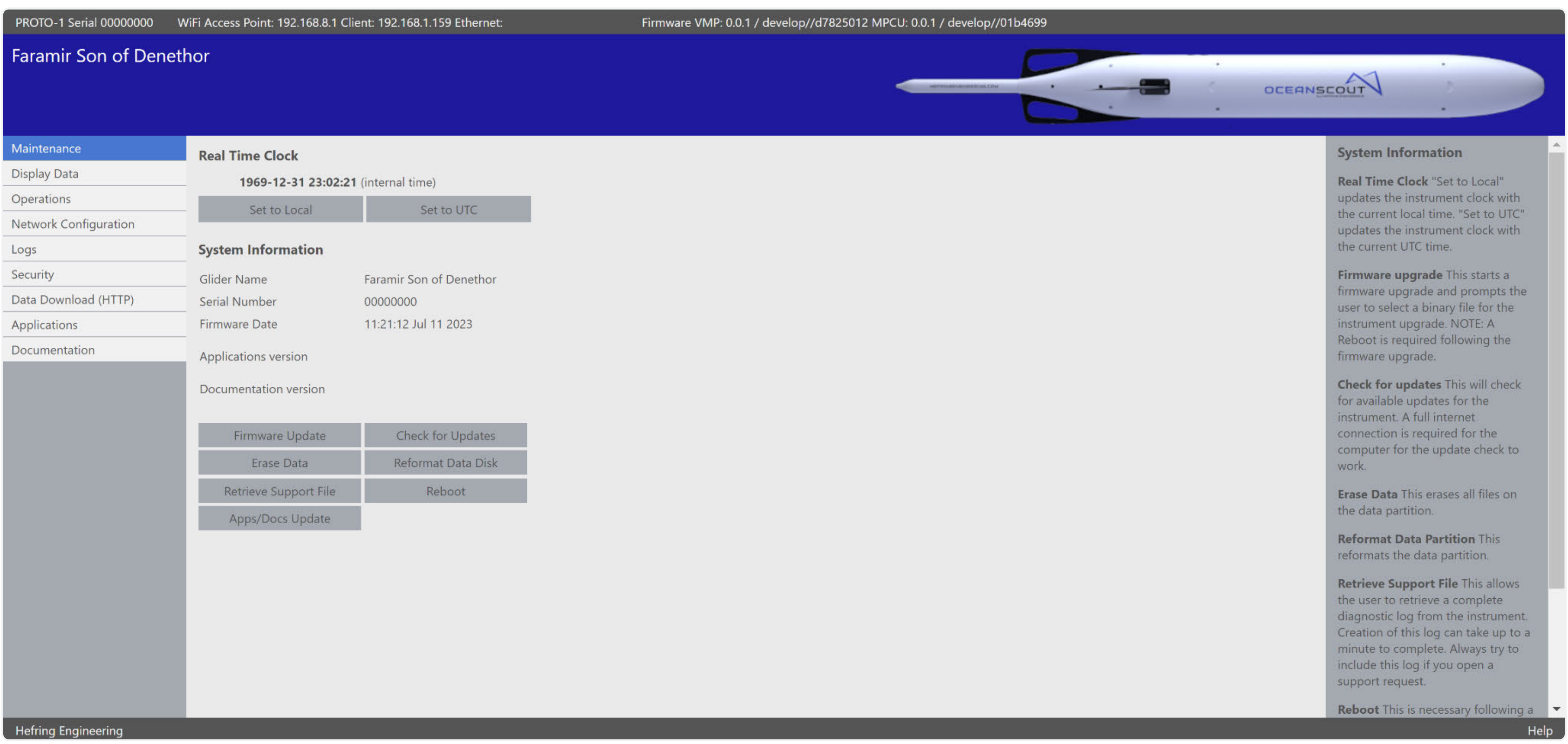
Firmware

Introduction:

This section covers operations involving the glider's firmware and local webpage. The local webpage is used for setup, calibration and test operations as well as downloading data and operational logs. This webpage is generated onboard the glider and is entirely distinct from the Hefring Cloud online interface.

Connecting to the Glider Webpage

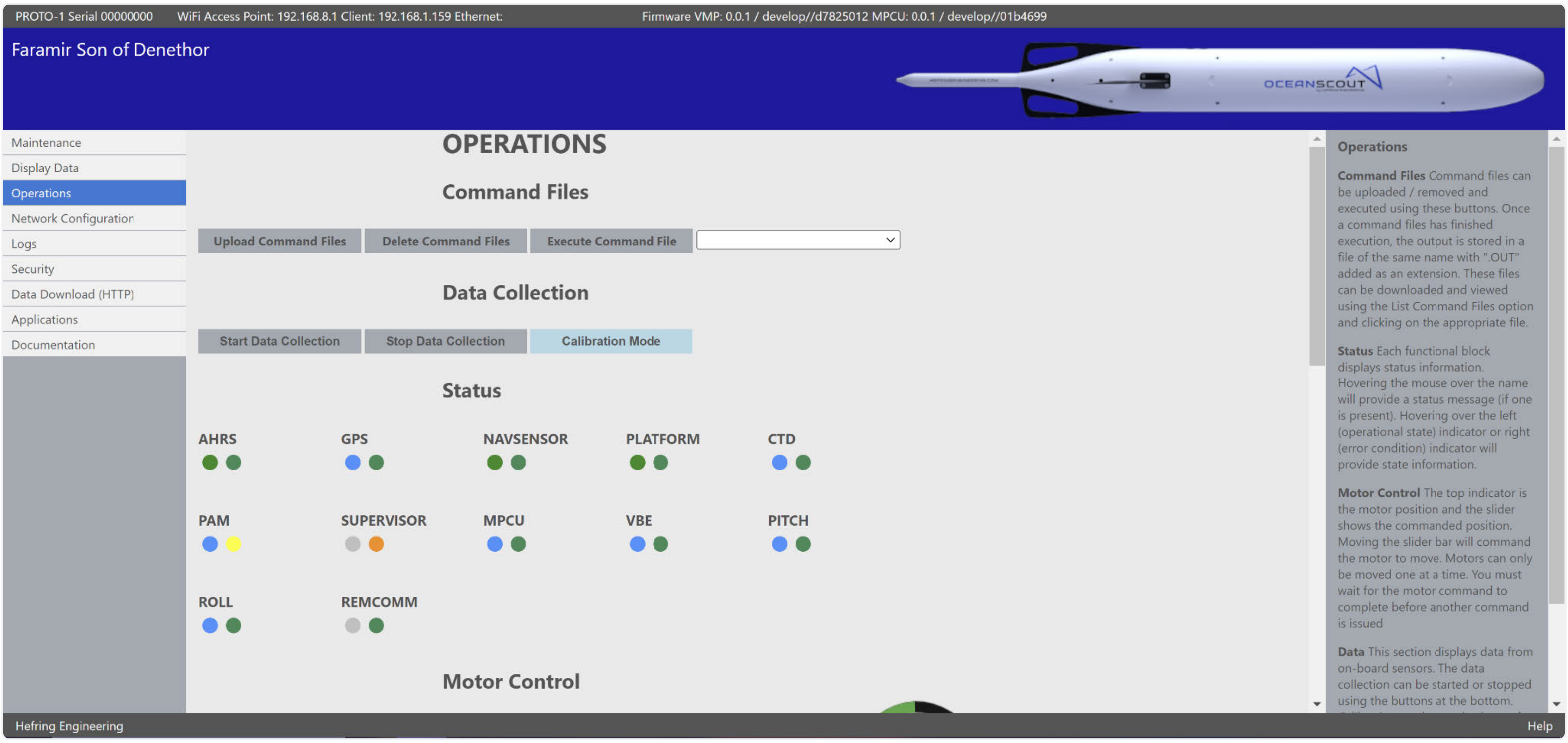
OceanScout gliders use WiFi to generate local, private wireless networks. Once connected to the *[name]*Glider WiFi access point (see “Powering up the Vehicle”) the glider’s internal web page can be accessed using a standard web browser. Navigate to the webpage by typing the glider’s address into the address bar (**192.168.8.1**).



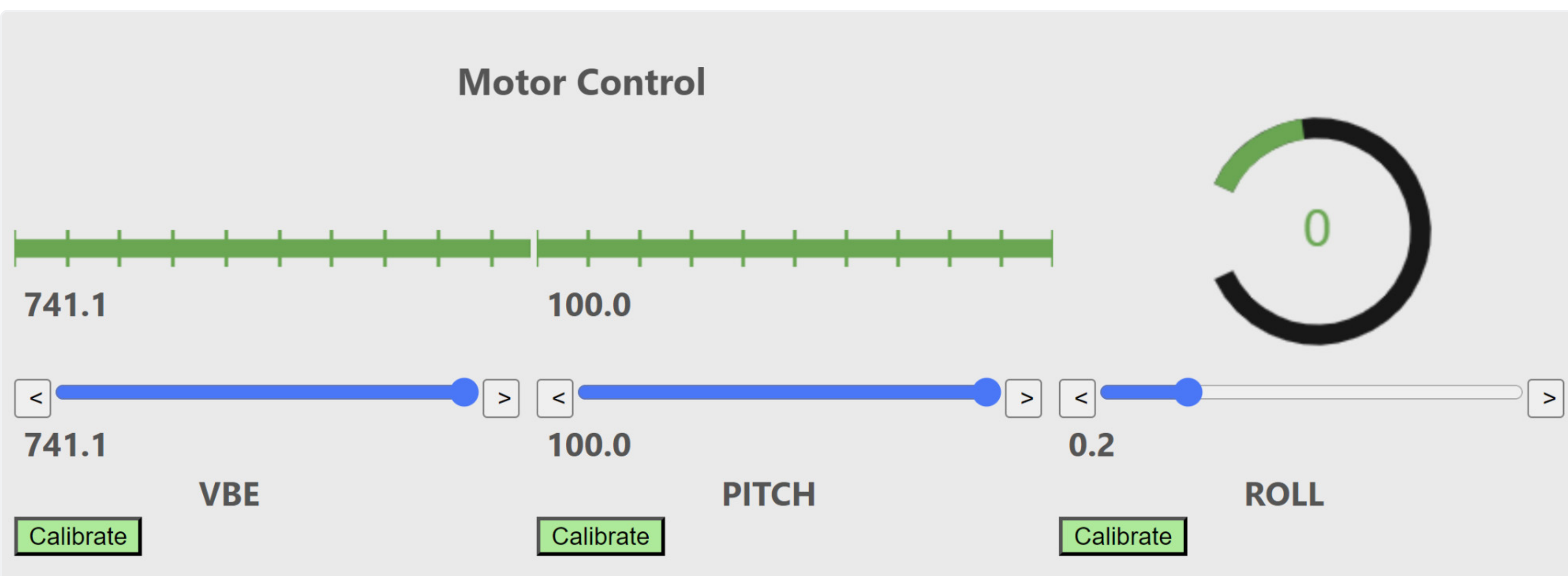
The maintenance web page is the initial page displayed. This page allows you to check the date of the firmware, and update the glider when necessary (see “Updating Glider Firmware” for more information). Apps/Docs is reserved for later use and will allow the user to download documentation and applications relevant to the glider operation.

Calibrating Motors

Once connected to the glider web page, click on the “Operations” tab along the left hand side of the page. This shows the status of the sensors and motors in the glider. The two lights show the operational status (idle, running, powered off, etc.) and error status for the sensor (none, minor, major, critical). Hovering over a light provides a text description. Hovering over the sensor name gives more information when an error occurs.



A calibration button is displayed in the motor control section to calibrate each motor. The calibration procedure automatically detects the limits and operating range for each motor and saves that information in non-volatile memory. All motors must be calibrated prior to deployment.

