The alogview Tool for Analyzing Mission Log Files

Dec 2022

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1 Overview

The alogview application is a post-mission analysis utility loaded with one or more alog files, typically one per vehicle. It is more than a log file playback tool. A full state is maintained across all vehicles for both playing back sequentially and rewinding or jumping to any arbitrary point in time. The main window may look a bit like the run-time pMarineViewer window, but many of the GUI components in alogview are available solely for post-mission analysis. A snapshot of the tool, with no pop-up sub-windows open, is shown in Figure 1.

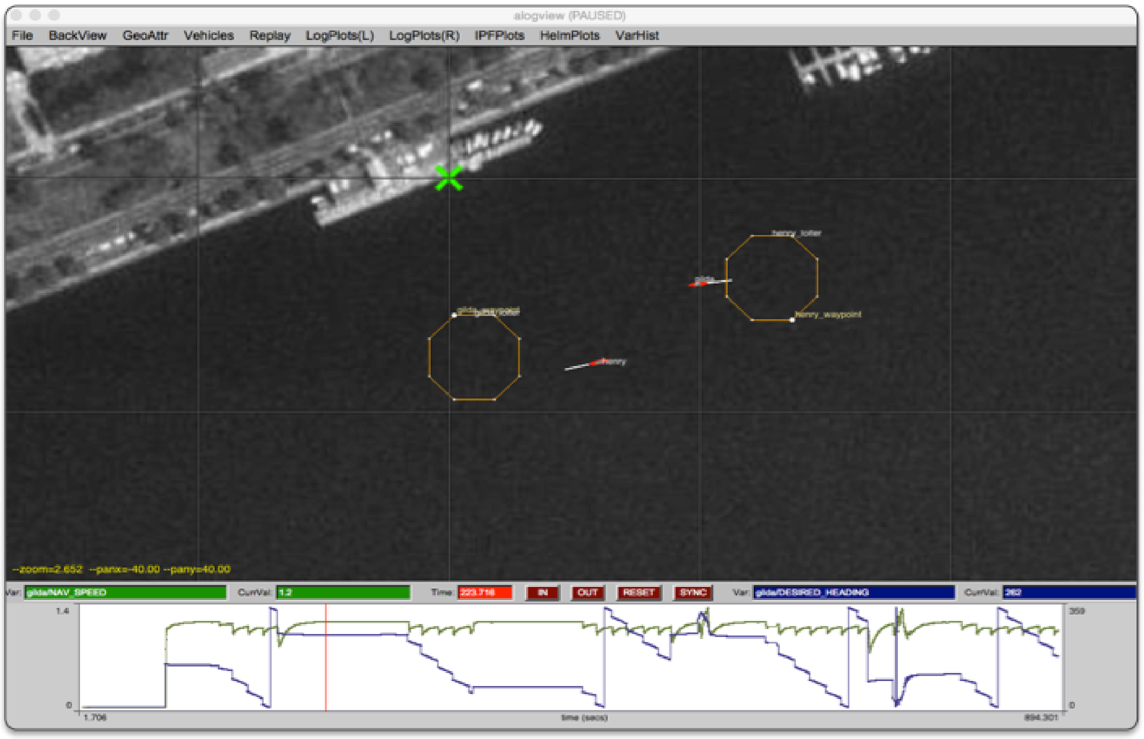


Figure 1: **The `alogview` tool**: used for post-mission rendering of alog files from one or more vehicles and stepping through time to analyze helm status, IvP objective functions, and other logged numerical data correlated to vehicle position in the op-area and time.

Quick Start: Launch alogview with one or more alog files on the command line, for example the two vehicle alog files from the `m2_berta` example mission:

```
$ alogview henry.alog gilda.alog
```

Upon launch, the viewer should look similar to Figure 1. Step forward or backward through time with the '[' or ']' keys, or click anywhere in the time-series in the bottom part of the screen. Replay can also be automated by accelerating or decelerating replay with the 'a or 'z' characters. Many other replay and visualization options are available via the pull-down menus and are introduced in later sections.

Recent History of Development with Releases

- Pre-2011: This tool existed as `logview`, was not documented and had limited support for rendering objective functions and helm information. Mostly used in-house by developers.
- 2011: Better support for IvP function rendering. Initial thin documentation. Support added for geometric log entries. Still very buggy but useful enough to share with other adventurous users. Biggest limitations: (a) initial full-alog load into memory too huge for anything but small missions. (b) no general scoping tool available for non-numerical data, (c) many little bugs or incomplete features.
- 2015: First real attempt to support users generally outside core developers. Better memory management for large and/or multi-vehicle missions. New scope for non-numerical data. Pop-up implementation of sub-windows. Unlimited sub-windows supported for multi-vehicle missions. Overall much less buggy and more feature-rich.

