate the system parameters automatically and open the relevant properties. Communication Establish process:



TCP Communication:

- Insert the system IP address.
- If your system doesn't use the default port, change it.

Scan IPS Button

- For scanning IPS use the Scan IPS button that scans the defined address space and show the available systems.

Ping Button

- For ping checking use the ping button that test and see if a networked device is reachable.
-

The ping command sends a request over the network to a specific device (to the IP address you inserted).

A successful ping results in a response from the computer that was pinged back to the originating computer.

If ping gets no response from the target host, most implementations of ping display nothing or a timeout notification.

For example:

```
Pinging 192.168.10.120 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.
```

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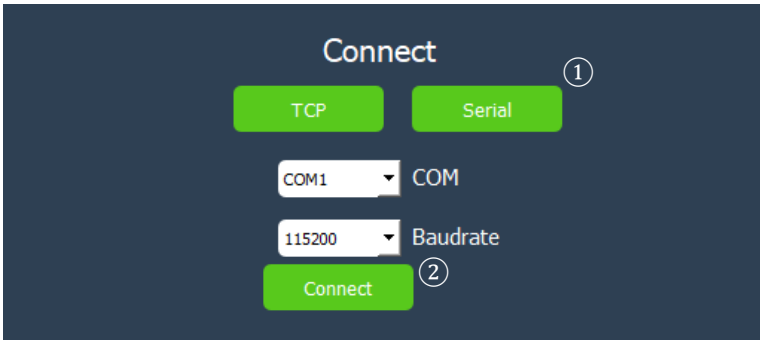
- Connect Button
  - When the connection process is finished, the window will be close.

    If a connection is not possible (from any reason), a message indicating will be displayed.

After the connection channel between the application and the system is opened, the various features of the system can be started.

Serial Communication:



- You can use the system with serial communication as well:
  - Choose the correct com port and baud rate and then open channel.
- Connect Button
  - The software will start communicating with the system and the current window will disappear.

Application Structure

It is important to understand the application in depth, in order to take advantage of all the possibilities it has to offer the user.

The application consists of a central operating panel, through which most of the system's operations are conducted. In addition, there are a number of windows (such as the Settings and Errors windows) which we'll discuss below.

Because there are different types of systems, there are parts of the application that are common to all systems and there are those that are relevant only to a particular system family (such as Tracker systems).

In this manual we will review the full software structure.

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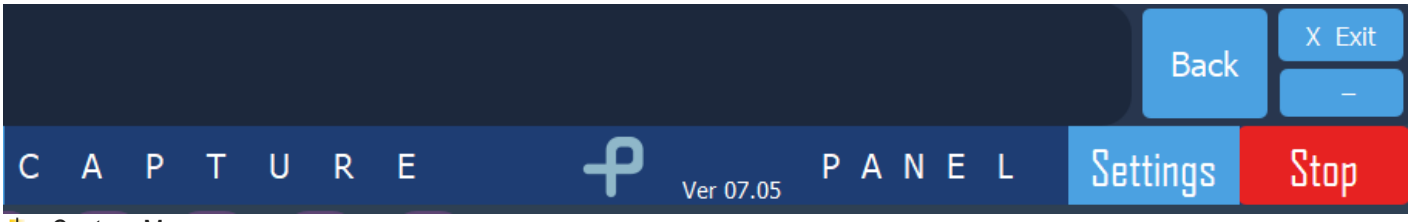
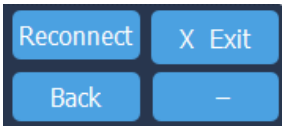
Upper navigation menu



- Capture Menu:
  - ① Stop – Turn off the axes.
  - ② Back – Closes the current project and return back to the connect screen.
  - ③ Exit – Close the application.
  - ④ Minimize – Minimize the current window.
  - ⑤ Reconnect – in case of a failure in the tcp communication, you will be able to reconnect by pressing that button.



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Top bar – Status

- The applications shown in this section are:
  - ① GPS – Indicates the communication state with the GPS components that connected to the system.
  - ② IMU – Indicates the communication state with the IMU sensor that connected to the system.
  - ③ System Error – Indicates if there are general errors in the system. You can examine in the errors window.
  - ④ Motor Error – Indicates if there are errors in one of the system axes. You can examine this in the Motor Registers window.
  - ⑤ Keep Alive – Indicates the keep alive state.

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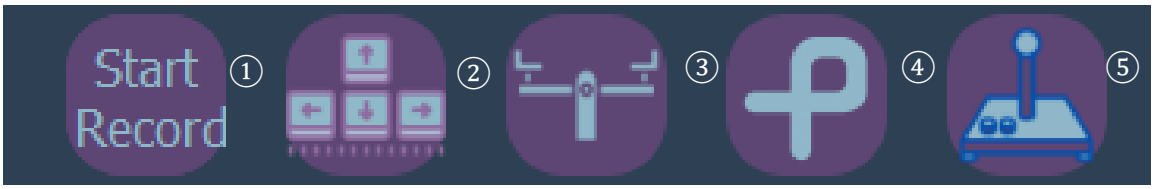
Mode Buttons:



There are 5 mode buttons: Record button, Arrows button, Stabilization button, Mode button and Target button (from left to right):

To return the pedestal view: press again the button you pressed before.

1. Record button:

In "Record Mode" you have the ability to capture and store real-time data into an Excel spreadsheet. This data includes several parameters, such as:

- Voltage – The voltage level of the axes.
- Current – The actual motor current.
- Position – The current position of the Apos parameter.
- Speed – The actual motor speed.
- Motor Error – Any error information related to the motor.
- Stab Error – Information regarding the stabilization process.