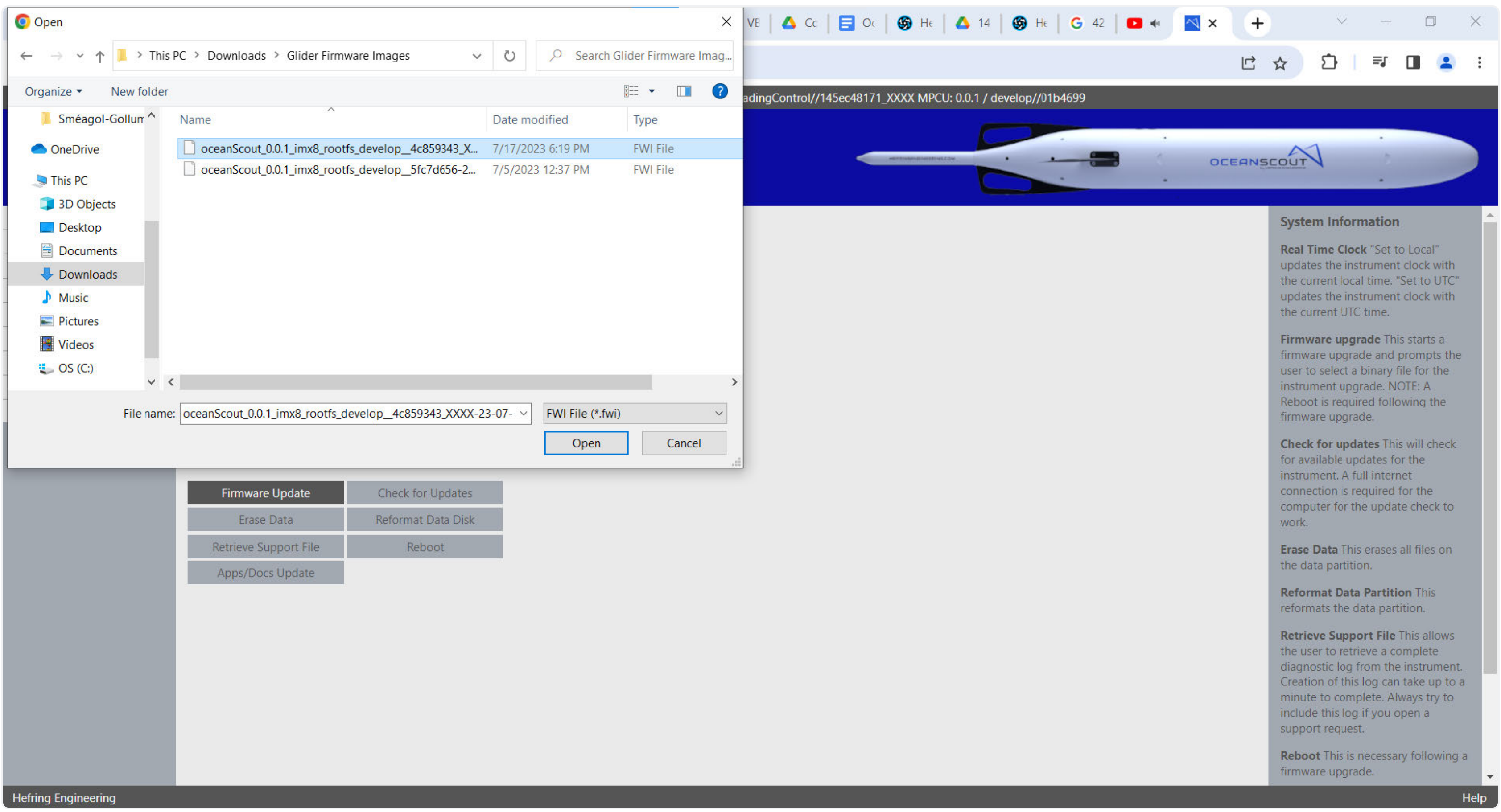


Updating Glider Firmware

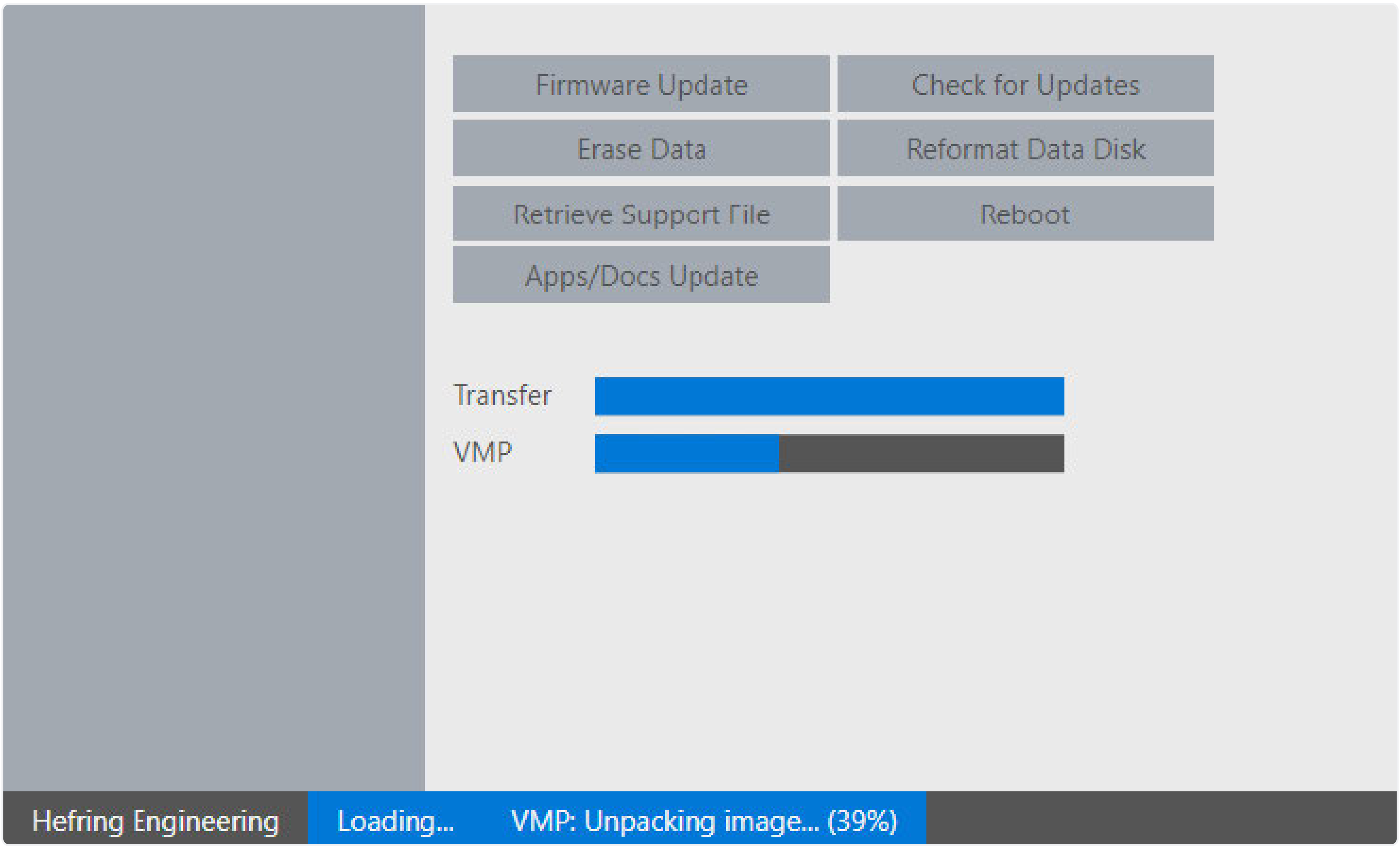
⚠️ **Do not interrupt power while a firmware update is in progress!** If an update is interrupted by turning off power, there is a chance the glider's software could become corrupted.

1. Download the appropriate .fwi firmware file from Hefring.
2. Type, 192.168.8.1 in a browser such as Firefox or Chrome to get to the glider web page.

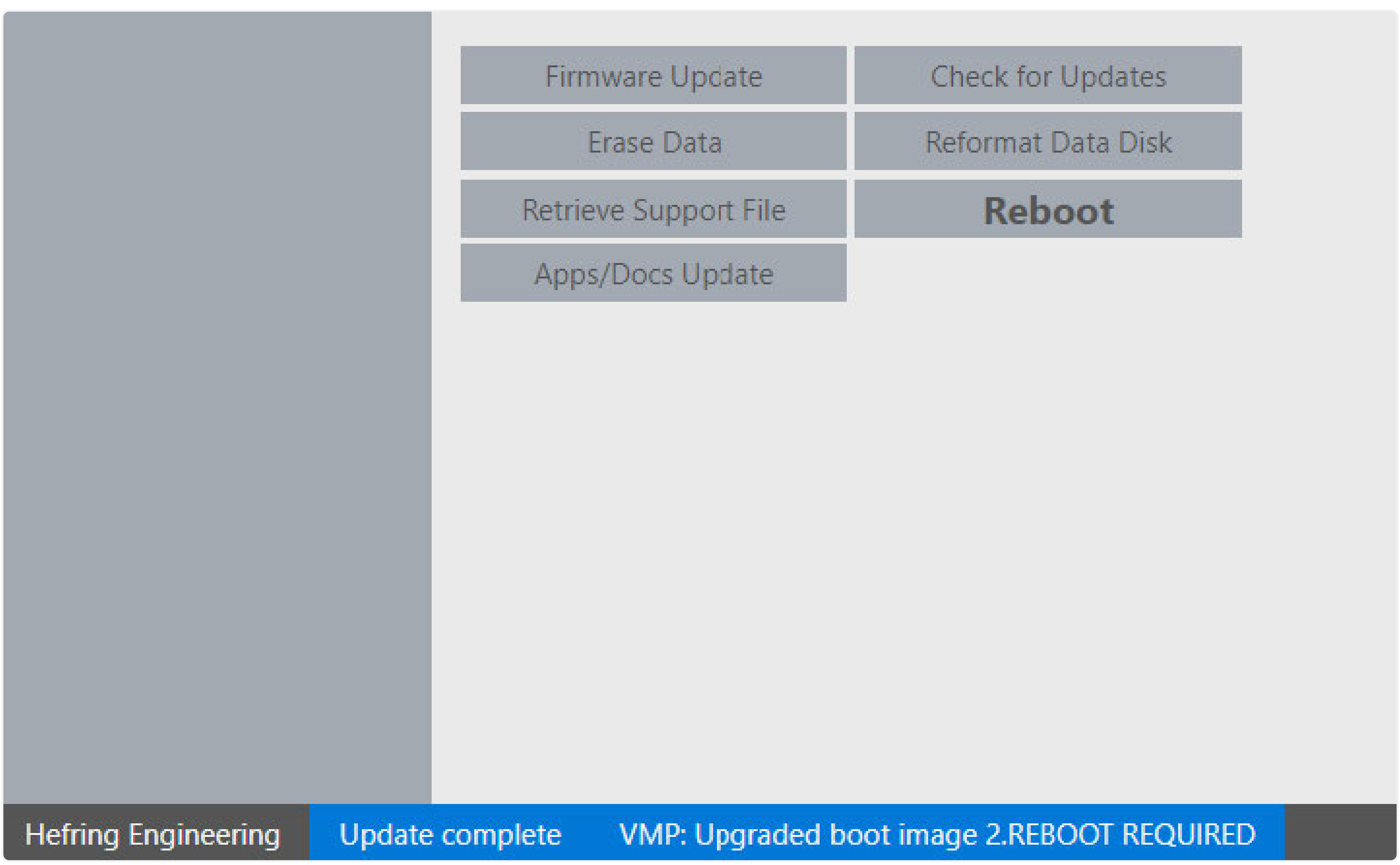
3. On the Maintenance Tab select the button that says "Firmware Update"
4. The file system on your computer should open for you to select a file. Select the .fwi file you downloaded.
5. Wait for the update to complete.
6. Select the "REBOOT" button when highlighted.
7. Once the glider comes back online confirm the firmware version at the top left of the page matches the file name of the firmware image. If it doesn't power off and power it back on. If the running version doesn't match, repeat the update process. If for some reason after two tries it still doesn't match, contact support.



The update has one progress bar per subsystem: one for transferring the image to the glider, and one for installing the image on the appropriate subsystem.



Once all bars have reached 100%, and the update is reported as complete the glider must be rebooted. Select the Reboot button (now displayed in bold). Wait 30 seconds, then power cycle the glider using the remote.

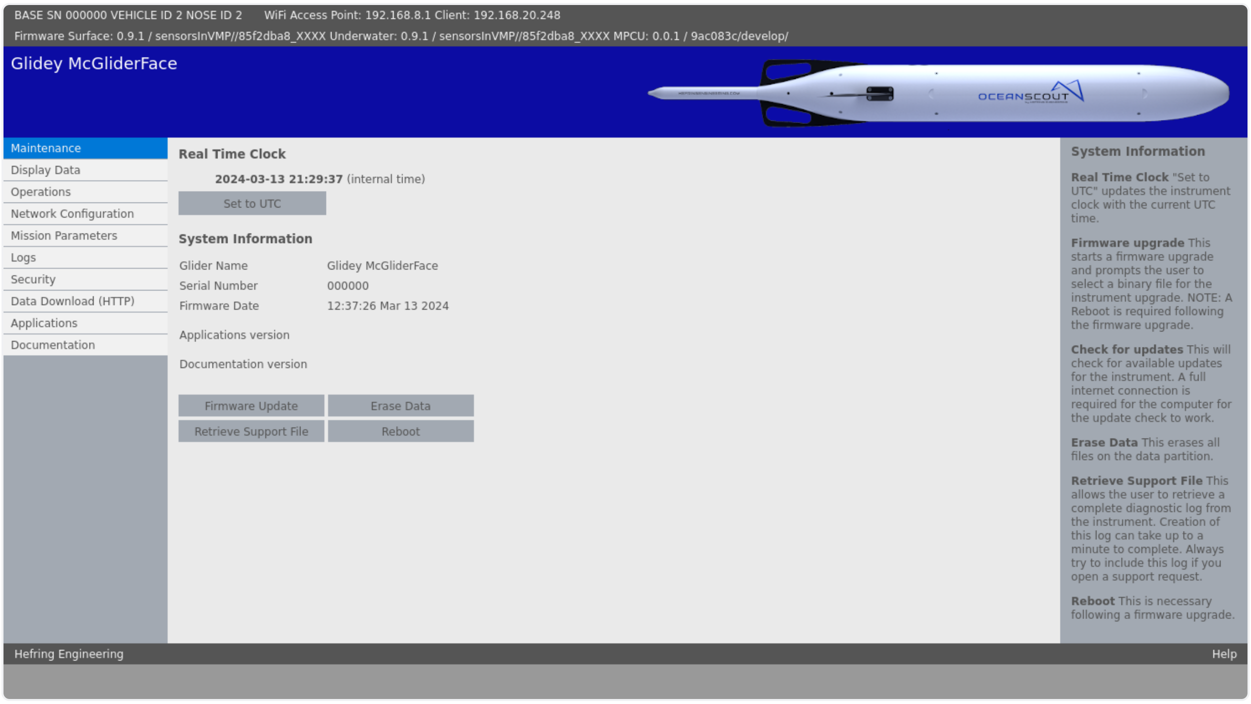


WiFi Access Point

By default, the glider creates a local access WiFi network with default SSID “HefringGlider”. Other devices, for example a laptop, can connect to the access point using the WPA2 password “hefringglider”. On this network the glider has IP address 192.168.8.1. Devices that join will be assigned an IP address in the 192.168.8.xxx subnet via DHCP.

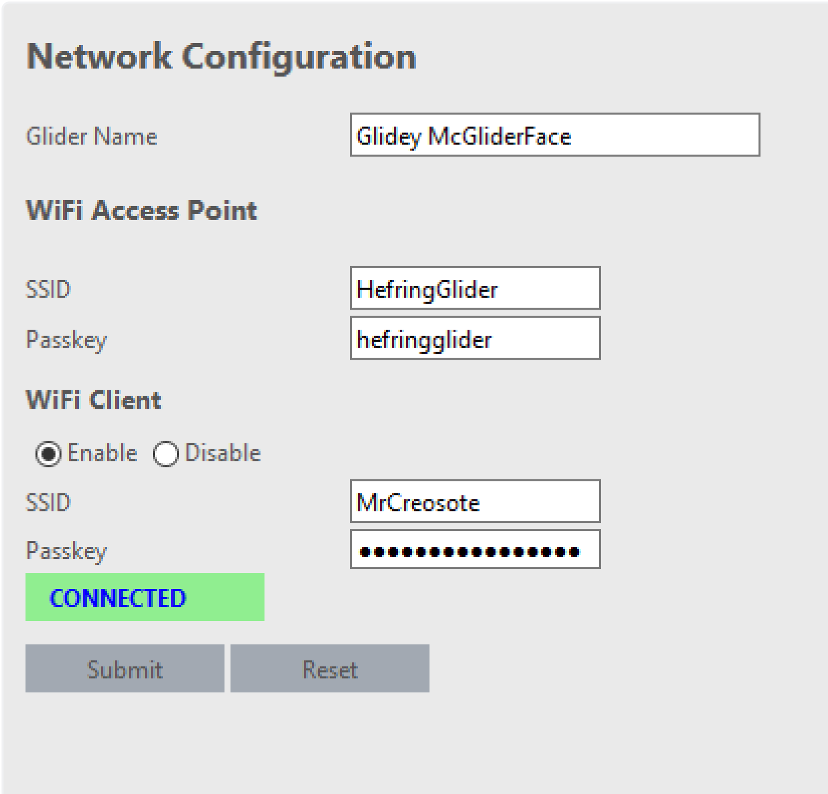
This interface allows multiple users to connect to the glider, but only allows the user to communicate with a single glider.

