VT 690 AUV User Manual

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Version: 0.0.1
Date: May 21, 2021

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1 Field Testing

This section provides instructions for operating the 690 AUV for field testing.

1.1 Before Departure

Before departure, ensure that the vehicle is charged sufficiently for the mission requirements. The 690 AUV has a minimum voltage of 20V, a maximum charged voltage of 33.6V, and a nominal voltage of 29.6V. Fully charged, the 690 AUV can operate for 24 hours with all systems running.

In addition to the 690 AUV, the following items are required for AUV operation and should be brought to field testing:

- AUV Deckbox
- Field testing toolbox
- Acoustic Pinger
- Laptop with AVL Mission Control software

Head to the testing area with these items in the truck.

1.2 Dock Arrival

Unload field testing equipment from the truck and load it onto the boat. Before leaving the dock, power on the vehicle, deckbox, and laptop and open AVL mission control on the laptop. To open AVL Mission Control, use the following steps:

1. Open Qt Creator from the task bar or by searching for it.
2. In Qt Creator, open the `avl_mission_control` project.
3. Run the project by pressing ctrl+r or pressing the run button.

Then, configure and set up the vehicle using the following subsections. Afterwards, head to the operation area in the boat.

1.2.1 Configuration

All vehicle config files can be found/edited in the `/var/avl_config` directory. These files can be edited with a command line text editor such as `nano`:

```
nano /var/avl_config/<filename>.config
```

Exit with ctrl+x and press y to confirm the edits. After a config file has been edited, AVL must be restarted for the changes to take effect.

The following is a list of config files that are important for field testing:

- `safety_node.config`: Contains vehicle safety limits. If limits are exceeded, the vehicle will abort and float to the surface with a fault status shown in the user interface. Be sure a depth limit appropriate for the operating area such that the vehicle will not hit the bottom in the case of an error.
- `mission_manager_node.config`: Contains maximum mission queue duration limits. Mission queues sent to the AUV that exceed this time will be rejected.

- `acoustic_channel_node.config`: Contains settings to enable/disable heartbeat over acomms and configure TDMA.
- `iridium_channel_node.config`: Contains settings to enable/disable heartbeat over Iridium and their rate.

1.2.2 Software Setup

For the following steps, including WiFi connection and SSH, use the password `Contr0ls` to log in. Connect the laptop to Deckbox WiFi if it does not automatically connect. Open two terminal windows and SSH one terminal into the deckbox:

```
ssh ascl@10.0.10.120
```

and launch AVL on the deckbox using

```
~/avl/src/avl_tools/scripts/avl_start.sh avl_system deckbox_v2.launch
```

Confirm that AVL launches with no errors. Next, SSH the other terminal into the 690 AUV with

```
ssh ascl@10.0.10.153
```

It may take a minute for the vehicle to establish a connection with the deckbox after they have both been turned on. Launch AVL on the AUV with

```
~/avl/src/avl_tools/scripts/avl_start.sh avl_system 690_v2.launch
```

Again confirm that AVL launches with no errors. Both the deckbox and the AUV should appear in the vehicle list of AVL Mission Control on the laptop in addition to the default vehicle (IP address 0.0.0.0). AVL can be stopped when needed on the deckbox or the AUV using

```
~/avl/src/avl_tools/scripts/avl_stop.sh
```

You may need to open a second SSH session to run this command since the AVL console output running in the background will make it difficult to see what you are typing. AVL can be stopped until the operation area is reached.

1.2.3 Hardware Setup

Confirm that the acoustic pinger is working correctly. Turn it on by removing the magnet from it and use the handheld pinger receiver from the boat's storage to confirm that you can hear the pings. To do this, connect the headphones to the pinger receiver, power it on, and turn the frequency to the value on the pinger label. Hold the pinger to the receiver transducer and listen for the pings. The receiver sensitivity/volume may have to be adjusted. After confirming that the pinger is working, tape it to the AUV.