In four Axes Mode, you'll additionally save the different positions of the pan and tilt axes. To initiate this data recording process, simply press the "Start Record" button. The system will begin collecting and storing this real-time data.

When you're ready to stop the recording and save the collected data, click on the "Stop Record" button. At this point, a file dialog will appear, allowing you to specify the location and filename for the Excel sheet where the data will be saved.

By default, the file location will open in the same folder as your GUI application, and the Excel sheet will be named "data". However, you have the flexibility to modify the location and filename as per your preferences.

Upon confirming the location and filename, the system will transfer all the collected data into the Excel sheet for your future reference and analysis.

2. Arrows button:

The "Arrows" button serves as a mode switch to enable keyboard input for controlling the axes. In this mode, referred to as a relative mode, you have the capability to maneuver the axes using the arrow keys on your keyboard. The specific parameters for acceleration, speed, and position are derived from the axis motion window.

Here's how the keyboard input works depending on the number of axes defined in the system:

- Single Axis Defined – In the case of one axis being defined, you can utilize the right and left arrow keys on your keyboard. The right arrow key will trigger positive movement, while the left arrow key will initiate negative movement.
- Two Axes Defined – In the case of two axes being defined, you can utilize the full range of arrow keys on your keyboard. The right arrow key empowers positive movement for the first axis, while the left arrow key initiates negative movement for this axis. Similarly, the up arrow key facilitates positive movement for the second axis, and the down arrow key facilitates negative movement.
- Three Axes Defined – In the case of three axes being defined, the right and left arrow keys correspond to the first axis, right mean positive movement while the left arrow key initiates negative movement. The up and down arrow keys to the second axis, up means positive movement while the down arrow key initiates negative movement. And the 4 and 6 number keys on your keyboard control the third axis, the number '6' mean positive movement while the number '4' initiates negative movement.
- Four Axes Defined – In the case of four axes being defined, the right and left arrow keys correspond to the first axis, right mean positive movement while the left arrow key initiates negative movement. The up and down arrow keys to the second axis, up means positive movement while the down arrow key initiates negative movement. The 4 and 6 number keys on your keyboard control the third axis, the number '6' mean positive movement while the number '4' initiates negative movement. The 2 and 8 number keys on your keyboard control the fourth axis, the number '8' mean positive movement while the number '2' initiates negative movement.

To exit the keyboard input mode, simply press the "Arrows" button again. This action will disengage the keyboard input, ensuring that no further axis movements are initiated via keyboard commands.

3. Stabilization button:

Pressing this button changes mode to stabilization view (see in stabilization commands).

4. Mode button:

Pressing this button changes mode to stabilization and GPS view.

5. Target button:

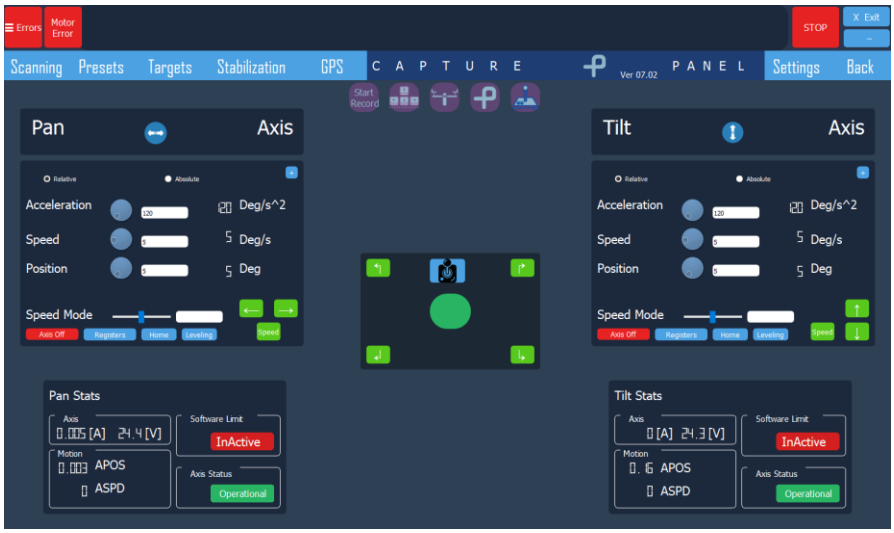
Pressing this button changes mode to target view. You can import map (jpg, png only) to see the target area (see in GPS Target Commands).

Main operation panel

This is the only part that common to all types of systems.

The main operating panel components are:

- Divide into separate axes. For each axis, position, speed, volt and current data is displayed, in addition each axis has a settings window.
- The axes activation buttons.



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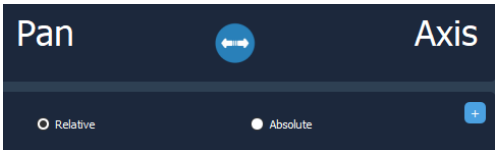
Axes Settings:

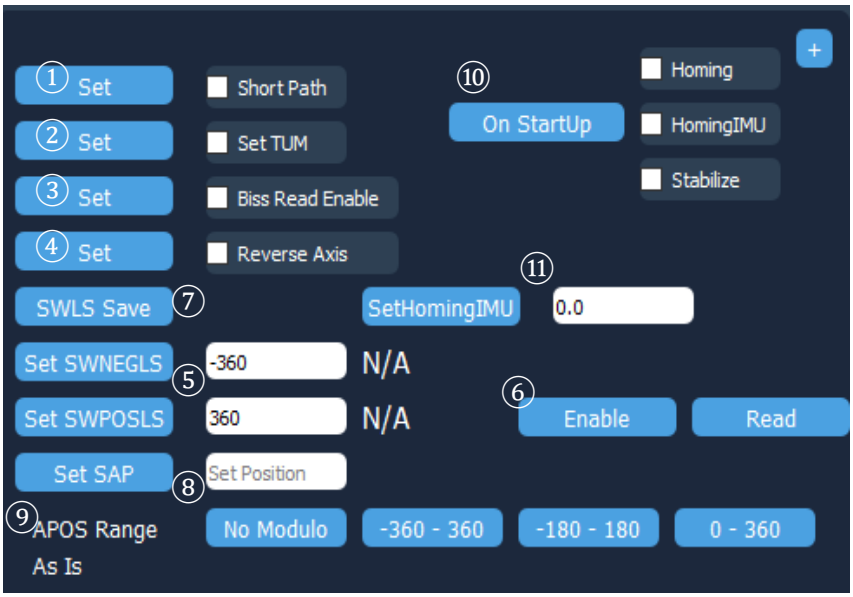
- Each axis has a settings window there all the axis settings are displayed. Pressing on the plus button will open the settings window.



1. Short Path – Belongs to absolute mode (when the angles are in the range of 0-360). When the shortest path is enabled the axis will reach the desired absolute angle by the shortest path.

When the short track is not enabled, the axis will reach the desired absolute angle without crossing zero.

2. TUM – Target Update Mode, build a new motion profile (with acceleration, speed and position) from scratch each time a new motion command is sent. In case the command isn't sent, the motion profile will use the actual parameters as a reference. In some cases the motor will not move properly if this command is missing from the motion commands. It is advisable to send this command before each command session.
3. Biss Read Enable – enable/disable the reading from the absolute encoder (biss).
4. Reverse – Reverse the axis direction.
5. Configure the software limits for the axis using the commands 'Set SWPOSLS' and 'Set SWNEGLS.'



These commands allow you to set both the positive and negative software limits for the axis while enabling or disabling the software limits. The 'SWNEGLS' command defines the software negative limit switch, specifying the negative limit beyond which the axis will not move when the software limits are enabled. Similarly, the 'SWPOSLS' command defines the software positive limit switch, determining the positive limit beyond which the axis will not move when the software limits are enabled.

Importantly, the negative limit switch value cannot exceed the positive limit switch value.

6. Disable, Enable SWLS – The Disable/Enable button disable/enable the software limit of the axis. Enabling it activates the software limit, and the status window will indicate it by turning green and displaying "Active". Disabling it deactivates the software limit, causing the status window to turn red and display "Inactive".
7. SWLS Save – The SWLS (Software Limit Switch) button allows you to save the values of the Set SWNEGLS and Set SWPOSLS buttons, along with the status of the enable/disable feature.

8. Set SAP – set the position of the axis. After set SAP the axis status window will reflect the new value as APOS.
9. APOS Range – set the desired range for the load position of the selected axis. The CapTrack supports the following types of position range:
    - -∞ to ∞ No Module: for full rotation with either positive or negative angles.
    - -360 to 360: for full rotation with either positive or negative angles.
    - -180 to 180: for half a rotation with either positive or negative angles.
    - 0 to 360: for full rotation with positive angles only.
10. On StartUp – mark v and click the "OnStartUp" button to activate the Homing, HomingIMU or Stabilize functions to execute automatically when the system starts up during CapTrack operation.
11. Leveling value – Specify the leveling value to set the desired angle for the Inertial Measurement Unit (IMU) that you want the axis to achieve. This feature is applicable only in systems equipped with an IMU. The leveling value determines the angle to which the axis should align itself.

Axes Status

In this window you can see the real-time data of the system. Here's what you can expect to find:

1. Real-Time Data

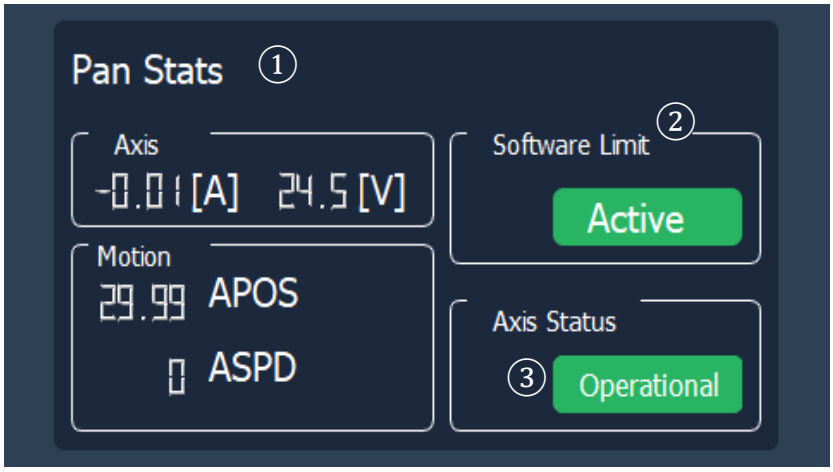
- This section provides a comprehensive display of essential information for each axis defined within the system. It showcases parameters such as the current status, voltage levels, current position (APOS) and current speed (ASPD) for every individual axis.

2. Software Limit Label

- Software Limit – indicates the status of software limit: Marked as "Active" signifying that the software limit switch is operational. In contrast, when the software limit is not in use, it is labeled as "Inactive" (you can change it in axis settings on disable/enable button).

3. Axis Status Label

- Axis Status – indicates the axis status: If an axis has no errors, it will be marked with a green label with the name "Operational". However, should any unexpected issues or errors arise, the label will transition to red, signaling a "Fault". By clicking on the "Motor Error" window, you can access detailed error information for further diagnosis and resolution.