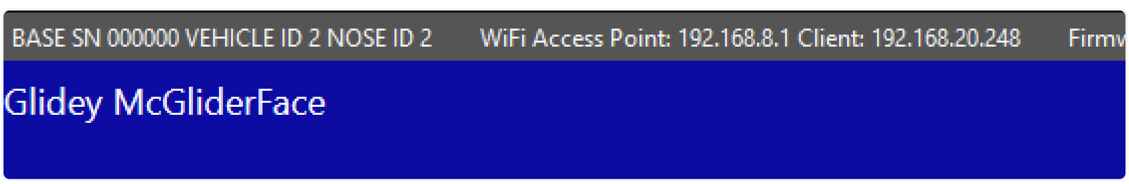
Once a connection has been made, the glider’s web interface can be accessed at http://192.168.8.1



Client Mode ("Internet Mode")

The WiFi interface can also be configured to connect into an existing access point by configuring the client mode of operation. In the glider web page, click on the “Network Configuration” tab.





This web page allows both the access point and client modes to be configured.

- Select the radio button WiFi Client enable
- Provide the SSID and password for the existing network
- click “Submit”.
- Reload the web page after ~ 15 seconds. A CONNECTED message is shown (see above) when the connection is made successfully. The IP address used by the client is displayed in the banner at the top of the web page.

At this point, if desired, the user can disconnect from the glider access point, connect to the new access point and the client IP address can be be used to connect to the glider.

Cloud communications can be changed from Iridium to internet by opening a command line session (see below) and issuing the command:

=> comm.setModeInternet

Note that internet mode requires that the client mode WiFi connection into a user network. The user network must also have full connectivity to the internet.

To change back to Iridium mode, use the command:

=> comm.setModeIridium

Setting the Internal Clock

The glider’s internal clock can be seen on the web interface at the top of the Maintenance page. Setting the clock before performing any tests will correlate logs with wall time. In the absence of internet connectivity or GPS signal, this is the only mechanism available for setting the internal clock.

NTP (Network Time Protocol) has been enabled and starts automatically. The default ntp.conf file uses NTP servers from pool.ntp.org as clock sources. NTP will only work when connected to an existing network with full internet connectivity.

Outdoors, once the GPS acquires lock and produces good data, the internal clock is automatically updated with the correct time.

Iridium SBD Messaging

Your Oceanscout glider communicates using Iridium SBD (Short Burst Data) messages rather than Rudics like some other vehicles. This reduces energy use, time spent on the surface, and Iridium costs. These messages are stored queues until the glider is ready to transmit/receive them. Refer to **Iridium Queue** in the Cloud section of this manual. Iridium limits the size of individual messages, so dives that collect and transmit large amounts of data (eg. deep yos set to transmit frequent CTD measurements) will send several messages per surfacing.

Telemetry Intervals

It is critical to understand **Telemetry Interval** and **Check Message Interval,** and to set appropriate values for your mission. These settings control the timing at witch the glider transmits Iridium SBD messages while on the surface in Idle, Recovery, and Abort. Long telemetry intervals mean slow communication, but lower power consumption and Iridium bills when surface drifting. Short telemetry intervals mean fast communication and responsiveness, at the cost of slightly higher power draw and Iridium fees if the vehicle is drifting and transmitting for a long time.

Telemetry intervals apply only to the surface modes Idle, Abort, and Recovery. Telemetry interval settings for these modes will NOT affect communication while the glider is Active (running a route). During an active mission, the glider will send and receive messages immediately upon each surfacing, then dive again without delay.

Telemetry Interval controls how often the glider sends surface telemetries. The "Telemetry" action sends a telemetry message and then receives any messages in the Iridium queue.

Check Message Interval controls how often the glider checks for messages waiting in the queue. The "check message" action receives any messages in the Iridium queue. From a technical perspective, check message sends an empty Iridium message.

If you set the check_message_interval greater than or equal to telemetry_interval, check message will never run, since sending telemetry is a superset of check message and pulls new messages anyway. This is OK.

Both sending telemetry or running check message should advance messages from "waiting" (Hefring server) to "Delivered" (Iridium server) in the Cloud message queue. Refer to Cloud manual.

> 👉 Important: Telemetry interval settings are not saved across power cycles until the glider receives a mission, at which point they are saved. For example: if you set telemetry intervals in the lab, turn off the glider for transport, then turn it on again at the deployment site it will have reverted to previous telemetry interval settings.

Telemetry Interval Recommendations:

Generally, you would want a short telemetry interval for quickly starting missions or communicating with the glider for mission changes or troubleshooting. Use longer intervals when the glider is drifting on the surface. Therefor, we usually set a short intervals for **Idle** (65 - 300 seconds) and longer intervals for **Abort** and **Recovery** (600 - 3600 seconds). We switch the vehicle to idle for communication, and Recovery for drifting. These are entirely up to the user to decide as the mission requires. For example, longer intervals may benefit a deep-ocean mission far from hazards where rapid communication isn't necessary but battery conservation in Abort is critical. Short intervals may benefit an inshore mission where quick reactions to mission changes may be necessary to avoid currents or obstructions.

Default telemetry intervals may be quite long, so check the settings to make sure you know what they are and are happy with them.

Changing Telemetry and Check Message intervals

- **Setting Telemetry and Check Message intervals in the glider webpage:**
  - Connect to your Oceanscout's WiFi network and log in to the local webpage.
  - Telemetry interval settings are in the mission parameters section.
- **Setting Telemetry Interval and Check Message Interval in the command line interface:**
  - Connect to your Oceanscout's WiFi network and SSH into the glider for command line interface. Refer to Command Line Interface section for detailed instructions.
  - **Idle**
    - Get: general.getIdle (this prints the settings)
    - Set: general.setIdle telemetry_interval=[number in seconds greater than 61] check_message_interval=[number in seconds greater than 61]
  - **Recovery**
    - Get: mission.getRecovery (this prints the settings)
    - Set: mission.setRecovery telemetry_interval=[number in seconds greater than 61] check_message_interval=[number in seconds greater than 61]
  - **Abort**
    - Get: mission.getAbort (this prints the settings)

- Set: mission.setAbort telemetry_interval=[number in seconds greater than 61] check_message_interval=[number in seconds greater than 61]

- **Setting a telemetry interval less than 60 seconds will disable Iridium telemetry.** This must be used with extreme caution. We recommend setting and double checking telemetry intervals on land rather than using the Cloud CLI on active vehicles unless absolutely necessary. However, cloud CLI may be used to change telemetry intervals when required. If using Cloud CLI to change telemetry intervals on a deployed vehicle, be aware that turning off telemetry is entirely possible, and is likely to mean vehicle loss. An oceanscout with telemetry accidentally left off before starting a mission will simply not be able to start a deployment. However, telemetry could be turned off while already deployed and cannot be re-enabled remotely. **Any telemetry_interval less than 60 seconds will disable telemetry.**

👉 Tip: If you're wondering why your glider isn't starting its mission, why messages are sitting in the queue, or why you haven't seen telemetry updates in a while when the glider is in Idle, Abort, or Recovery, then you have a slow telemetry interval set.

Command Line Interface (CLI) Operation

❗ The Command Line Interface is a powerful tool. It can issue commands or make changes to the system that may be unintentional, unexpected, untested, or dangerous to your vehicle. Use caution, and always consult your Hefring support representatives if you have any doubts.

Any computer can be used to connect to the glider's command line interface (CLI), provided that a SSH client program is installed. (3rd party programs such as PuTTy can be used if a local version doesn't exist). A phone with a terminal app also works.

- Start the terminal program.
- Type "ssh hefringcli@192.168.8.1"
- A warning message may be displayed; this can be ignored. Type "YES" to agree to connect.
- When prompted for the password, type "hefringCLI"
- If successful you should see the Glider Command Line Interface "=>". Reference Electrical, CLI, Image 1. (Note: This interface is not intended for customer use in the final product).
- Within the command line interface you can issue commands to the glider to perform certain actions such as calibrating motors, or request information such as firmware version, and battery health. In the final product this data will be displayed as part of the web interface, and will be available on the piloting website.
- The most useful command is 'help'. When typed alone it will print a command description and relevant parameters for all available commands. A search function is also available by entering a partial command

after the 'help'. For example, to get help on commands related to the PAM subsystem, you can type 'help pam'. Other helpful searches, 'help sensor', 'help mpcu', 'help info', 'help status'.

- Commands are not case sensitive.

CLI Access Quick Ref

- ssh hefringcli@192.168.8.1
- Password: hefringCLI

Commands

platform commands are used to interface with the VMP in the nose cone.
mpcu commands interface with the Motor and Peripheral Control Unit in the glider body.
mission commands are used to set / view mission parameters.
sensor commands control individual sensors in the nose cone.
super commands interface with the supervisor that controls the glider flight and navigation capabilities.
comm commands are used to access the remote communications device.

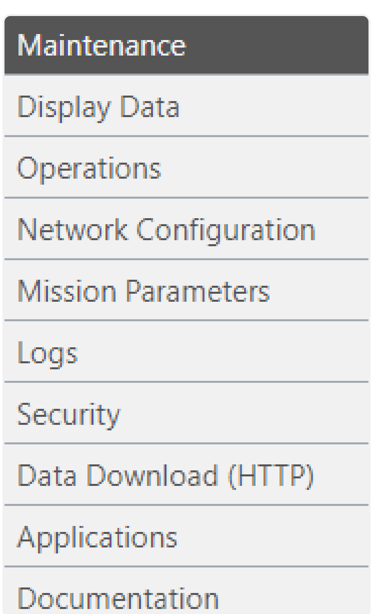
Command List

The following .PDF document contains a comprehensive list of commands accessible at the user level. These commands are also available by entering "help" in the CLI.
CommandLineManualforUsers.pdf

Consult Hefring before entering commands that may change glider behaviors.

Web Pages

Web page displays are selected using the page selection tab:



The **Maintenance** tab is used to set the glider clock, do firmware updates, erase the data disk and retrieve support files. *Check for Updates, Apps/Docs* are not currently functional.

Firmware will be provided in the form of a *.fwi* file that updates all subsystems within the glider.

The **Display Data** tab displays in real-time data collected by any sensor that are running. Sensors can be turned on / off using the *sensor.start* and *sensor.stop* commands in the CLI.

The **Operations** page details information about the current glider state. Each subsystem has two buttons (state and severity) that have associated hover text. Hovering the mouse over the subsystem name will provide more detailed information if available.

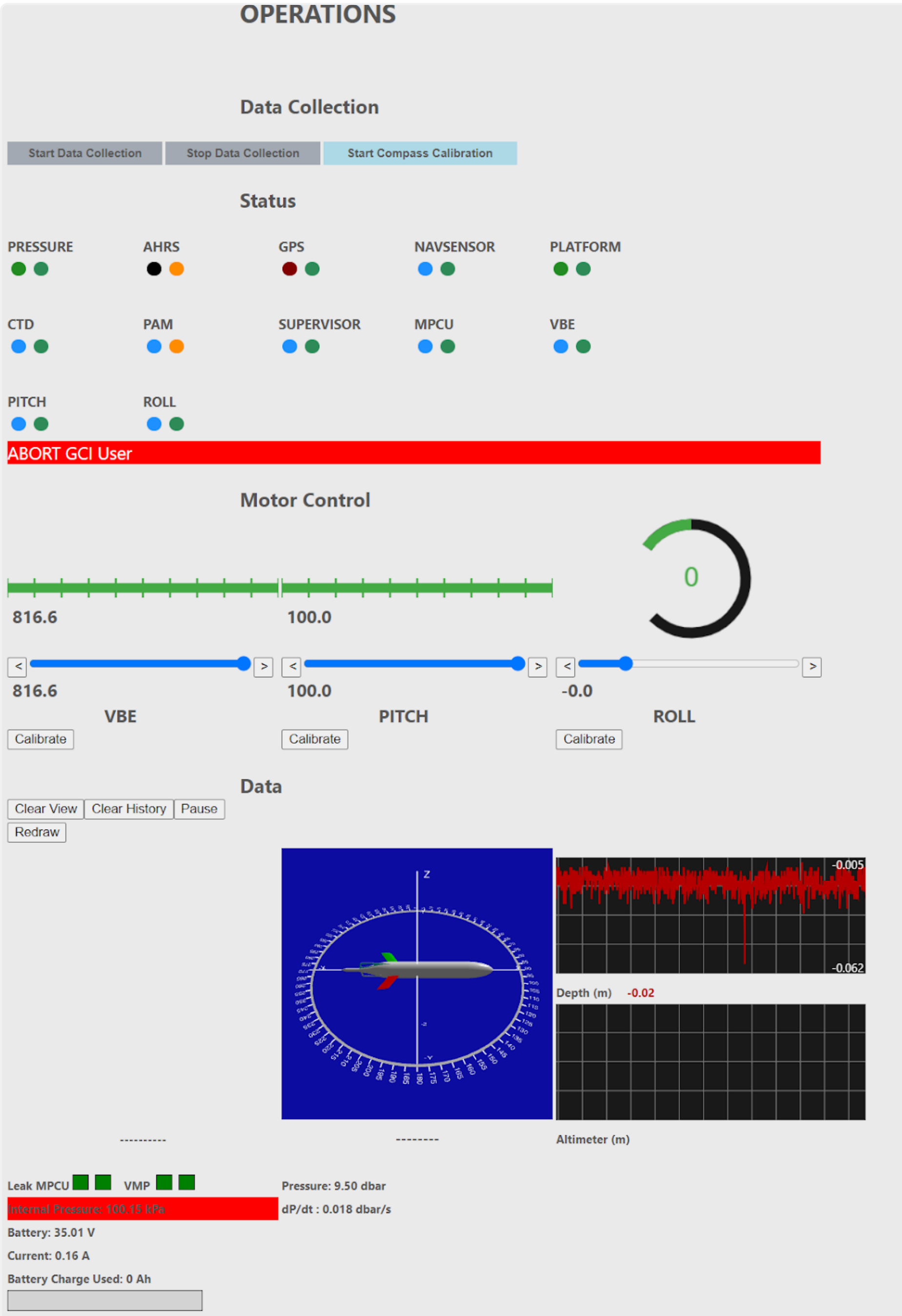
Any abort condition is highlighted in red at the bottom of the states.