1.2.4 Status Monitoring

During field testing, vehicle status information will be displayed on the Overview tab of the vehicle details window of AVL Mission Control every time a heartbeat message is received from the vehicle or deckbox. The number of seconds since a heartbeat message was last received is indicated by the `Age` parameter under the `Status` section. Clicking a vehicle in the vehicle list to select it will display the status for that vehicle. The AUV status is also shown, indicating if the AUV is ready for operation of if it is disabled because of a fault.

1.3 Operation Area Arrival

Upon arrival at the operation area, the vehicle's depth limit should be set to be appropriate for the operating area such that the vehicle will not hit the bottom in the case of an error. Set the maximum FSD mission queue duration appropriate for the missions being run.

After the vehicle is configured, it can be deployed into the water and AVL can be started. Turn on the AUV strobe light by selecting the AUV in the vehicle list and going to the `Command` section of the `OVERVIEW` tab. Select `STROBE` in the dropdown menu and set `ENABLE` to `TRUE` and press send. Similarly, tare the vehicle pressure sensor by sending the tare pressure command. After a few seconds, the depth should read close to zero in the heartbeat information. The AUV is then ready to execute missions.

1.4 Mission Execution

The following steps give an overview of the process for executing missions.

1. Start AVL on the AUV if it was stopped.
2. Enable the AUV strobe lights and ensure that there are no boats or obstacles that may endanger the AUV while it is surfaced.
3. If AVL was previously stopped, load the navigation maneuvers mission, send the missions to the vehicle, and start the mission.
4. Configure the desired mission and send it to the AUV. When the navigation maneuvers are completed, the new mission can be started.
5. Wait for the vehicle to finish its mission.
6. Locate the vehicle when it resurfaces and reposition the boat near the AUV.
7. If needed, stop AVL and view the log files. Otherwise, repeat until missions are completed.

The following subsections contains more information about some of these steps.

1.4.1 Mission Configuration

To configure a mission in AVL Mission Control, select the vehicle in the vehicle list by left clicking it. Then, navigate to the `MISSION` tab. Any number of actions can be added to the mission queue by pressing the plus button or using the right-click menu on an action that has already been added. Actions can be re-arranged with the buttons on the right of the action. Alternatively, a mission can be loaded from a JSON file using the load button and a mission can be saved with the save button.

To load the mission queue onto the vehicle, press the send button. This will attempt to clear the mission currently on the AUV and load the mission that you have configured. Progress will be shown in a popup window. If the mission is rejected or failed to send, an error message will be shown. If the mission is rejected, fix the issue and re-send. If the mission failed to be sent due to connection issues, re-try until the mission loads successfully.

NOTES:

- There is currently no speed control for the 690 AUV. Use an RPM of 1500 for cruising speed.
- The AUV requires specific maneuvers to get off the surface and under water. This can be accomplished by setting a 60 second DIVE action with a desired yaw. The AUV will turn and accelerate along the specified yaw and then attempt to dive. Upon reaching a depth of 0.3 meters, the action will complete and move on to the next action in the mission. If the DIVE action fails to get the AUV under water, the mission will be aborted and will have to be started again.

1.4.2 Navigation Maneuvers

Currently, the AUV navigation system is tied to ROS and starts/stops when AVL starts/stops. This means that any time AVL is restarted, navigation maneuvers on the surface with a GPS signal must be executed in order for the navigation algorithm to initialize before running a mission underwater. It is recommended that you run the vehicle through four primitive missions at 1500 RPM on the surface, one at each cardinal direction for 60 seconds. This will have the vehicle travel in a square and provides good navigation initialization.

NOTE: A mission file should be saved on the lab laptop for this mission.