2 The Five Primary Viewing Windows

The `alogview` tool can be described by its five GUI components, listed below. The first two are always open upon startup, and the remaining three are upon user request via the pull-down menus:

- The *NavPlot* window: This is the main vehicle viewing area shown at the top in Figure 1. It primarily shows the current vehicle position(s) and perhaps recent trajectory and other geometric artifacts produced by the vehicle apps or behaviors, such as waypoints or sensor artifacts. More detail in Section 3.
- The *LogPlot* window: This is the time-series window shown at the bottom in Figure 1. The variable's rendered are selected by the user from the list any logged numerical data from any vehicle. More detail in Section 6.
- The *IPFPlot* window: (pronounced "i-p-f-plot") This is a pop-up window launched from the `IPFPlots` pull-down menu, for a chosen vehicle. It will render the prevailing IvP objective functions responsible for latest helm decision. More detail in Section 7.
- The *HelmPlot* window: This is a pop-up window launched from the `HelmPlots` pull-down menu, for a chosen vehicle. It shows the helm state in terms of active, running, idle behaviors, as well as behavior warnings, errors and life events. More detail in Section 8.
- The *VarPlot* window: This is a pop-up window launched from the `VarPlots` pull-down menu, for a chosen vehicle, and chosen logged MOOS variable (string or double). It shows an ordered list of recent and pending postings for the given variable. Additional variables can be added resulting in an interleaved sequence. More detail in Section 9.

In all windows, the current time can be altered with the same keyboard hot keys, found in the

`Replay` pull-down menu and described in Section 3.

3 The NavPlot Window and Controlling Replay

The *NavPlot* window is the main viewing space, shown upon startup, with the current and recent vehicle positions rendered for each vehicle alog file. It is the top part shown in Figure 1.

3.1 Controlling the Current Time in Paused Mode

By default `alogview` is paused upon startup. The options for stepping forward and backward through time may be seen from the `Replay` pull-down menu. There are three pairs of options:

- The `'['` and `']'` keys for stepping forward and backward by 1 second.
- The `'' and ''` keys for stepping forward and backward by 5 seconds.
- The `'ctrl-['` and `'ctrl-]'` keys for stepping forward and backward by 0.1 seconds.

3.2 Controlling the Current Time in Streaming Mode

Replay may also be put into a streaming mode at any time by accelerating or decelerating the streaming speed. Streaming is controlled by the following three keys:

- The `'a'` key will accelerate the time warp, doubling the warp upon each successive hit, up to 64Hz.
- The `'z'` key will decelerate the time warp, halving the warp upon each successive hit, down to 1/8Hz.
- The `'SPACEBAR'` key will pause or unpause the streaming mode at any time.

The time warp is always shown in the very top of the `alogview` window. When streaming at say 16Hz, you should see `(Time Warp = 16)` in the window title bar. When not streaming, i.e., paused, this is indicated instead of the time warp, as in Figure 1.

Note that in streaming, between each update, there is work going on under the hood in addition to the rendering tasks. This includes the update of the current state of what is being rendered in the main and pop-up windows. Often it is not possible to refresh at the time warp requested. In this situation, `alogview`, and your machine, will do the best it can to keep up. Instead of seeing `(Time Warp = 16)` in the title bar, you may see something like `(Time Warp = 16)(Actual:8.73)`. The latter number will vary, but represents the best warping rate possible given what is being updated between refreshes.

A faster observed time warp can be achieved by altering the *streaming redraw interval.* By default this interval is 0.5 seconds. So, for example, if the replay time warp is 4, then 8 re-draws will need to be handled per second. This may or may not be achievable. If the redraw interval is instead 1.0 seconds, then half as many re-draws are required for the same effective time warp. The drawback will be that the motion of the vehicle and objects will appear more "jumpy". The *streaming redraw interval* may be altered in the `Replay` pull-down menu.

4 Background Region Images

In both pMarineViewer and alogview, typical use involves a background region image upon which vehicles and other geometric objects are overlayed. Both utilies can be configured to use images of their own choosing. See examples in Figure 2. The user provides these images from whatever source they wish. Options for obtaining images and proper format are discussed below in the section *Obtaining Image Files*.

Figure 2: **Example Background Region Images**: The example images downloaded from freely available tile servers that may be utilized in either pMarineViewer or alogview.