Abort Conditions

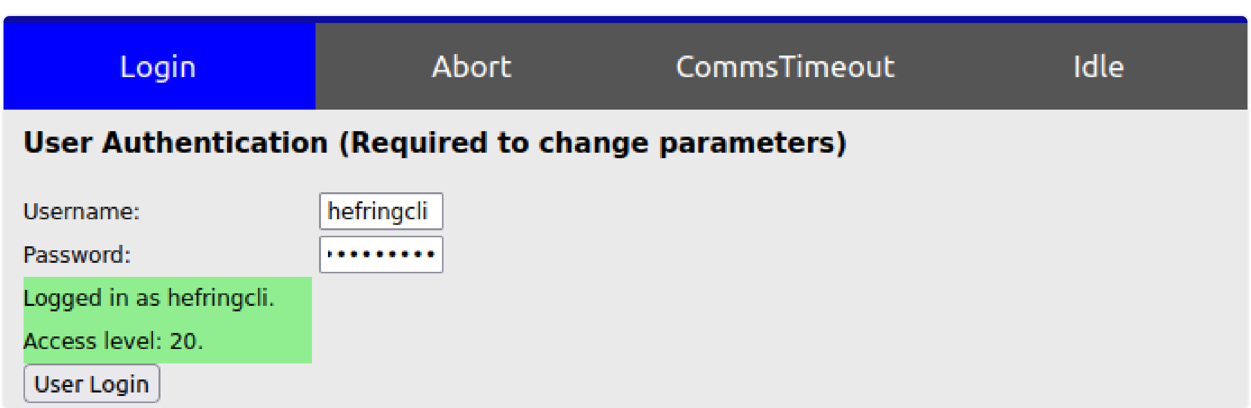
- No communications timeout
- Mission timeout
- Max Depth Exceeded
- Minimum Battery percent
- Minimum Battery voltage
- Minimum disk space percent
- Minimum disk space MB
- Internal Pressure (vacuum)
- Leak detect

The *Motor Control* block shows the current motor positions and commanded positions. Motors can be moved by moving the commanded motor position slider. Motor calibration (used to determine the full travel range allowed for each motor) is required after power on. The calibration process can be initiated for each motor using the associated calibration button.

The data displays show GPS position, orientation and depth / altimeter data. Note that these displays will only be updated when the corresponding sensor is running. While these displays are typically used during engineering / simulation testing, they are also useful for ensuring that the relevant sensors are working correctly.

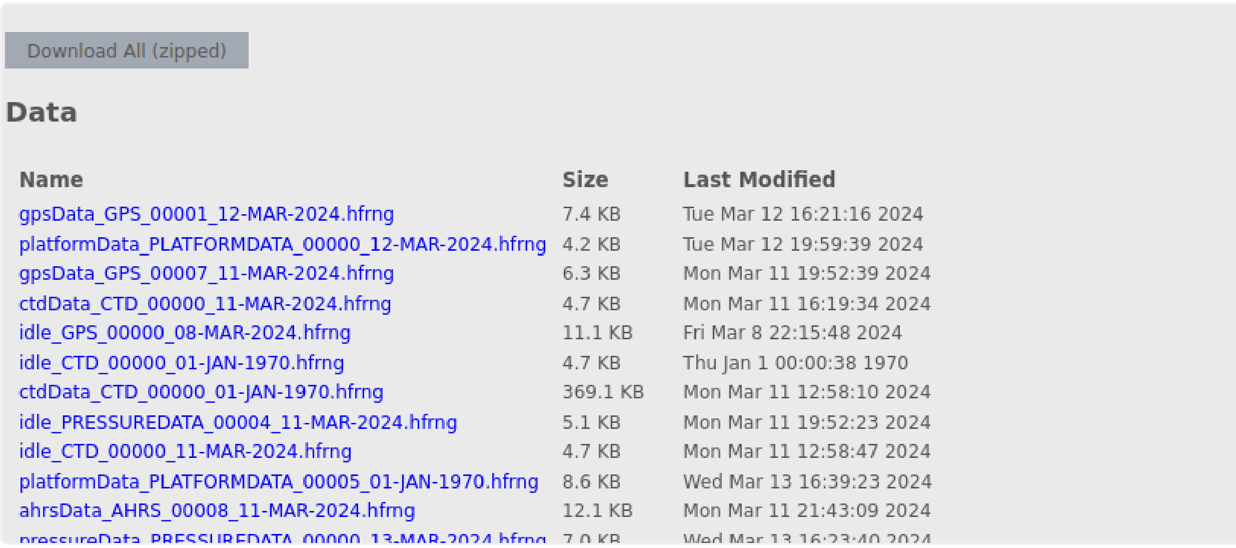


Mission Parameters



Mission parameters can be updated by logging into the Login Page. The login credentials are the same as for the command line interface. If not logged in, parameters can be viewed, but not changed. Note that a cloud configuration may overwrite values set by the user, so the glider is typically programmed through the cloud first before any other parameters are fine tuned.

Data Download



The entire data disk can be zipped and downloaded at once using the *Download All* button. Alternatively, individual files can be downloaded by clicking on the appropriate file name.

The entire data disk (including logs) can also be downloaded using the command prompt:

scp -r hefring@*ip_address*:/mnt/data .
Password: **HefrinG**

The data and logs are stored in the subdirectory “data”.

> After downloading, remember to clear data off the glider using the Erase Data button in the Maintenance tab. Running multiple missions without erasing data will accumulate a large number of files that can be difficult to sort through, and will eventually fill up the memory if never cleared.

PAM data is recorded separately on SD cards located in the nose cone, behind the nose cable connector.

Processing Glider Data

Once downloaded, glider data files can be opened and processed with the following tools:

Hefring Data Tool
Hefring Data tool manual including download links in Section 4: https://doc.clickup.com/24539728/d/h/qcwjg-7151/547e695156a9cb6

Hefring PAM tool
Hefring PAM tool manual including download links in Section 4: https://doc.clickup.com/24539728/d/h/qcwjg-6031/3a378aa79f496b0

OceanContour can also process, preview, and convert Hefring data files. It is available from OceanIllumination here:
https://www.oceanillumination.com/downloads.html

Compass Calibration

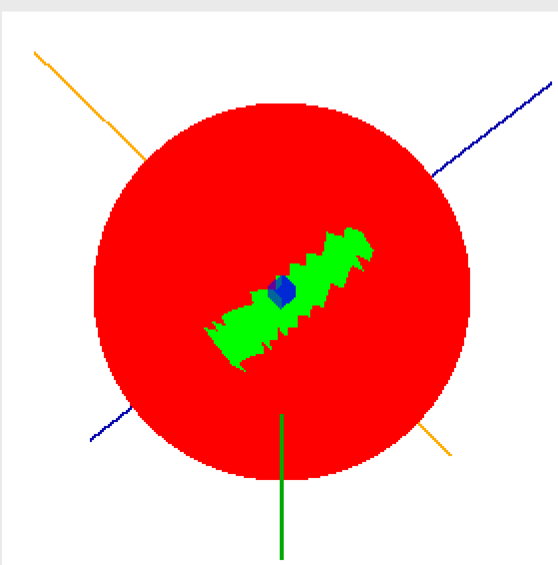
OceanScout includes an attitude heading reference sensor that produces heading, pitch and roll data for navigation purposes. The compass calibrates continuously and automatically when the glider is running. However, it may need to be calibrated when new, if the calibration is cleared, when equipment is changed, or occasionally under other circumstances to ensure that any magnetic interference is removed from the heading data.

The compass can be calibrated started using the Operations web page and progress / results viewed using the Data Display tab.

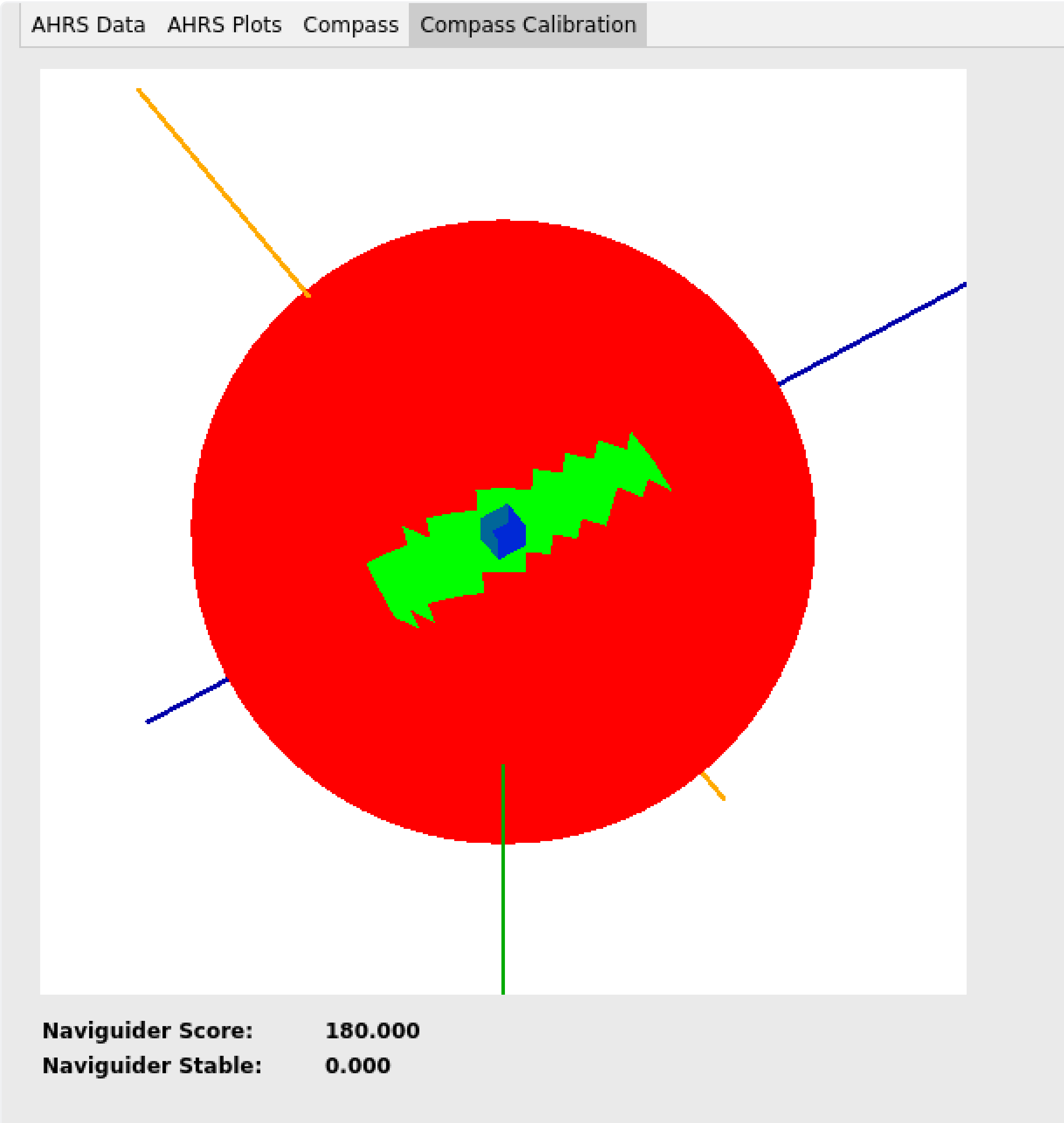
The glider should be hung in an area free of any metals or other magnetic anomalies using a mounting mechanism that allows the glider to rotate freely around all axes.

Pressing the "Start Compass Calibration" button in the operations page starts data collection and displays a sphere showing which orientation positions have been covered (green) and which need to be covered.

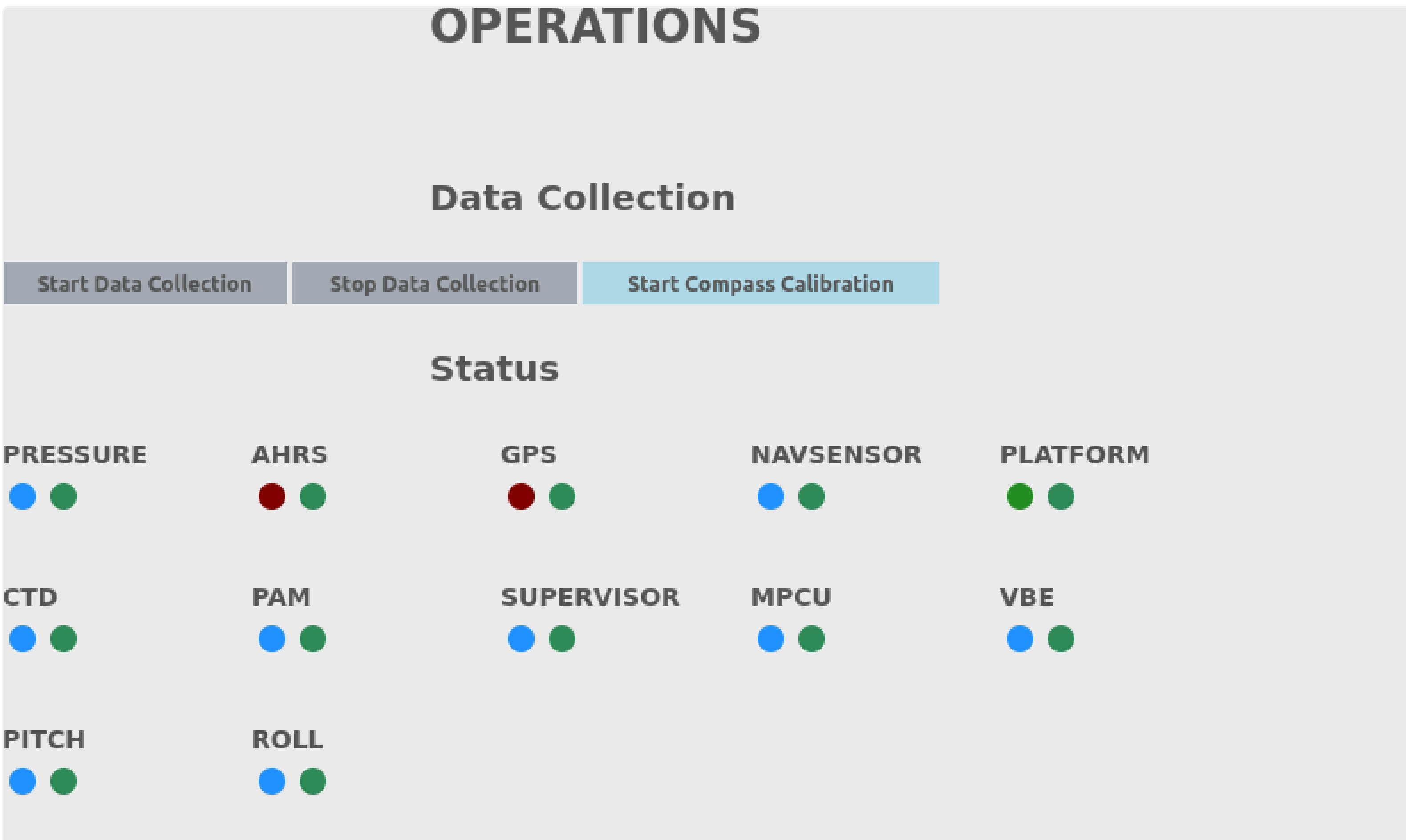
The Data Display tab incorporates progress information on the calibration.