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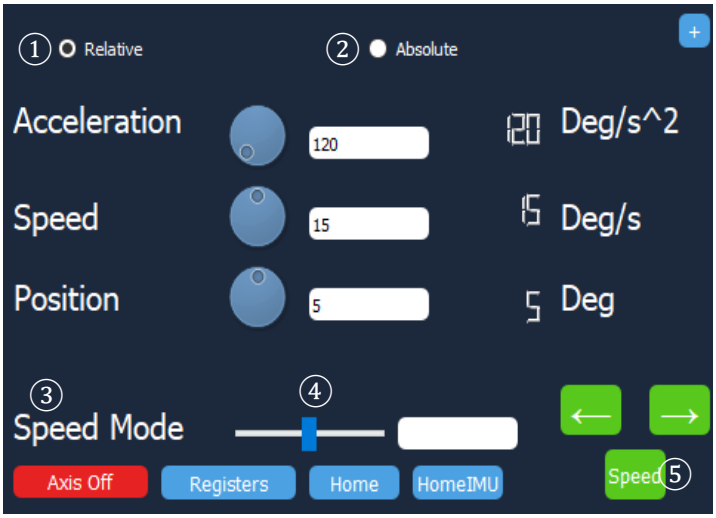
Axes Motions

Capture's systems can work with three different control modes. The control modes are:

- Relative positioning mode (default).
- Absolute positioning mode.
- Speed mode.



1. Relative Movement Selection:

In this mode, the system operates by default, treating the current position as the reference point (zero).

Users can specify acceleration, speed, and the target position relative to the current position.

- Choose the "Relative" radio button to enable relative movement mode.

I. Acceleration Specification:

- Specify the desired acceleration value for the motion profile.

II. Speed Specification:

- Specify the desired speed value for the motion profile.

III. Position Specification:

- Specify the desired position value for the axis.

- Use left Use left and right arrows to indicate negative or positive movement.

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2. Absolute Movement Selection:

Absolute positioning mode allows users to designate a specific reference point (typically zero) for the axis. Acceleration, speed, and position values are specified with respect to this fixed reference.

- Choose the "Absolute" radio button to enable absolute movement mode.

  Acceleration Specification:

  - Specify the desired acceleration value for the motion profile.

  Speed Specification:

  - Specify the desired speed value for the motion profile.

  Position Specification:

  - Specify the desired position value for the axis.
- It is important to note that negative position commands are not accepted in this mode. The system will move the axis according to the specified acceleration, speed, and position values within the defined 0 to 360 degrees range.

3. Speed Mode:

Speed mode offers two options: "Speed with Slider" and "Speed with Button". It provides a way to control the system's velocity without explicit positioning requirements. Users can manipulate speed using either a slider or buttons, depending on the selected option. This mode is beneficial when precise positioning is not the primary concern, and users are more focused on controlling the speed of the system.

4. Speed with Slider:

Utilizing the slider is an intuitive way to dictate the direction of movement. By sliding it to the right, you initiate positive movement, and by sliding it to the left, you command negative movement. It's important to note that the acceleration is controlled by the value entered in the acceleration text -box. The speed range is according to the maximum speed parameter defined within the system, you can see the maximum speed value within the settings window.

5. Speed with Button:

To regulate the speed, input speed value and activate it by clicking the "Speed" button. The system will move at a constant speed according to the entered value. For halting the movement, you have two options: you can either click the "Speed" button again, or input a speed value of 0 and then activate it by clicking the "Speed" button once more. To positive movement enter positive value, to negative movement enter negative value. Arrows buttons are not relevant in speed mode.

System Activation:

You can send commands to the system using three methods.

- ① Arrows control – there are four arrows for motion, each arrow moves both axes together:

  Pressing on the arrow button will send to CapTrack:

  TUM to drive (opcode 0x013F).

  Position to relative (opcode 0x0138).

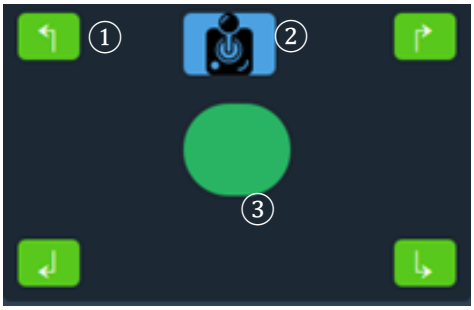
  Position mode (opcode 0x013B).

  Motor acceleration (opcode 0x0130).

  Motor speed (opcode 0x0131).

  Motor position (opcode 0x0132).

  Update (opcode 0x0134).



  - The "Up Right" arrow moves both yaw and pitch axes to a positive position.
  - The "Up Left" arrow enables negative movement for the yaw axis and positive movement for the pitch axis.
  - The "Down Right" arrow enables positive movement for the yaw axis and negative movement for the pitch axis.
  - The "Down Left" arrow moves both yaw and pitch axes to a positive position.
- ② Joystick control – To initiate joystick control, simply click on the joystick icon. Upon pressing the joystick button, you'll notice a notification indicating "Physical Joystick: ON". This signifies that the application is now actively monitoring input from an external connected joystick. As you maneuver the joystick, it will convert your movements into speed commands, aligning with the maximum system speed settings.
- ③ Green circle control – The green circle button offers an alternative control method akin to the joystick. When activated, it functions in a manner similar to the joystick.

  The maximum speed is according to max system speed, the acceleration is controlled by the value entered in the acceleration text box.

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Axes buttons:

Within the motion window, each axis has 4 buttons: axis off/on, Registers, Home and Leveling.