4.1 Default Packaged Images

Image files can be large, and of course there are endless possibilities depending on where you are operarating and which kind of background images you prefer. That being said, a couple images are distributed with MOOS-IvP. This allows example missions distributed with the MOOS-IvP code to having working images out-of-the-box without requiring the new user to fetch images. These two images are for (a) the MIT Sailing Pavilion, and (b) Forest Lake in Gray Maine, the site of some of the earliest in-water experiments circa 2004. This files are:

- `MIT_SP.tif`
- `forrest19.tif`

Both are distributed with MOOS-IvP and can be found in `moos-ivp/ivp/data`. When pMarineViewer or alogview is launched, this directory will be examined for the specified image file. Instructions for loading user-provided images is are given below in section *Loading Images at Run Time*.

4.2 Image File Format and Meta Data (Info Files)

Images loaded into pMarineViewer and alogview are in the format of `"Tiff"` files. These files have the suffix `".tif"`. Tiff files have been around since the eighties, use lossless compression, are typically high quality, but are not as common as formats such as jpeg. There are many freely available tools for converting back and forth between tiff and jpeg and other formats. Tiff files are used in pMarineViewer and alogview primarily due to the availability of the `libtiff` library, readily available through package managers on both the MacOS and Linux platforms.

Each `.tif` file used in pMarineViewer and alogview has a corresponding `.info` file, containing (a) the latitude and longitude coordinates of the image edges, and (b) the datum, or `(0,0)` coordinate, on the image. For example, the MIT_SP.tif file has a corresonding MIT_SP.info file found in the same directory.

```
lat_north = 42.360264
lat_south = 42.35415
lon_east  = -71.080058
lon_west  = -71.094214
datum_lat = 42.358436
datum_lon = -71.087448
```

4.3 Obtaining Image Files

Image files may be obtained and used in pMarineViewer and alogview from any source convenient to the user. This includes opening an image in say Google Maps on a web browser and performing a screen grab. The drawback of this method however is that it may be hard to precisely determine the lat/lon coordinates of the edges used in the corresponding .info file.

There are several open *tile servers* which allow a user to download an image tile, or set of tiles, provided with a range of lat/lon coordinates. These tiles can then be stitched together to make a single image. Although this sounds cumbersome, this process can be automated in a script. One such script is Anaxi Map, written by Conlan Cesar:

https://github.com/HeroCC/AnaxiMap

This utility is capable of using one of several tile servers with various background styles, such as Google Maps, maps with terrain or bathymetry information, or maps with street data. See Figure 2.

AnaxiMap, or similar utilities, may produce images in jpeg or png format. MacOS and Linux provide native utilities for converting the format, or ”exporting” the file, to tiff format. On MacOS or Linux, if the free ImageMagick package is installed, you can use the ”convert” utility:

```
$ convert region.jpg region.tif
```

4.4 Loading Images at Run Time

Post Release 22.8, both pMarineViewer and alogview support operation with multiple background images. Toggling between images at run time is done by selecting the BackView pull-down menu and selcting tiff_type toggle, or by simply hitting the ‘ (back-tick) key.

In pMarineViewer, the multiple background images may be specified with multiple configuration lines, for example:

```
 tiff_file  = MIT_SP.tif
 tiff_file  = mit_sp_osm18.tif
```

In alogview, the multiple background images may be specified on the command line:

```
$ alogview --bg=MIT_SP.tif --bg=mit_sp_osm18.tif file.alog
```

4.5 Automatic alogview Detection of Background Image

When launching alogview typically the user wants to use the same background region image used by pMarineViewer during the course of the mission that generated the alog file. In a new feature, post Release 22.8, alogview will automatically attempt to detect the image file used by pMarineViewer. The name name of region image is now published by pMarineViewer during the execution of the mission. This information is contained in the variable REGION_INFO. For example:

```
REGION_INFO = lat_datum=42.358436, lon_datum=-71.087448, img_file=MIT_SP.tif,\
              zoom=2.5, pan_x=129, pan_y=-364
```

The region info contains the name of the image (tiff) file used during the course of the mission, as well as the pan and zoom information as hints for alogview for use upon startup. The images found in REGION_INFO in the alog file will be loaded, as well as any images specified on the command line with the --bg options.

4.6 Background Image Path

Support for the IVP_IMAGE_DIRS shell path is a new feature, post Release 22.8, relevant to both pMarineViewer and alogview. This is explained below.

Image files are named in either the pMarineViewer config block of the .moos mission file, or named on the command line when launching alogview, as specified in Section *Loading Images at Run Time*. For alogview, the file may also be named in the REGION_INFO logged variable as discussed above.

Both apps need to *find* the named .tif file. When found, it looks for the corresponding .info file in the same directory. There are four options for making this work:

- The image file is in the same directory as the mission file.
- The image file is in the special directory moos-ivp/ivp/data.
- The full or relative path name of the file is specified.
- The file exists in a directory on your IVP_IMAGE_DIRS path.