Compass Calibration



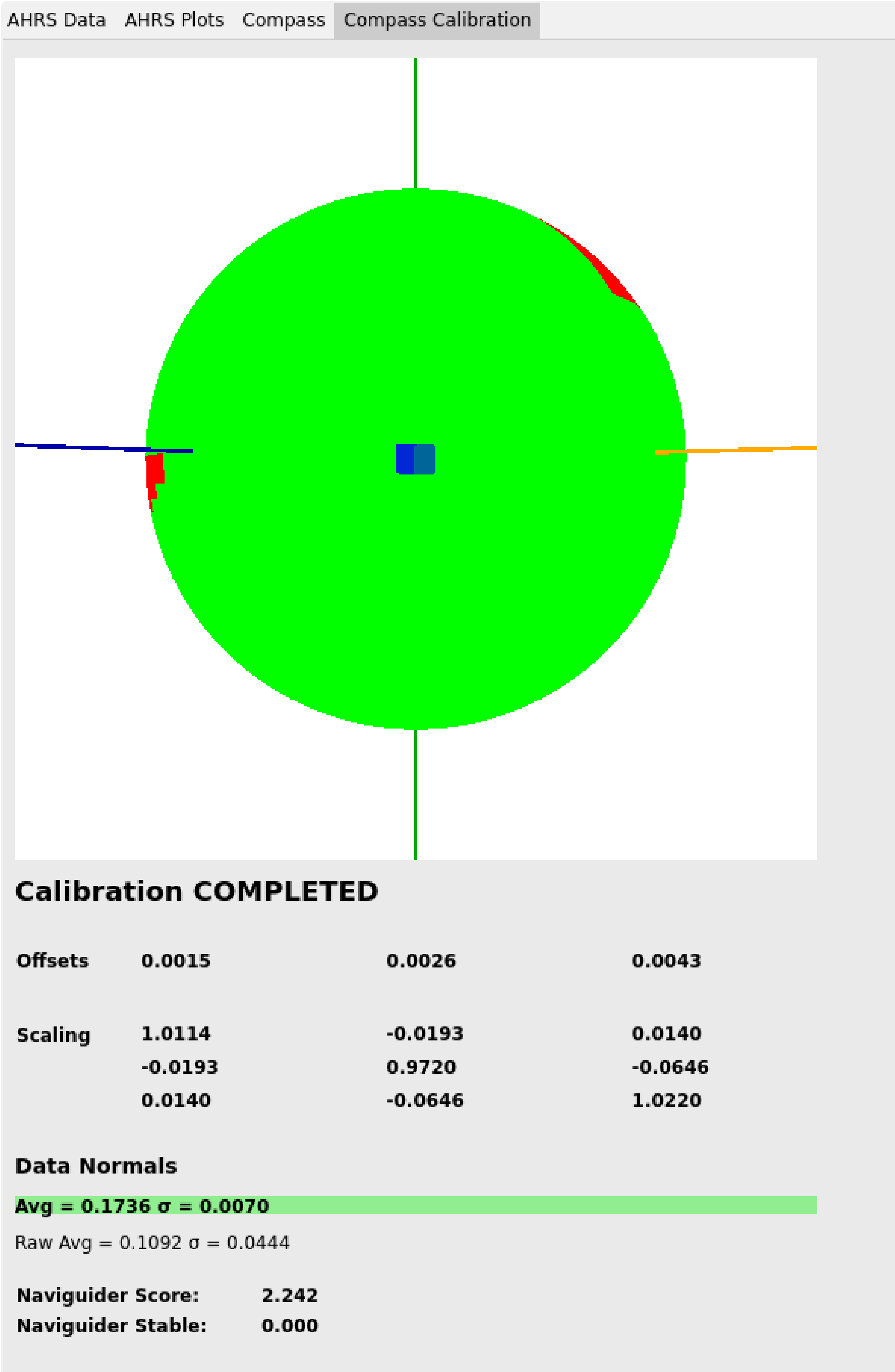
The Data Display tab also includes information on how the calibration is proceeding:



The score represents an approximate RMS error for the heading. A value of 180 is uncalibrated and the goal is to produce a value < 2.5. The calibration may or may not be stable depending upon the environmental conditions.

To change the calibration score, the glider should be slowly rotated in around all axes in an attempt to fill in as much of the sphere as possible.

Once a suitable score is achieved, the calibration is marked complete and relevant calibration data is displayed on the web page. The calibration is automatically saved within the AHRS to be preserve when the glider is power cycled.



Testing Iridium

To test the iridium connection the glider must be outside with the antenna tail pointed upwards with a clear view of the sky unobstructed by buildings or equipment. Put your glider in Idle mode, set a short Idle telemetry rate (65-300 seconds) then watch for messages on the Cloud. You should see frequent telemetry with position updates.

One convenient way to position your Oceanscout for Iridium connectivity on land is to keep it inside its transport case, and secure the whole case vertically. While the plastic case may cause a small impediment to Iridium signal strength and message latency, the glider is still be able to send and receive messages from inside. The case will safely support and protect the vehicle without the need for an additional jig. Use a strap and stable object to ensure that it does not fall over. Never allow the nose tip hydrophone to press directly against the ground. Always safely secure your glider and case when balanced vertically.

Status LED:

The Oceanscout has a multi-colour status light located on top between the vacuum port and over-pressure valve. This light provides a quick reference for glider status.

Booting: Red blinking at 100ms intervals
Idle mode, normal operation: Blinking green
Abort: Red blinking at 300ms intervals
Vehicle Management Processor (VMP) error: Blinking red (faster for higher severity) + blinking green
MPCU error: Blinking blue (motor error, boot error, motor not calibrated) + blinking green

- The status LED will be off while the glider is running a mission to conserve power.
- CLI command "mpcu.getLEDStatus" provides more information on the operating status.

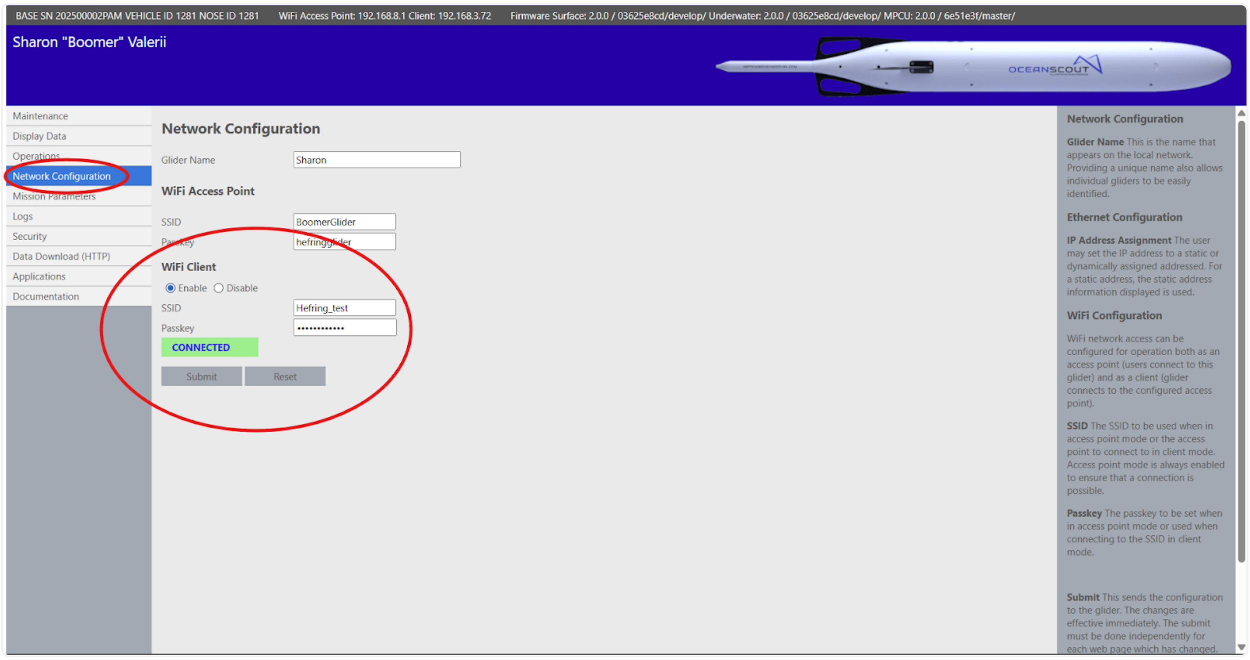
Internet Mode

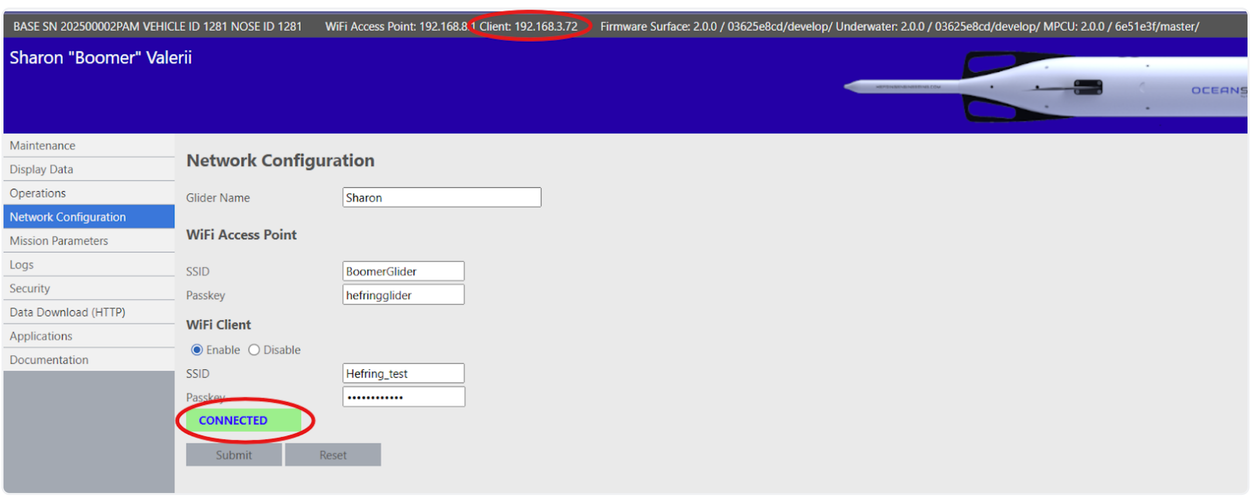
Internet Mode allows your Oceanscout glider to communicate with the Hefring server via a regular internet-connected WiFi network or hotspot instead of the Iridium network. You may then use cloud to communicate with your glider or send missions, essentially emulating normal Iridium operation over the internet. This may be useful while outside of Iridium communications range but in range of an internet-connected WiFi network, eg. indoors.

How to switch to Internet mode on the Bench

This covers how to switch the glider’s remote communications to the Cloud site so that instead of relying on an iridium satellite connection to download a mission it can download it from your local wi-fi network.

- In order to download a mission from the Cloud site over the internet, the glider first needs to be connected to your local wi-fi network. To do this, open the glider webpage on google chrome or firefox (192.168.8.1).
- Navigate on the webpage to the “Network Configurations” tab.

- 

- The Wi-Fi Client section is where you will need to put in the name of your local wi-fi network and its password, as if you were connecting to the wi-fi on your computer.
- Make sure the wi-fi client is enabled and hit "Submit"
- You should see a green 'Connected' bar show up, and a client wi-fi ip address along the top of the screen.
- 

- Now that the glider is on the local wi-fi you'll need to switch to Command Line. Open up a terminal app (terminal, powershell, command prompt, etc), and use the command 'ssh hefringcli@192.168.8.1' with the password 'hefringCLI' when prompted.
- In the command line type 'comm.setModeInternet'
- If you receive the following error
-

```
=>  comm.setModeInternet
recvfrom failed: Resource temporarily unavailable ERROR

=>
```

It means the glider is actively using iridium comms at present. This can be confirmed by asking the glider what it is presently doing using the command 'super.status.' You can also slow down the rate of iridium communication (general.setIdle) in order to increase your chances of trying it when it's not sending an iridium message. When it works you should get the response.

```
=>  comm.setModeInternet

OK

=>
```

- Now make sure the iridium telemetry and check message rate are fast enough and you should see the glider last seen time update on the Cloud
- You can now send messages to the glider over the Cloud including sending it a mission to store on the glider until deployment time.
- Once the glider receives a mission it will switch automatically back to iridium for remote communication. You can confirm this using "comm.info" on the command line. If it is not switched back to iridium comms you can use the command, "comm.setModeIridium".

How to: Power GPS to confirm present Latitude and Longitude

GPS locations are transmitted over cloud, and every GPS location is recorded on the glider, and can be accessed in the Data Downloads tab as xx_GPS_xx_.hfrng files. The GPS location can only be viewed live on the Display Data tab if the GPS is on and actively reporting a location. During normal operation the GPS turns on only when it needs a new telemetry fix and as soon as it has a location it turns back off. To catch it at that moment would be difficult, so you'll need to manually turn on the GPS to extend the time you can see the data.

- Login to the command line interface and type the commands "sensor.power gps 1" and then "sensor.start gps".
- ```
  Sméagol (Gollum) Ocean Scout CLI (Level 0)
  => sensor.power gps 1

  OK

  =>  sensor.start gps

  OK

  =>
  ```

Then switch to the glider webpage (192.168.8.1), go to the Display Data tab, and wait up to several minutes for the GPS location to update. If it's a cold start (first time connecting since you turned on the glider) it will take several minutes, whereas if it's been regularly getting a fix it will update very quickly. Make sure the glider is outside with a decent skyline.