1. Axis on / off – This button empowers you to turn on/off the specific axis,

When the "axis off" button is pressed, it means that the axis is currently active. Pressing the button will change the status and turn off the axis. Similarly, when the "axis on" button is pressed, it means that the axis is currently turn off. Pressing the button will change the status and turn on the axis.

2. Registers: this button opens a new window displaying the status and errors of the current axis.
   - SRH (Status Register High) – This option retrieves information from the motion status register high.
   - SRL (Status Register Low) – Here, you can access data from the motion status register low.
   - MER (Motion Error Register) – This option retrieves details from the motion error register.
   - DER (Detailed Error Register) – For more comprehensive error information, the "DER" option provides access to the detailed motion error register.

When an error is detected, the indicator LED transitions from green to red. Within this window, you'll also find two additional buttons:

① Reset Axis – This button serves to reset the current axis, aiding in the resolution of specific issues or recalibrations.

② Reset Faults – This button resets the errors of the axis.

③ Home – pressing 'Home' initiates a predefined system procedure, guiding it to its home position.

④ Leveling – pressing on this button will activate the HomingIMU, note that it is only relevant for a system connected to an IMU under the system's load.

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View Menu

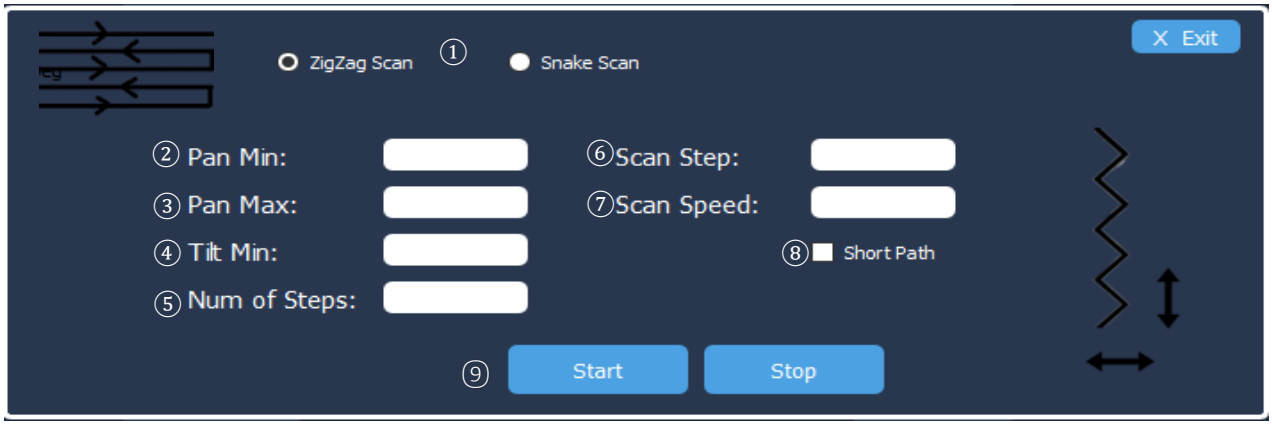
From this menu the user can open the various windows of the application. The user can approach this window only when the communication channel is open, by opening a window that doesn't support the system, the window will be shown, however all the values will be change to 'a6' which means the system does not support this commands.

The windows are:

1. Scanning Commands:

Clicking on the scan button in the upper menu bar will open the scanning window.

①There are 2 options for scanning: Zig-Zag and Snake. In this guide we will demonstrate the Zig-Zag pattern. The implementation of the snake



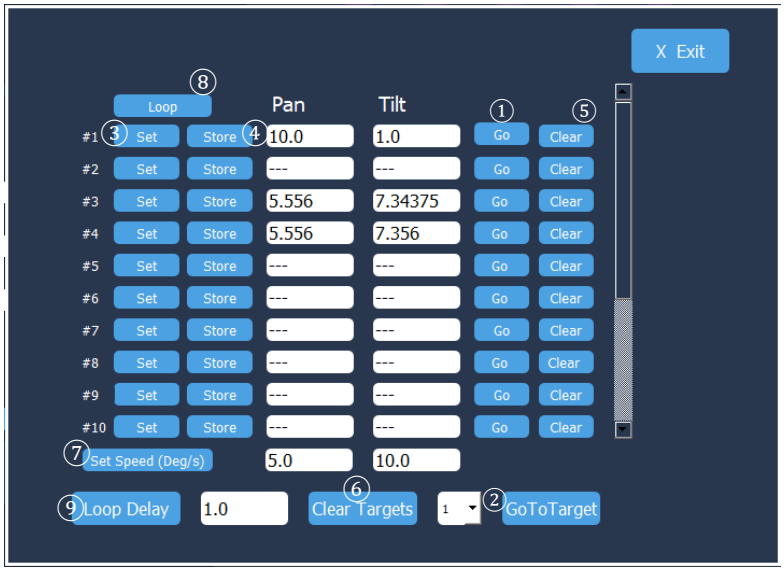
and square patterns are pretty much the same. When the system performs the Zig-Zag scan, there is a diagonal movement, depending on the data entered by the user. To enter the system into automatic scan mode, the following data must be updated:

- ② Pan minimum value: set left border for scanning area.
- ③ Pan maximum value: set right border for scanning area.
- ④ Tilt minimum value: set bottom border for scanning area.
- ⑤ Number of steps: set number of scanning steps in each scanning cycle.
- ⑥ Scan Steps: set step size for each segment of scanning.
- ⑦ Scan speed: Scan speed for the Yaw axis (The pitch speed derived from the scanning calculations).
- ⑧ Shortest path: By selecting this option, the shortest path between Yaw Min and max will be selected as the scan path.