The first option has the drawback of duplicating the image file in potentially many places. The second option has the drawback that the directory moos-ivp/ivp/data is part of the MOOS-IvP code distribution which users otherwise consider to be read-only. A fresh check out of MOOS-IvP would reset this directory and users would need to take care to migrate files to a new checkout. The third option is that full or relative path name may not be the same between different users or machines. The fourth option is the newest option and arguably has the least downside.

The IVP_IMAGE_DIRS is shell (e.g., bash) environment variable. It contains a list of one or more directories on your local computer where pMarineViewer or alogview will look when attempting to load image files. Shell environment variables are already common settings that users will customize on their particular machine.

The recommended way for users to use a set of custom image files is to (a) organize them in one or more directories, preferably under version control, (b) install them at a convenient location on your local machine, (c) configure the `IVP_IMAGE_DIRS` shell variable to contain the one or more directories where your image files reside.

For example, if you have a folder of image files with the following structure:

```
my_images/
   napa_bay/
      napa_bay_gmaps.tif
      napa_bay_gmaps.info
      napa_bay_osm.tif
      napa_bay_osm.info
   happy_harbor/
      happy_harbor_gmaps.tif
      happy_harbor_gmaps.info
      happy_harbor_osm.tif
      happy_harbor_osm.info
```

If this folder is installed on your machine in the home dirctory folder call `"project"`, then you would set your `IVP_IMAGE_DIRS` path in your shell configuration file, e.g., `.bashrc`, as follows:

```
IVP_IMAGE_DIRS=~/project/napa_bay
IVP_IMAGE_DIRS+=:~/project/happy_harbor
```

To verify which file has been loaded, the appcasing output of `pMarineViewer` shows the full path name of the loaded file(s). And when `alogview` is launched, the terminal output indicates which directories are being searched, in order, for the image files. This information may be obscured however when the `alogview` window pops up, but you can find it if you go back to it and perhaps scroll up. Note: It is not sufficient, in the example above, to simply set `IVP_IMG_DIR= /project`, the parent directory of all image folders. Each image folder must be named.

4.7 Troubleshooting

4.7.1 pMarineViewer fails to load the image (see only gray screen)

1. Check the appcasting output of `pMarineViewer`. The top few lines should show which image file is loaded. Is this a file you recognize?
2. Does this file exist on your computer? Verify it is where you think it is.
3. How are you specifying this file in your `pMarineViewer` config block? If it is specified as a relative path, e.g., `../my_images/napa_bay.tif`, make sure that relative path location is correct.
4. If you are specifying the image file with just the file name (no path information), then check you have your `IVP_IMAGE_DIRS` variable set properly. Run `echo $IVP_IMAGE_DIRS` on the command line.
5. Simplest but most common: Make sure your image file name (configuration and actual name) end in the suffix `.tif` and not `.tiff`.

4.7.2 pMarineViewer or alogview image is fine but no vehicles

1. Check the `.info` file. Make sure the lat/lon values sanity check, e.g., rough magnitude, relative values.
2. Make sure the `datum_lat` and `datum_lon` values are in the range of the image.
3. Make sure the `datum_lat` and `datum_lon` values match the datum set at the top of the vehicle and shoreside mission files.

4.7.3 alogview fails to load the image (see only gray screen)

In the newer version of `alogview`, when launching it will attempt to read the name of the image file used by `pMarineViewer`. So if `pMarineViewer` launched ok, chanches are good `alogview` will also launch with the same image. However, it could be the case that (a) the mission was run on some other computer that contained the image file and your current computer does not. The image file is not logged. (b) the mission was named

1. Does this file exist on your computer? Verify it is where you think it is. It is possible that you are trying to run `alogview` on your computer with alog files generated on someone else's computer. Make sure you have the image file.
2. Check the terminal output of `alogview` as it is loading. To demonstrate the below output from an `alogview` launch purposely use the the file `dforrest19.tif` instead of `forrest19.tif`. Note the sequences of folders searched in the attempt to find the image file. The first attempt is the in the `moos-ivp/ivp/data` directory. The next attempts are based on the value of `IVP_IMAGE_DIRS`. The final attempt is in the current working directory where `alogview` was launched. Does this match up with your expectations?

```
TIFF FILES COUNT:1
[1] Looking for dforrest19.tif and dforrest19.info in:
    Dir: [/Users/james/moos-ivp/ivp/data]
    Not found.
[2] Looking for dforrest19.tif and dforrest19.info in:
    Dir: [/Users/james/pavlab_map_images/popolopen]
[3] Looking for dforrest19.tif and dforrest19.info in:
    Dir: [/Users/james/pavlab_map_images/mit]
[4] Looking for dforrest19.tif and dforrest19.info in:
    Dir: [/Users/james/moos-ivp/ivp/datax]
[5] Looking for dforrest19.tif and dforrest19.info in:
    Dir: [/Users/james/moos-ivp/ivp/data-local]
[6] Looking for dforrest19.tif and dforrest19.info in:
    Dir: [/Users/james/moos-ivp/ivp/data]
[*] Looking for dforrest19.tif and dforrest19.info in:
    Dir: [./]
    Not found.
Could not find the pair of files:
dforrest19.tif and dforrest19.info
Opening Tiff:
TIFFOpen: : No such file or directory.
  Failed!!!!!!!!!
```