Test Dives

Oceanscout gliders have a Test Dive feature, allowing the user to manually program a simple dive for testing. Test Dives are essentially miniature missions consisting of a single dive (which may have multiple yos) run manually without Cloud. Test dives may be run with the glider tied to a fishing rod line or buoy line, however the drag will affect glide and control performance. Test dives are useful for troubleshooting and confirming functionality.
  ```

CLI commands for test dives:

help testdive - prints relevant help notes on how to define a test dive
super.getTestDive - prints the test dive
super.setTestDive - sets the test dive parameters
super.startTestDive - runs the test dive that is loaded on the glider

An example of a basic test dive command might look like:

```
super.settestdive heading=55 descend=10 ascend=1 altitude=1 yos=2 quiet=60 gps=0 comms=0 runtime=1200 maxdepth=15
```

Keep test dives and missions separate as test dives can interfere with missions. Do not load a mission for manual start, run a test dive, then manual start the mission afterwords. Always load and start your missions after test dives are complete. Do not run a test dive during an active mission.

Glider Behaviors

This section documents some of the mission behaviors that the glider

Start dive

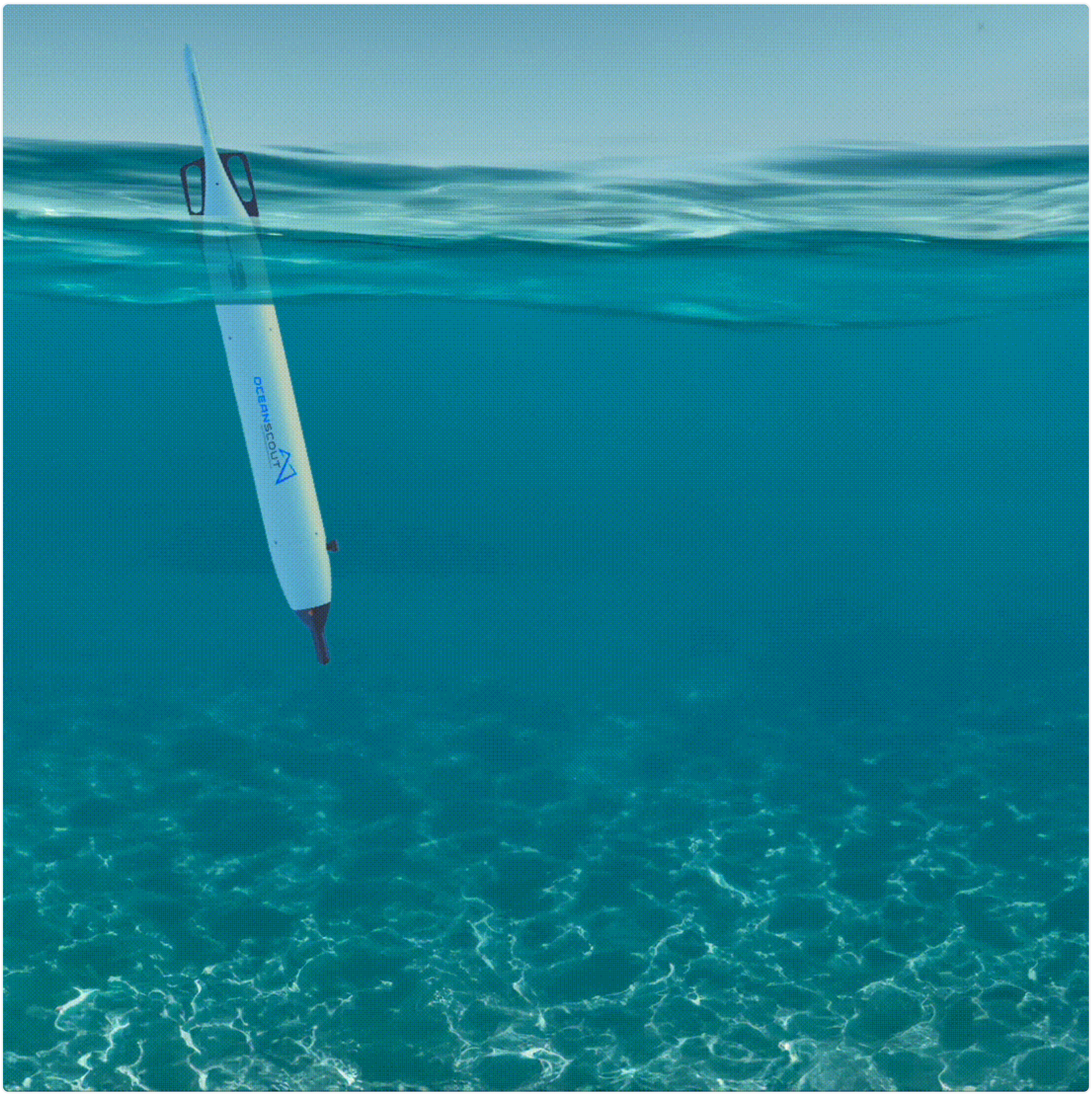
- Communicates current position (starts in comms position)
- Move motors into position required to enter descent mode

Parameters

- Completion Depth
- Timeout to achieve depth

Control implications

- First dive of mission, the VBE sinking point is determined by slowly moving the VBE until the glider stays to sink. This motor position is then used by subsequent dives directly instead of searching for it.
- The sink search is done every 12 hours to make sure that the density hasn't changed significantly.



Glide (descend)

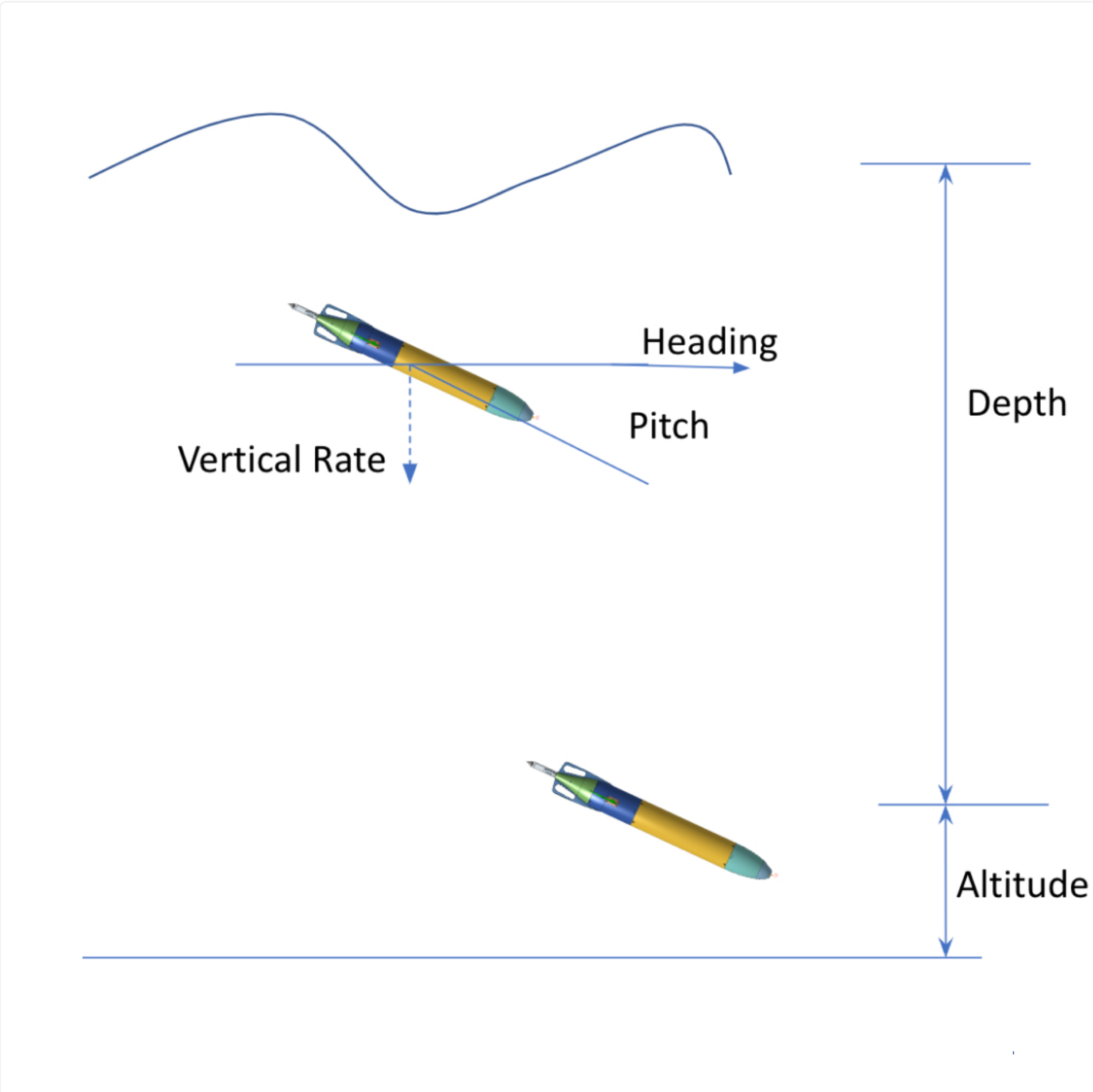
Parameters

- Timeout to completion
- Target depth
- Target altitude
- Target heading
- Target heading rate (for spiral descent)
- Target pitch
- Target depth rate
- Speed control (on/off)
    - Use pump volume if off
- Pump volume
    - Only applies if no speed control

      Pitch control (on/off)

- - Use feed forward setting only if off

- Guidance interval
  - “Deep sleep time” (no monitoring)



Quiet