⑨ By pressing the 'Start' button, the system will move to the starting point and from there, start the scan back and forth until the user initiates the stop scan by pressing the 'Stop' button.

2. Presets Commands:

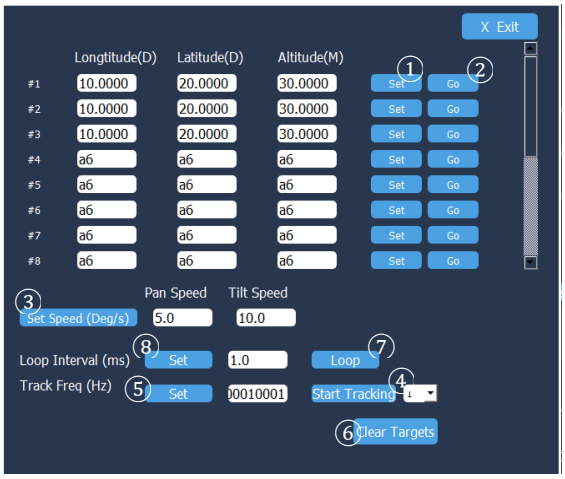
- Define a preset list that will be saved for later usage.
- The system supports in up to 15 presets.
- The presets represent absolute positions.
- The preset value must be set as Degrees value.
- The values must be in the range of 0 to 360.
- The application using the only the data that's relevant to the connected system.



- ①② In order to reach a preset, select the desired one and then click on the 'GoToPreset' button, or simply press on the 'Go' button.
- ③ Clicking on the 'Set' button will save the preset data to the system.
- ④ Clicking on the 'Store' button will save the current axes (APOS) position to the system.
- ⑤ Clicking on the 'Clear' button will delete the saved preset from the system.
- ⑥ Clicking on the 'Clear Presets' button will delete all the saved presets from the system.
- ⑦ You can change the speed for each axis by pressing the Set speed button.
- ⑧By pressing the loop button the system will start looping over the presets.
- ⑨You can adjust the loop delay by pressing the Loop Delay button. The delay time is the duration waited at a point before progressing to the next point in the loop (in milliseconds).

3. Targets Commands:

- ①Set the list of GPS targets, which will be saved for quick movement later.
- ②In order to reach a target, select the desired one and then click on the 'Go' button.
- ③You can change the speed for each axis by pressing the set speed button.
- ④ Clicking the button enables tracking of the selected target number. After pressing the tracking button, the tracking begins, and the button changes to "Stop Tracking".
- ⑤Track Frequency: This setting determines how frequently the system corrects itself based on the selected target.



- ⑥Clicking on the 'Clear targets button will delete all the saved targets from the system.
- ⑦Clicking on the Loop button will start looping over the targets.
- ⑧You can adjust the loop delay by pressing the Loop Interval button. The delay time is the duration waited at a point before progressing to the next point in the loop (in milliseconds).
- When not explicitly defined within the points system, the default display will feature 'a6'.

4. Stabilization Commands:

In this window you will see the real-time IMU data. In addition, there are several buttons as detailed below:

- ① Reset IMU – This option allows you to perform a reset operation.
- ② Stab Calibration – In this window you will see the stabilization definitions for each axis.

①Stabilization on / off – Turn on and off the system stabilization mechanism.

②Axis Defined – set the axis definitions.

- Control Type – set the mode of motion command that will be sent to the drivers (speed mode / relative position mode / absolute mode).
- Speed Multy – for position control loop only. The constant speed command that will be sent to the drivers in addition to the calculated position and acceleration commands.
- Acceleration Multy – A factor that multiply the calculated stabilization acceleration (greater acceleration enables faster response).
- PID const:

  Kp – Higher Kp leads to a faster response but excessive Kp can increase the overshoot.

  Ki – Higher Ki helps to reach and maintain the desired position accurately but excessive Ki can introduce instability.

  Kd- Higher Kd leads to dump rapid changes but excessive Kd can amplify noise and lower Kd may cause delayed response or decreased stability.
- Max Pos Error – the maximum position error the system will try to stabilize. The system will not increase the response to an error greater than the maximum.
- Min Accel – minimum acceleration value for the calculation of the stabilization acceleration.

③Axis Error – Each axis has an error graph that showing the stabilization error.

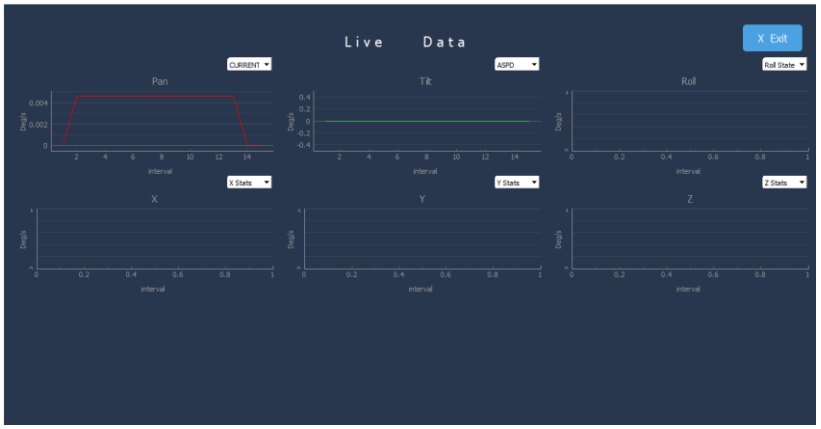
④General Defined – set the general defined.