3. Simplest but most common: Make sure your image file name (configuration and actual name) end in the suffix `.tif` and not `.tiff`.

5 Video Capture

Video capture is no longer natively supported in `alogview` due to the common availability of third party video capturing software. Just launch `alogview`, put it into streaming mode (Section 3.2) at the desired rate, and launch your favorite video capture program.

6 The LogPlot Window For Viewing Time-Series Data

The *LogPlot* window allows the rendering of any numerical data from any loaded alog file to be plotted against time, as shown in Figure 1 and up close in Figure 3 below. The user may zoom in to see finer resolution in the postings, by clicking either the `IN` or `OUT` buttons, or by the `'i'` or `'o'` keys while the mouse is in the *LogPlot* window. To return to the original full apperature zoom, hit the `RESET` button. The user may left-click at any point in the time series to adjust the current time (shown by the red bar in the viewer). This time adjustment is propagated not only to the *NavPlot* viewer but to all open pop-up windows.

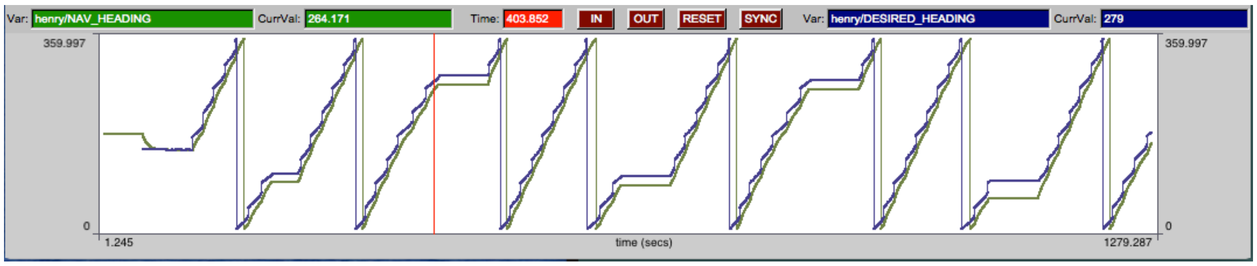


Figure 3: **The `logplot` window**: is used for viewing any numerical data found in any of the alog files loaded into `alogview`. Here the desired and actual vehicle headings are logged side-by-side.

Two variables, and two y-axes are available for selection. By default they are drawn on independent scales to allow variables with starkly different ranges, such as speed and heading, to be meaningfully rendered. The user may choose to synchronize the two variable ranges rendered to allow for more meaningful comparisons when the two variables have the same range, such as desired and observed speed. The synchronization is done by hitting the `SYNC` button at the top of the logplot window. The user chooses which two variables are rendered from the pull-down menu as shown in Figure 4.

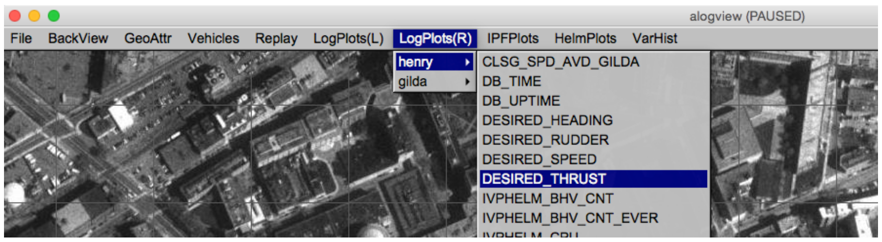


Figure 4: **The `logplot` pull-down menu**: is used for first selecting the vehicle and then the variable to be plotted.