Parameters

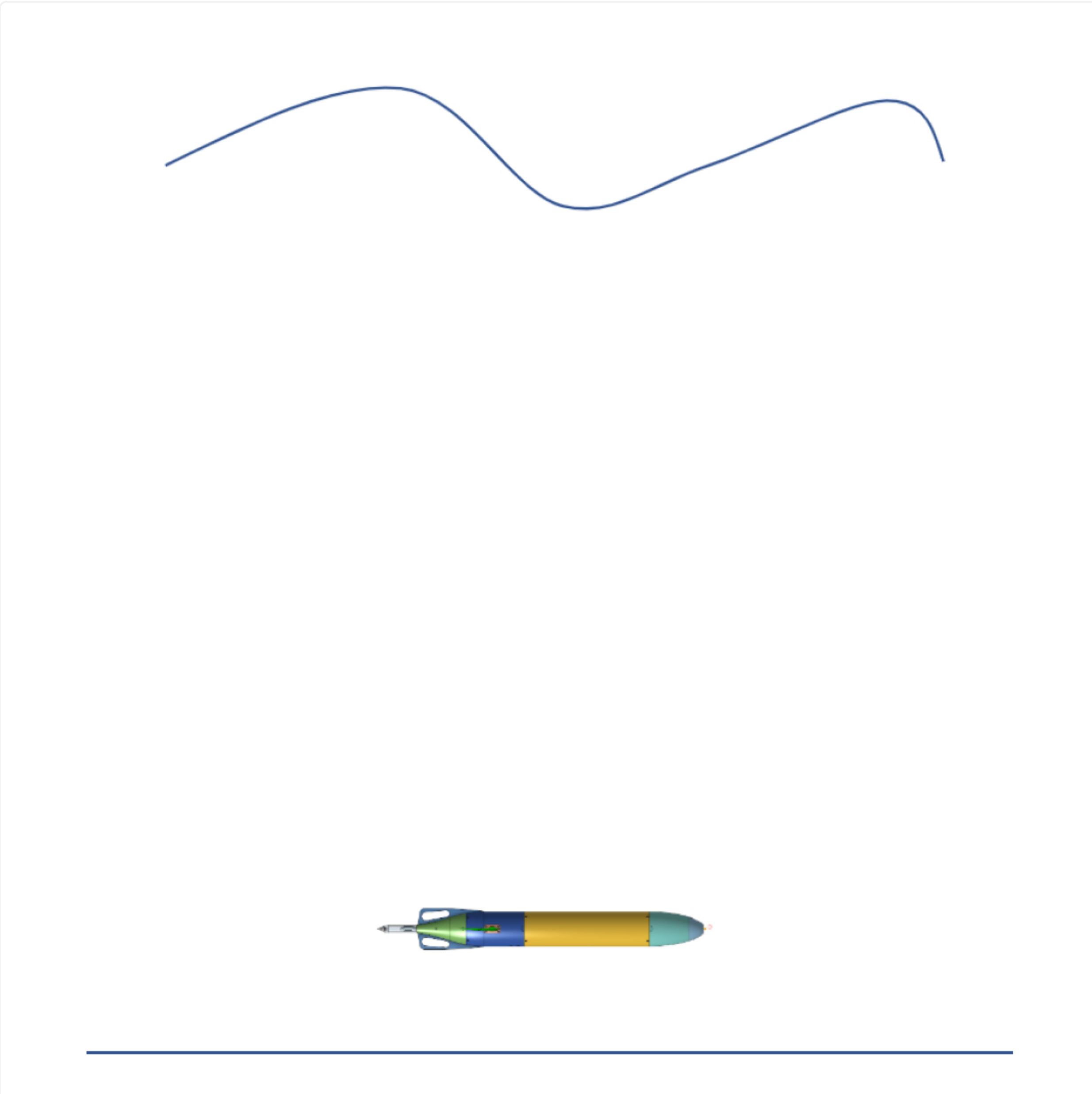
- Number of yos between quiet periods
- Timeout for PID convergence
- Duration (non-essential systems off)

Control Implications

- Depth control to minimize vertical motion
- Pitch control to make glider horizontal
  - Maximize drag

Future

- Rest on bottom and collect data



Bottom inflection

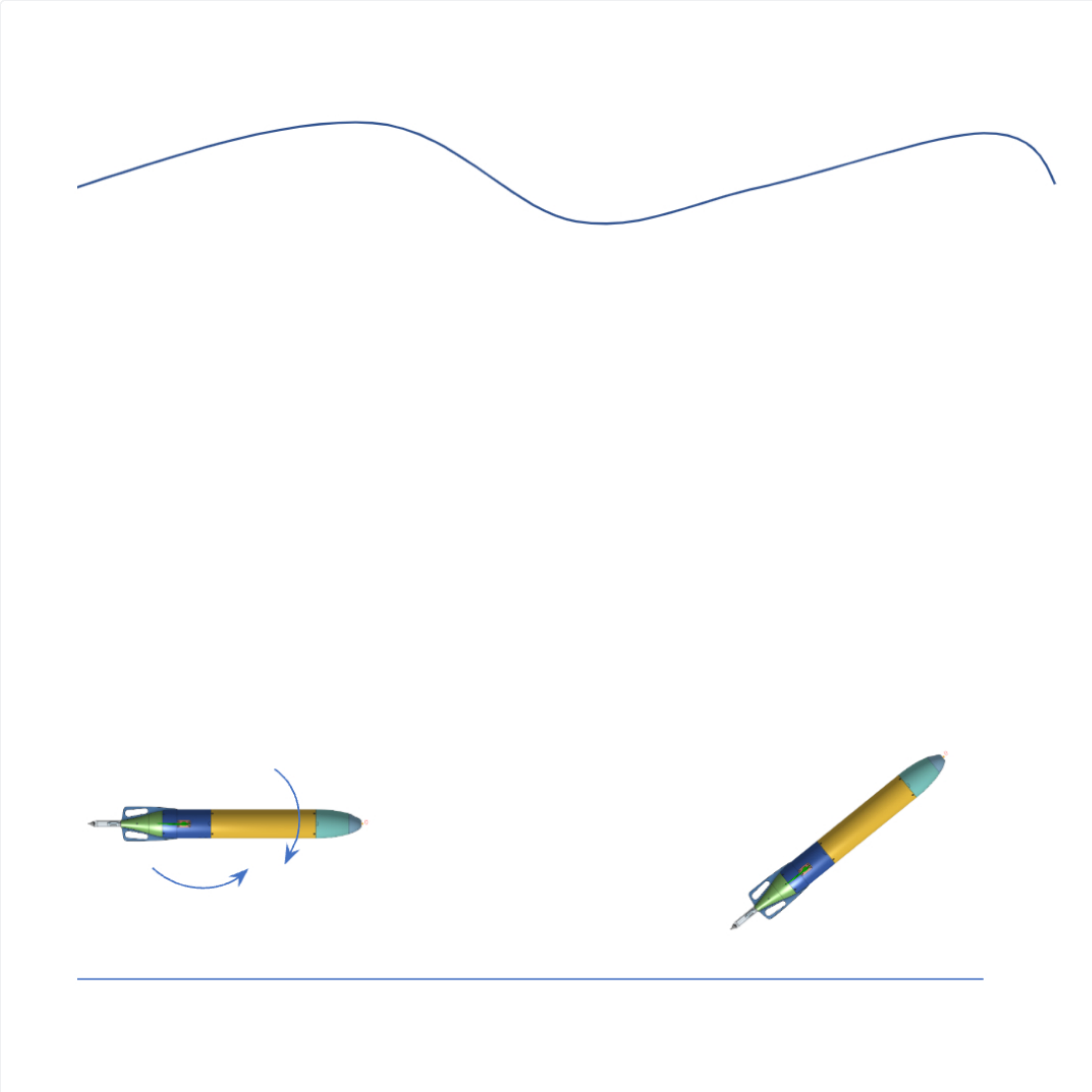
Inflect, rotate, move VBE. Monitor orientation until pitch / roll are within expected range.

Parameters

- Timeout to complete behaviour

Control implications

- Is this a straight forward maneuver (simply set motors to new positions) or will it require some sort of monitoring) with additional motor motion)
- Different behaviour if no quiet behaviour (straight from descend to ascend) ?

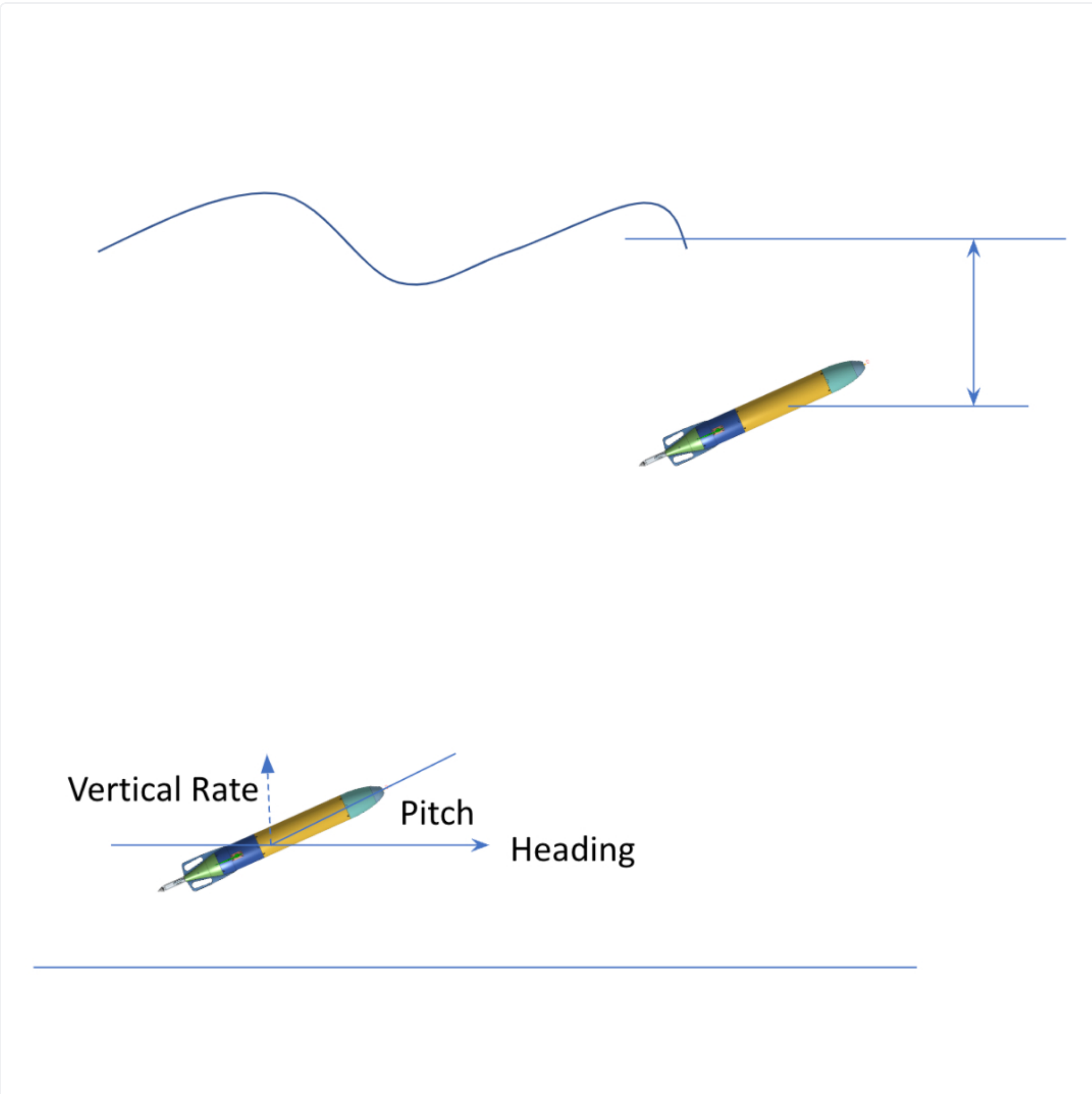


Glide (ascend)

Parameters

- Timeout for completion
- Target Depth
- Target heading
- Target heading rate (for spiral ascent)
- Target pitch
- Target depth rate
- Speed control (on/off)
    - Use pump volume if off
- Pump volume
    - Only applies if no speed control
- Pitch control (on/off)

    - Use feed forward setting only if off
- Guidance interval
    - “Deep sleep time” (no monitoring)



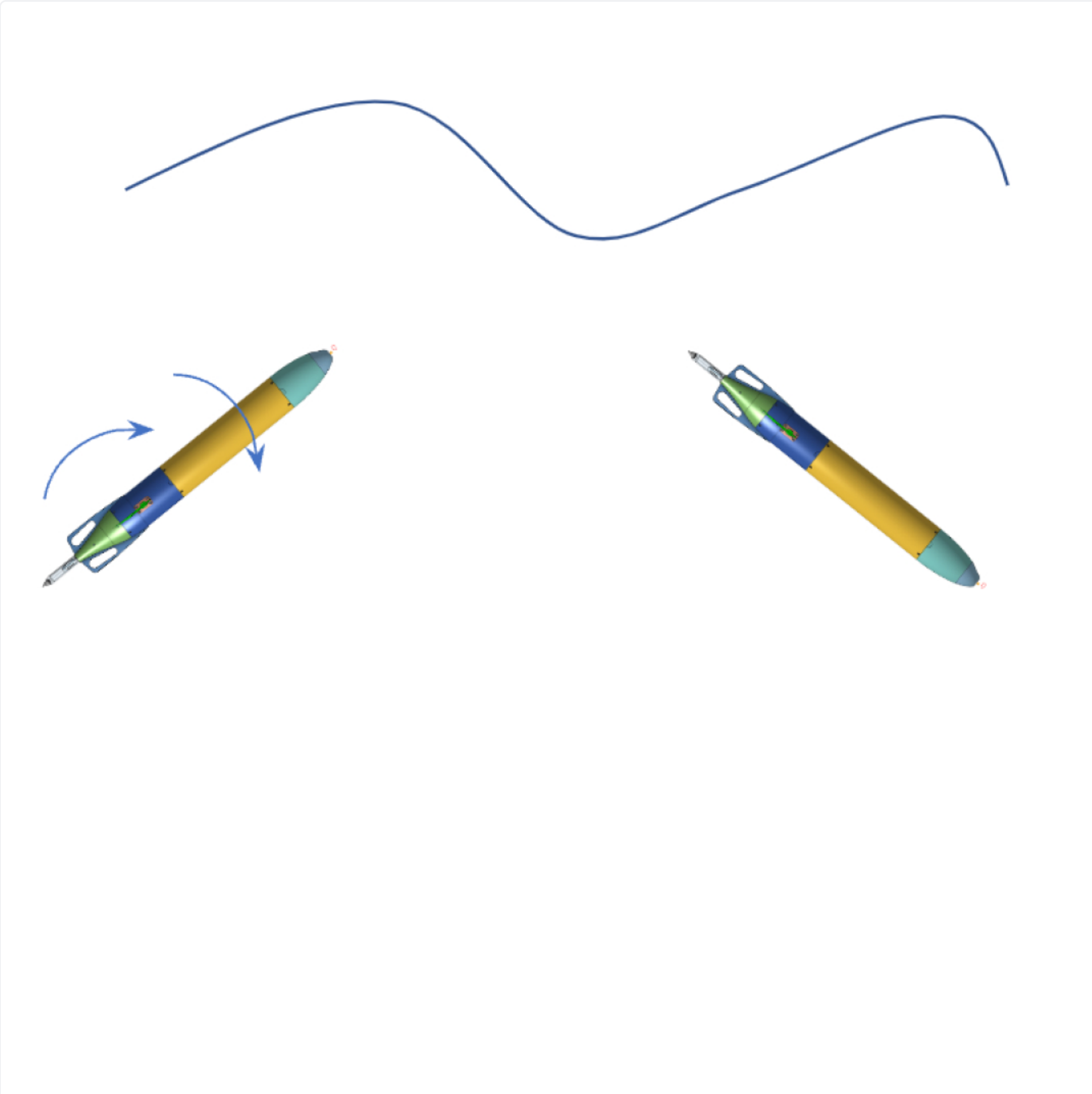
Top inflection
Inflect, rotate, move VBE. Monitor orientation until pitch / roll are within expected range.

Parameters

- Timeout to complete behaviour

Control implications

- Use previous VBE position during descent to guesstimate initial VBE position for ascent.



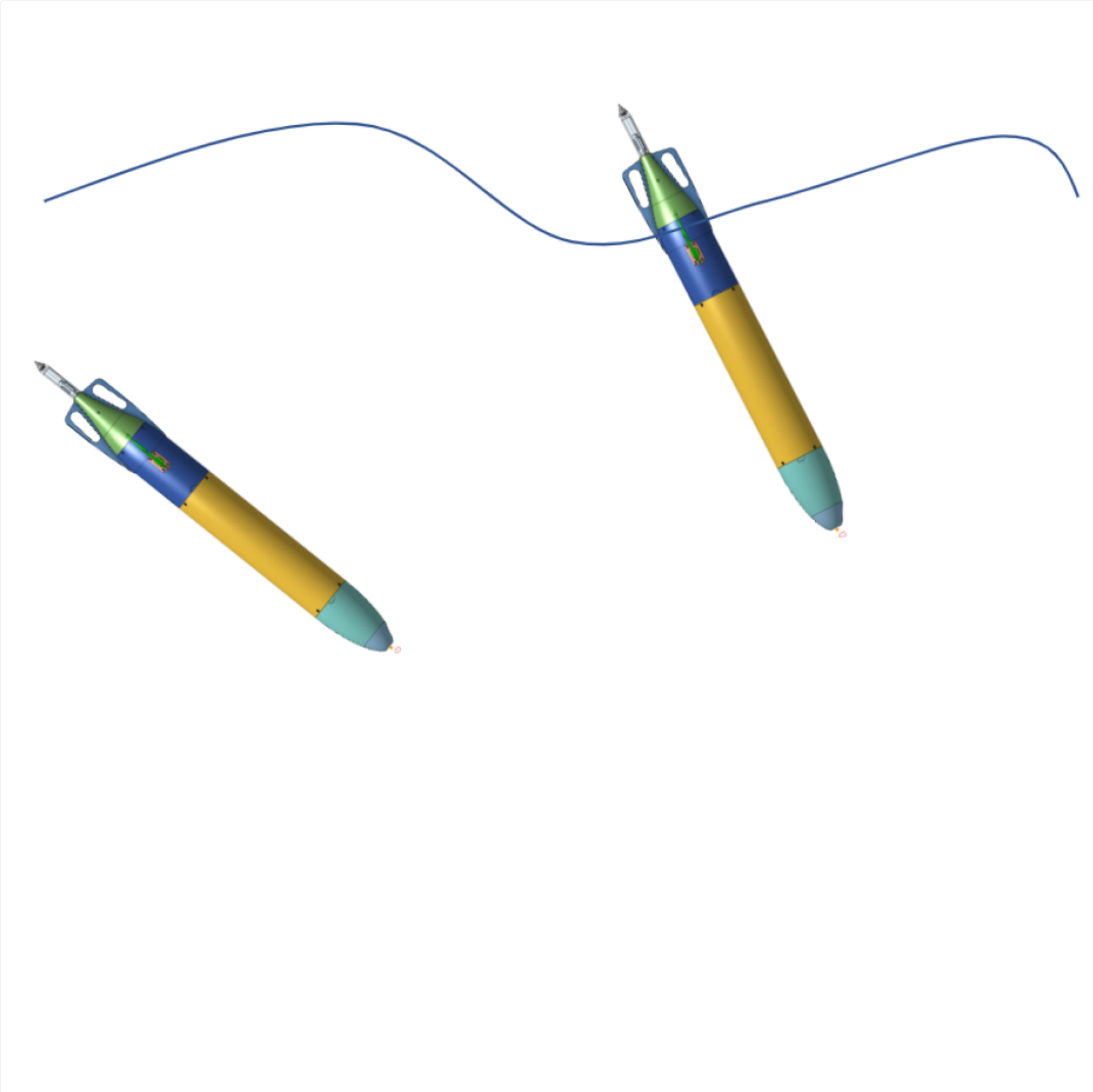
Surface
GPS fix + dive summary/ check for shore + data transmission.

Surfacing

- Timeout to complete
- Surface when waypoint reached (on/off)
- Number of yos to surface
- Timeout to reach surface

Control Implications

- VBE set to maximum buoyancy and pitch to maximum nose down



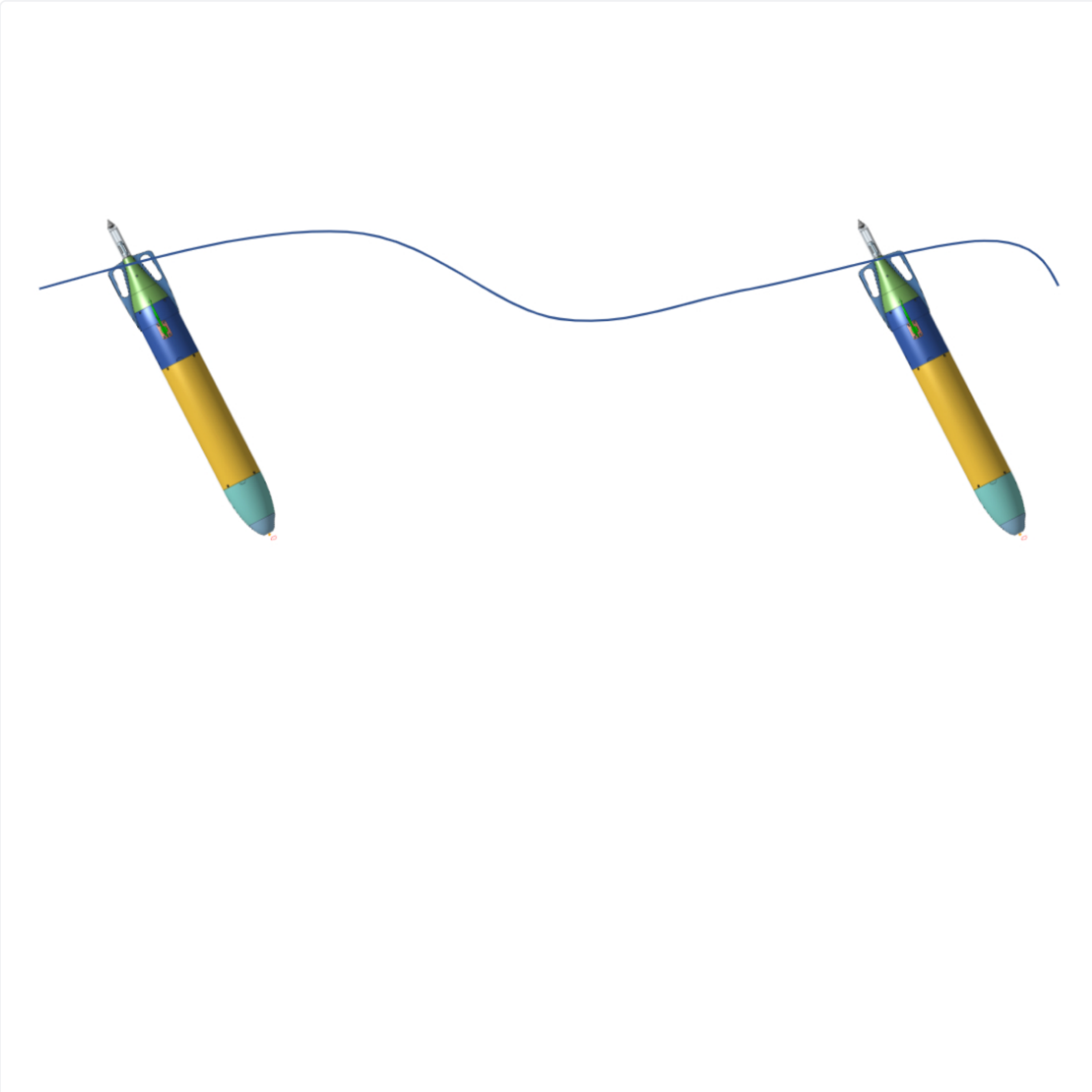
Drift

Remain on surface and regularly transmit telemetry / check for shore messages

- Occurs at waypoints

Parameters

- Telemetry interval
- Duration
- Waypoint travel information for station keeping



Hover
Part of station keeping

- Occurs at waypoints

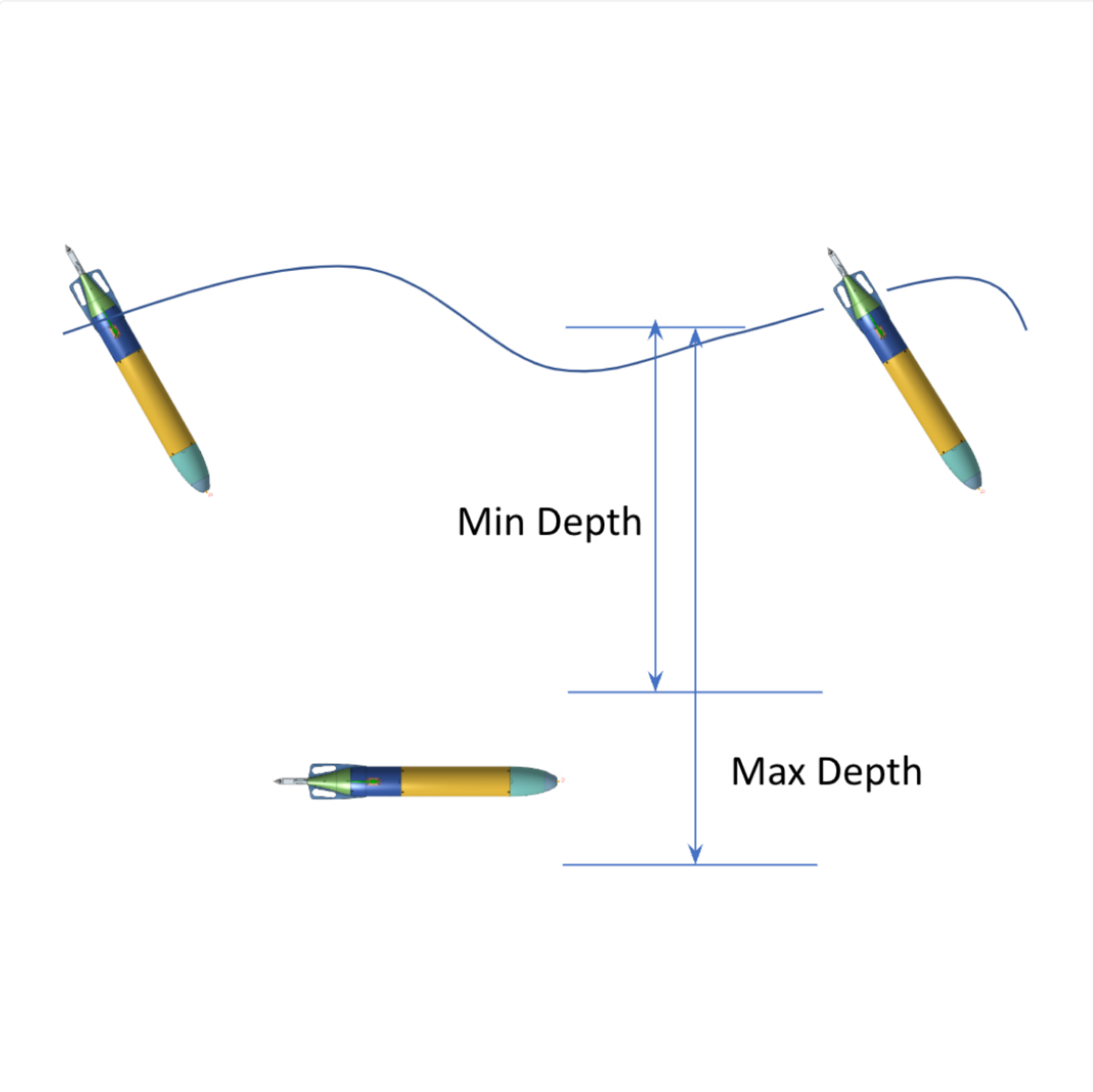
Parameters

- Min depth
- Max depth
- Quiet time
- Hover time
- Timeout (for reaching depth)

Control Implications