- Roll correction – add calculation for pan & tilt axis to compensate roll error, for keeping the watching the target although the roll error.
- Target Range – distance to target, the distance between the system and the observed target. Necessary for roll compensate.
- ⑤Sensor Distance – the distance, at X, Y and Z axes, between the system to the center of mass of the platform on which the system is installed (vehicle, aircraft etc.). Necessary for roll compensate.
- ⑤Filter Gyro & Euler – filter on gyro (angular velocity) and Euler angles readings from IMU reduces noise and attenuating rapid changes. The filter helps to obtain more stable and accurate measurements. A Higher value provides greater noise reduction and stability but introduces more response delay.

- ⑥Loop Interval – set the stabilization loop interval.

⑦To preserve all the settings within the controller's memory, simply click the "Save" button. This ensures that your adjustments are retained for future use.

⚠ **The system has been calibrated and the saved configuration provides the best performance. Changing this configuration may damage system performance, it is the user's responsibility.**



③ Live plot – By selecting this function, you'll gain access to a graphical epresentation of values for each axis. This

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includes visualizations for parameters such as position (apos), speed (aspd), voltage (volt), and current. This graphical display offers an intuitive view of real-time data trends.

5. GPS Commands:

This page represents real-time GPS data and general information about the GPS sensor that connected to the system.

- ①The GPS real-time data information such as: current GPS, date and time, GPS current Northing and easting update in the left part of the frame.
- ②Self Location – in order to define your own location points (LLA target: longitude, latitude, altitude) you can set your system positioning data. Pay attention, you can do it only when the 'override' option is selected.
- ③In case of surfer you can connect to an external GPS device.
  Enter the IP of the device and the real-time data will be read.

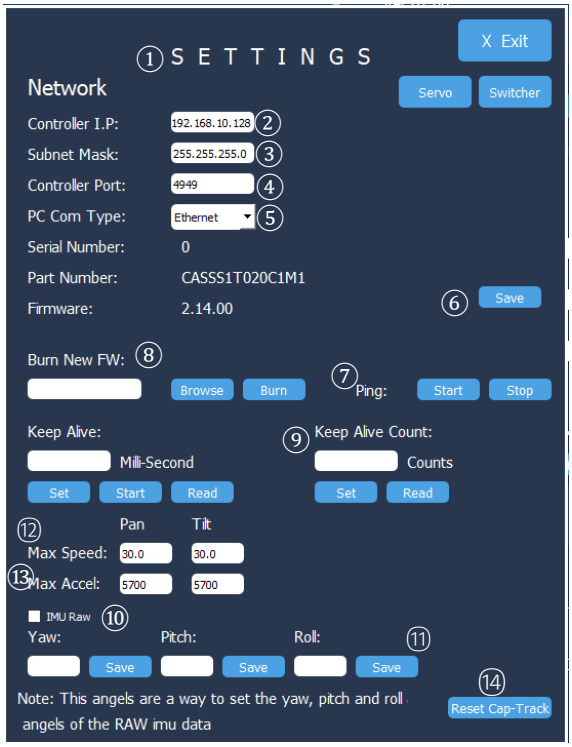
⑥Settings:

In this window you can read the Network definitions and change them by pressing the save button.

- ② Controller IP – The main system IP address.
- ③ Subnet Mask – The system subnet mask address.
- ④ Controller Port – You can change the system port number or leave the default value.
- ⑤ PC Com Type – Set to the controller the PC communication type (Serial or Ethernet).
- Make sure that the subnet of this address is the same as the subnet of the system's primary IP address.
  Failure to assign address with the same subnet will result disabling the system.

⚠ ⑥After setting the new value press on the 'Save' button.

- In order to apply the address change a system restart is required.
- Once the system is restarted, it will be possible to connect, using the newly defined address.
- ⑦ Start, Stop Ping – Press the Start/ Stop button to test and see if the network of the current device is reachable.
- ⑧ Burn new firmware – Updating the controller firmware. Only performed by a technician.



⑨Keep Alive

- Keep Alive Timeout represents the interval between each cycle for checking communication with the customer.
- Keep Alive Count – counts the number of consecutive cycles without communication renewal until reaching the maximum limit. At that point, an error occurs, leading to a system stop.
- Start Keep Alive – Initiate or stop the Keep Alive mechanism time parameter. Upon activation, a message will appear:" Notice! Keep alive is ON" on the top bar - status.
- In case of communication failure, if the controller doesn't receive messages within the set timeout and max count, the engines will immediately stop.

- ⑩When clicked, it retrieves the pure Euler angles values from the IMU. When it's selected, it obtains the calculated Euler angles values relative to the system load(including encoder angles if necessary)
- ⑪Set Actual Values: To modify the yaw, pitch, and roll values of the IMU, enter the desired values and click the save button. After saving, the angles obtained from the IMU will be relative to the entered values.
- ⑫ Max Speed – The maximum system speed (Deg/s).
- ⑬ Max Accel – The maximum system acceleration (Deg/s^2).
- ⑭ In order to apply the changes a system restart is required – press on the Reset CapTrack button.

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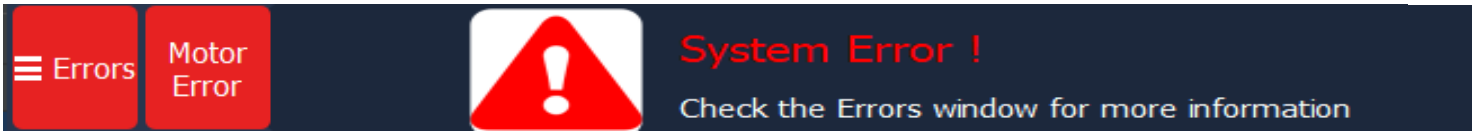
Errors:



①When there are errors an Error System will pop up, you can see the current error by pressing the Error button.