If you find yourself wanting to repeatedly open an alog file with same one or two variables chosen for the *LogPlot* window, these variables can be chosen and at launch time passed as command line arguments:

```
$ alogview --lp=henry:NAV_SPEED --rp=gilda:NAV_SPEED
```

6.1 Additional Buried but Useful Hot-Keys in the LogPlot Window

There are a few hot-key functions available (only when the main window is active and the mouse is over the *LogPlot* window, that may not be apparent from simply interacting with the window:

- The `'i'` key: will zoom in the resolution on the plot. This can also be done by hitting the `IN` button.
- The `'o'` key: will zoom out the resolution on the plot. This can also be done by hitting the `OUT` button.
- The `'LEFT'` and `'RIGHT'` keys: will step forward and backward through time by 1 second.
- The `'UP'` and `'DOWN'` keys: will zoom in and out on the plot, essentially the same as the `'i'` and `'o'` keys.

The above hot-keys are in addition to the time control hot-keys listed in Section `sec_alv_time_replay` and Section 3.1.

7 The IPFPlot Window For Viewing Helm Objective Functions

The *IPFPlot* window allows the rendering of an IvP function (IPF) from any vehicle and any behavior found in any of the alog files loaded into `alogview`.

7.1 Launching an IPFPlot Window

An *IPFPlot* pop-up window is launched from the `alogview` main pull-down window as shown in Figure 5, by choosing a vehicle name. Separate windows can be opened for different vehicles, or even for the same vehicle.

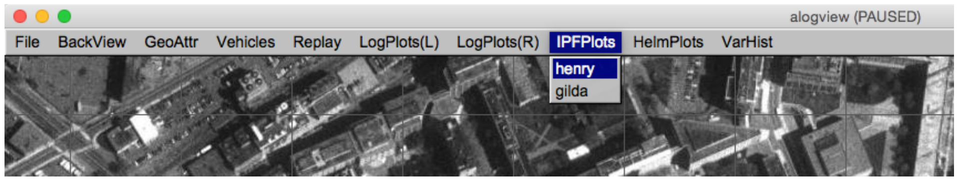


Figure 5: **The `ipfplot` pull-down menu**: is used for first selecting the vehicle and then the variable to be plotted.

A newly launched pop-up window loads the relevant information from disk into the `alogview` memory space. This includes all IvP functions for all behaviors at all times, for the given vehicle. This can be large. For some (larger) missions and some computer configurations, the larger memory footprint will begin to be noticed in terms of application responsiveness. Likewise, the internal data structure updates, each time the current time is changed, increases for each pop-up window. This may result in a slower streaming rate when in replay. Closing the pop-up window releases the memory and should immediately boost responsiveness and playback rate.

7.2 Stepping Through Time and Replay Control in the IPFPlot Window

The current time is shown in the upper left corner and is synchronized with the main viewing window and any other pop-up windows that may be open. The same time keys are functional when this window is active, e.g., `'['`, `']'`, `''`, `''`, for stepping forward and backward in time. The replay control keys, e.g., `'a'`, `'z'`, are also functional, and the replay state and rate is also shown in the title bar of this window.

7.3 Selecting the IvP Function in the IPFPlot Window

The user may choose any single objective function at a time from the menu on the left side of the window shown in Figure 6. The current behavior weight is shown alongside the behavior name in the menu. If a behavior presently has a weight of zero, no function will be rendered when that behavior is selected. Multiple objective functions may be viewed simultaneously by launching more pop-up windows.

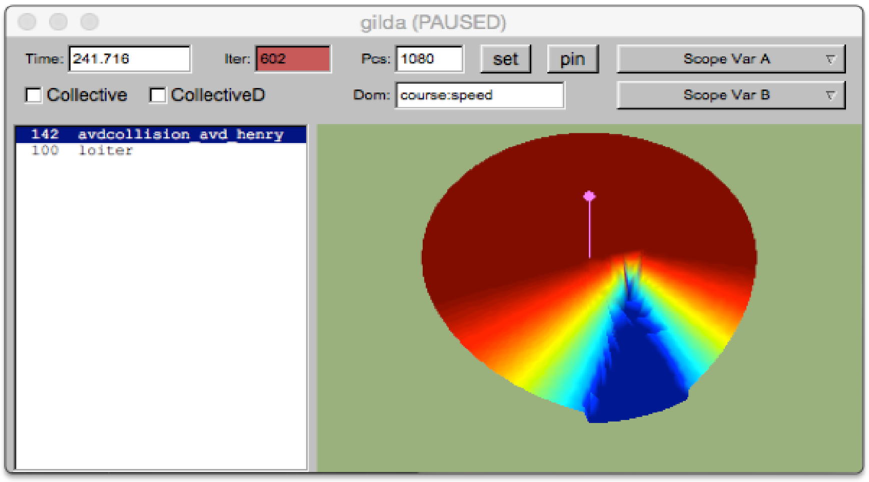
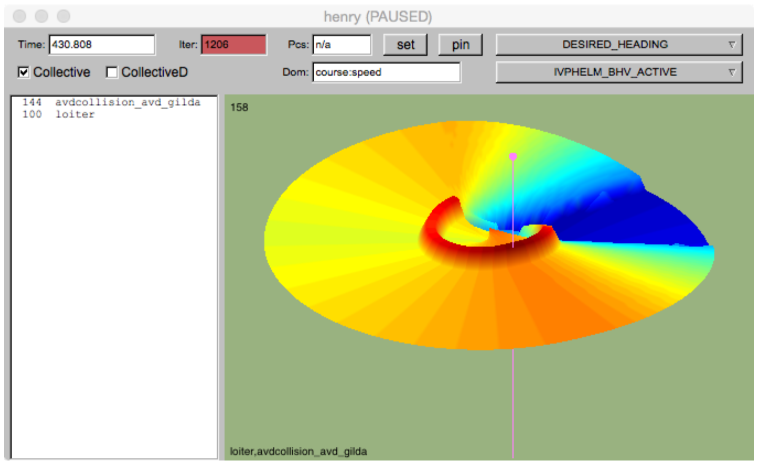