1.4.3 Mission Execution

Before executing a mission, ensure that the AUV strobe lights are turned on and there are no nearby boats that may hit the vehicle before it dives. After a mission is sent to the vehicle, mission execution can be started by pressing the `START` button on the vehicle's `MISSION` tab. A popup will indicate whether this command was successful or not. If a mission is successfully started, the Mission Time timer will start counting on the vehicle's heartbeat information page to indicate how long a mission has been running. The timer will not stop automatically but will reset when the start button is pressed again. A radio connection is not required for this timer to work.

If the vehicle is still within radio range on the surface, the mission can be stopped with the `STOP` button.

1.4.4 Vehicle Recovery

When the AUV's mission queue is completed, it will float back to the surface. In most cases, the vehicle will acquire a radio or Iridium signal in order to send heartbeat messages to AVL Mission Control and its position will be displayed on the map. When the AUV is located, the boat should be positioned close to it to discourage other boats from getting near to the AUV.

In cases where radio, acomms, and Iridium are failing to deliver a vehicle status heartbeat and the AUV is not easily visible, the pinger receiver and binoculars can be used to locate the vehicle if it is on the surface. The pinger receiver is highly directional and can be used to pinpoint direction to the AUV.

1.4.5 Viewing Log Files

During operation, AVL will write log files to a timestamped log folder in the `\var\avl_logs` directory. Additionally, the most recent log folder will be linked to the symbolic link `\var\avl_logs\current` for convenience. The timestamped log folder contains a `config` folder containing the config files used when AVL was launched, and a `log` folder that contains the log files.

Log files from the vehicle may be viewed using the AVL Log Plotter script in Matlab. First, the log folder must be transferred from the AUV to the laptop. If you wish to view the most recent log folder, first stop AVL on the vehicle since files should not be transferred while they are still being logged to. On the laptop, open FileZilla or any other FTP software and log into the vehicle with the following credentials:

```
Host: 10.0.10.153
Username: ascl
Password: Contr0ls
Port: 22
```

In Filezilla, the left half of the interface is the local computer's file system and the right half is the AUV's. Navigate to the AVL Log Plotter's `~/avl_log_plotter/plot_me` directory on the laptop and the `\var\avl_logs` directory on the vehicle. Delete any log folder already in the `plot_me` directory. A log folder can then be dragged from the vehicle to the `plot_me` folder to transfer it to the laptop. Transfer status will be shown on the bottom of the FileZilla window.

When the log folder tranfer completes, open the `~/avl_log_plotter/avl_log_plotter.m` script in Matlab. Ensure the `plot_current` parameter at the top of the script is set to `false` so that the log folder in the `plot_me` folder will be plotted. Press the Run button to start the script and plot the log folder contents.

NOTE: A new timestamped log folder is only created when AVL is restarted on the AUV (until bugs are fixed with the log splitting feature). It is useful to restart AVL before each mission so that the mission is in its own log folder. However, since restarting AVL resets navigation, the navigation maneuvers must be run again before each mission.

NOTE: Transfer of an entire log folder can be time consuming over the vehicle's radio link. If you know exactly what data you would like to view, you can transfer only that log file. However, you must mimic the log folder structure so that the log plotter will properly detect it. First, make a folder in `plot_me` and, in that folder, make a folder named `log`. Transfer the individual log file(s) that you wish to plot from the vehicle's `log` folder within the timestamped log folder into the `log` folder that you created. For example, if you just wanted to view depth controller performance, you could transfer only `ss_depth_control_node.log`.

1.5 Field Testing Wrapup

When you are finished operating the AUV, recover it back onto the boat and stop AVL on the AUV and deckbox and power them off. Remove the pinger from the AUV and re-attach the magnet to turn it off. Use the pinger receiver to confirm that the pinger is off before storing it. Return to the docks and move the field testing equipment from the boat to the truck and return to the lab.

It is best to transfer the log files from the AUV to the laptop and then to Google drive after arrival back at the lab. However, this is extremely slow over the radio. Ask Charles to fix the Ethernet port on the AUV or open the AUV to connect Ethernet directly.

Make sure the AUV is turned off before leaving it.