②This window displays to the user general online error report about the system.

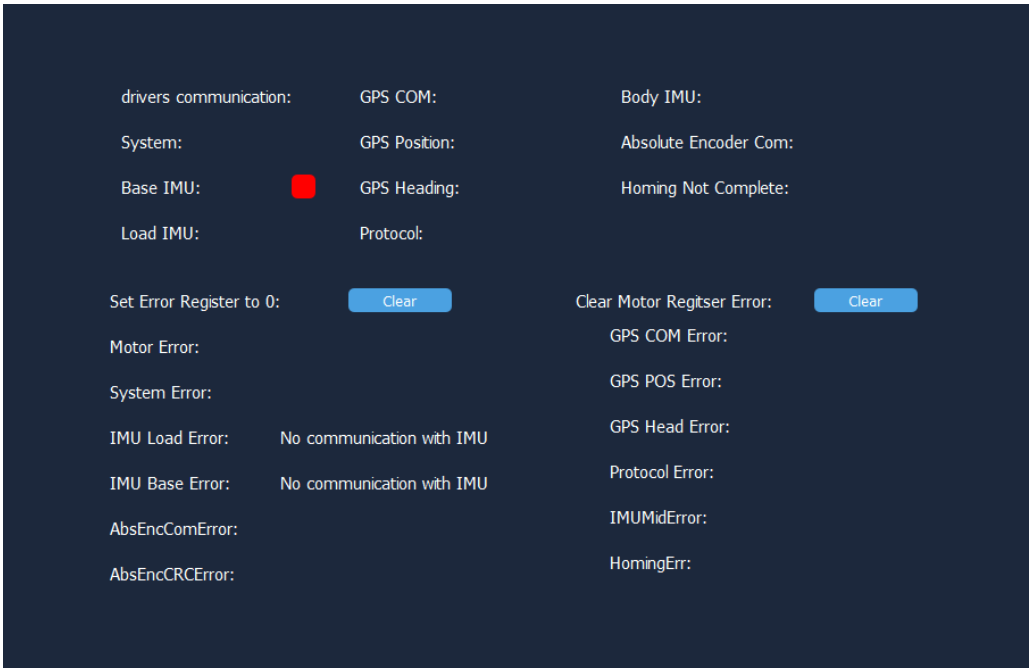
The general system errors split into two categories:

Communication Errors:

indicated the communication state with all of the connected components. Since the fact that system may contain several sensors that reflects on the systems performance, the user should get detailed information about the communication state with each and every one of them.

Protocol Errors:

In cases where the user implements the communication protocol, the system will return an error byte for wrong protocol implementation. After getting a command error from the system, the user can read the last error in order to learn his mistake.



③Motor errors will be shows in Motor Error window by pressing the Motor error button.

This window displays to the user an online error report about all of the system connected axes. Our systems have two main error types: Critical and Non-Critical.

- Critical Error:

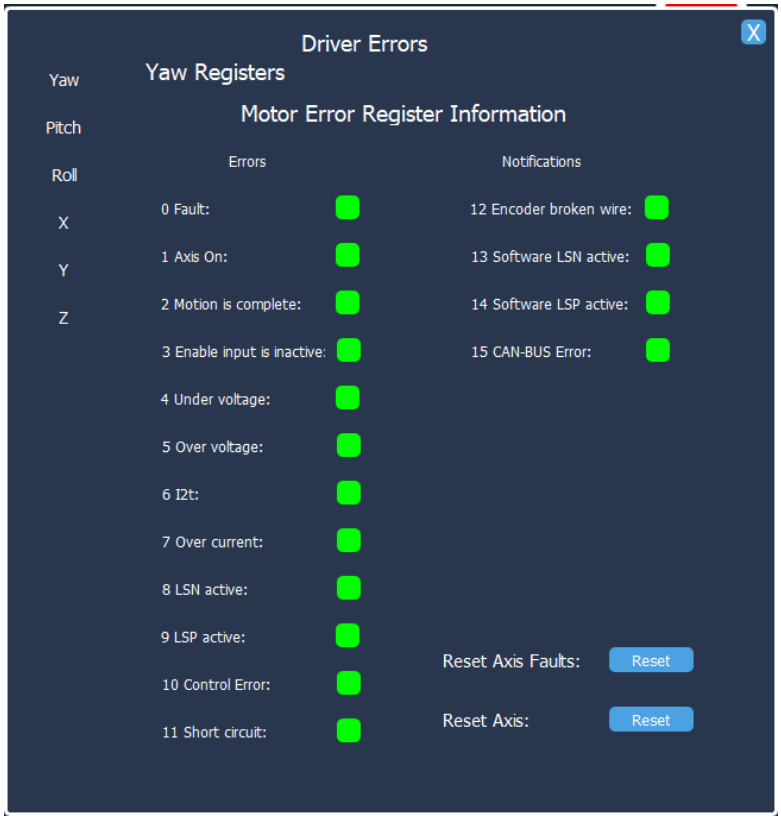
When critical error is raised, mostly, the corresponded axis will be stopped until we will reset the error.

Common critical errors are: Over current, Software limits switches, etc.

- Non-Critical Error (warnings): Defined by Status register. While a non-critical error is raised the corresponded axis won't stop his movement' but a warning indicator will rise in order to set the user attention. Some of the non-critical errors are just references on the system state.

Within this window, you'll also find two additional buttons:

- ①Reset Axis Faults – Set the software limit switch for the axis on and off.
- ② Reset Axis – This button resets the errors of the axis.



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