Figure 6: **The `ipfplot` window**: used for examining IvP functions for the chosen vehicle at the current time.

Since each window is associated with a particular vehicle, the helm iteration may be shown unambiguously in the redish window in the upper left. The rendering of the IvP function may be rotated or tilted for different perspectives by using the arrow keys. The perspective may be returned to the bird's eye view by hitting the `SET` button.

7.4 Rendering the Collective IvP Function in the IPFPlot Window

IvP functions of two forms are renderable - those defined over course and speed, and those defined over depth. In both cases, a rendering of the collective function is possible by clicking on the `Collective` or `CollectiveD` check-boxes on the left. In Figure 7 below, the collective objective function is shown, showing the weighted sum of the two behaviors The purplish pin rendered in Figures 6 and 7 shows the actual chosen decision for the present helm iteration. When rendering the collective function as in Figure 7 the pin should be visually consistent with the peak of the function. When rendering a single objective function, as in Figure 6, the pin may not visually correlate to the peak of the function since other functions may be in play. For example in Figure 6 the pin identifies one of many points on the red plateau. The pin can be toggled on and off by hitting the `PIN` button.



Time: 430.808 Iter: 1206 Pcs: n/a

[✓ Collective] CollectiveD Dom: course:speed

```
144  avdcollision_avd_gilda
100  loiter
```

158

loiter,avdcollision_avd_gilda

Figure 7: **The `ipfplot` window**: showing here the collective objective function representing the weighted sum of the two active behaviors.

7.5 Variable Scoping Within the IPFPlot Window

Often it is useful to scope on a couple key variables related to the rendered objective function, to observe how they change and perhaps influence the function as time evolves. Although a general scoping ability exists via the *VarPlot* window described below in Section 9, it can be handy to see the variable value(s) right in the *IPFPlot* window. The two pull-down menu buttons in the upper right in Figure 7 allow the selection of two variables whose values are output in the upper and lower left hand corners of the window as shown. The choice of these two variables is specific to the chosen behavior, or collective function. A different set of variables my be associated with each behavior, and they will be refreshed accordingly as the user switches between behaviors.

7.6 Additional Buried but Useful Hot-Keys in the IPFPlot Window

There are a few hot-key functions available that may not be apparent from simply interacting with the window:

- The `'+'` key: will increase the font size in the browser pane, and the font size of any scoped variable.
- The `'-'` key: will decrease the font size in the browser panes, and the font size of any scoped variable.
- The `'c'` key: will toggle the IvP function rendering from an individual selected function to the collective objective function.
- The `'f'` key: will put the window in a "full-window" mode showing only the rendered objective function, without the browser pane.
- The `'UP'` and `'DOWN'` keys: will tilt the rendered objective functions.
- The `'LEFT'` and `'RIGHT'` keys: will rotate the rendered objective functions.

The above hot-keys are in addition to the time control hot-keys listed in Section `sec_alv_time_replay` and Section 3.1.

8 The HelmPlot Window For Viewing Helm State

The *HelmPlot* window renders information regarding the present helm state, including which behaviors are in which state and for how long, summary of update attempts for each behavior, behavior warnings, behavior errors, a history of helm mode changes, and a history of helm life events.

8.1 Launching the HelmPlot Window

The *HelmPlot* pop-up window is launched from the `alogview` main pull-down window as shown in Figure 8, by choosing a vehicle name. Separate windows can be opened for different vehicles, or even for the same vehicle.