- Depth control to achieve minimum vertical rate
- Pitch control to horizontal

- Maximize drag



Recovery

Turns on strobe / WiFi and sends periodic position reports

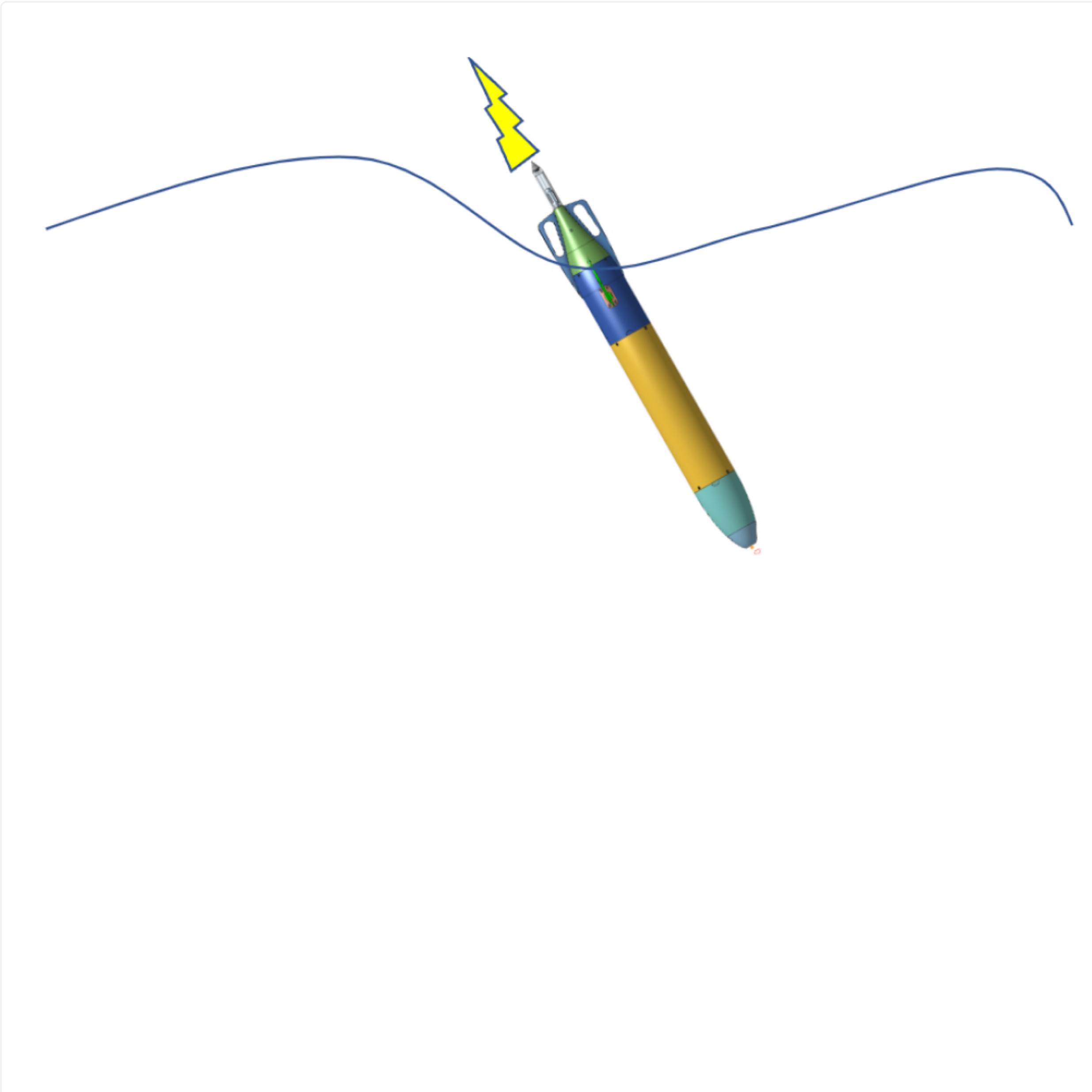
- Entered via shore command

Parameters

- Strobe on / off / cycle times
- Wifi on / off times
  - When a client connects, WiFi must stay on.
- Telemetry interval

Control Implications

- None (?)



Abort

- VBE to maximum buoyancy, pitch to nose down
- Strobe lights turned on
- Send telemetry information

Abort Conditions

- No communications timeout
- Mission timeout
- Max Depth Exceeded
- Minimum Battery percent
- Minimum Battery voltage
- Minimum disk space percent

- Minimum disk space MB
- Internal Pressure (vacuum)
- Leak detect

Parameters

- Telemetry reporting interval

Control Implications

- Abort ascent needs to be monitored and “bad” situations (e.g. obstructed by kelp) need to be dealt with if possible

Simulation and Simulated Gliders

Several types of simulated Oceanscout gliders exist for the purposes of testing, training, demonstrations, and development. Contact Hefring for assistance with glider simulation.

- **Simulation Mode (running in a complete functional glider)**
  - Oceanscout Gliders have a **Simulation Mode** allowing them to simulate missions while dry in the lab. A glider running a simulation will execute missions from cloud and move all motors as it would in the ocean, generating simulated data and positions. Simulated gliders may be connected through internet mode.
  - Use extreme caution not to physically deploy a glider that is accidentally left in simulation mode. If a glider is dropped the ocean while running a simulation, it may not surface or communicate correctly.

- **Cloud software sim gliders**
  - Software simulated gliders in Cloud. These don't run the full firmware but simulate the piloting experience. They can run missions faster than real time for convenience. These are useful for training, demonstrations, and testing Cloud functions.

- **Firmware sim gliders**
  - Full firmware simulation running on a computer instead of actual glider hardware. Used for testing.

- **Bench sim gliders (test fixtures)**
  - Actual glider electronics and mechanical systems set up to run on a test bench, outside of an actual hull. Used by Hefring for testing and development.