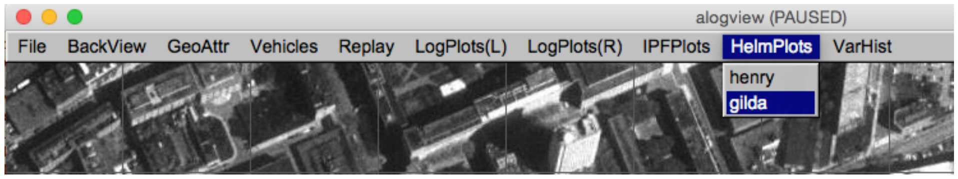


Figure 8: **The `helmplot` pull-down menu:** is used for first selecting the vehicle and launching the *HelmPlot* window.

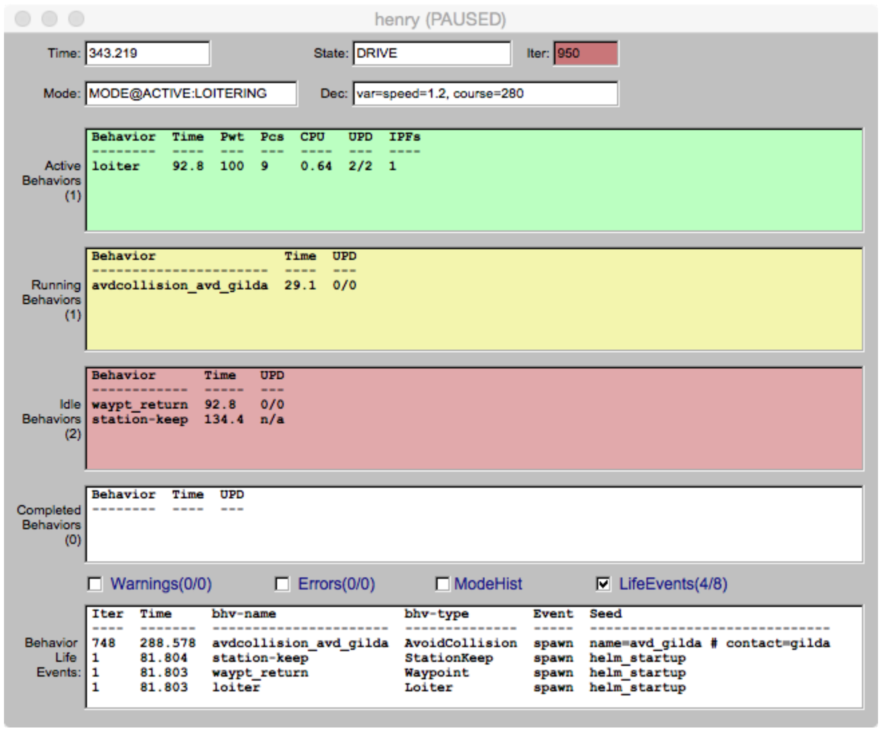
A newly launched pop-up window loads the relevant information from disk into the `alogview` memory space. For some (larger) missions and some computer configurations, the larger memory footprint will begin to be noticed in terms of application responsiveness. Likewise, the internal data structure updates, each time the current time is changed, increases for each pop-up window. This may result in a slower streaming rate when in replay.

8.2 Stepping Through Time and Replay Control in the HelmPlot Window

The current time is shown in the upper left corner and is synchronized with the main viewing window and any other pop-up windows that may be open. The same time keys are functional when this window is active, e.g., `'['`, `']'`, `''`, `''`, for stepping forward and backward in time. The replay control keys, e.g., `'a'`, `'z'`, are also functional, and the replay state and rate is also shown in the title bar of this window.

8.3 Behavior States in the Helm Plot Window

Each behavior known to the helm up to the present time is grouped into a list of either active, running, idle or completed modes as shown in Figure 9.



Time: 343.219 State: DRIVE Iter: 950

Mode: MODE@ACTIVE:LOITERING Dec: var=speed=1.2, course=280

Active Behaviors (1)

```
Behavior  Time  Pwt  Pcs  CPU   UPD  IPFs
--------  ----  ---  ---  ----  ---  ----
loiter    92.8  100  9    0.64  2/2  1
```

Running Behaviors (1)

```
Behavior               Time  UPD
---------------------- ----  ---
avdcollision_avd_gilda 29.1  0/0
```

Idle Behaviors (2)

```
Behavior      Time   UPD
------------  -----  ---
waypt_return  92.8   0/0
station-keep  134.4  n/a
```

Completed Behaviors (0)

```
Behavior  Time  UPD
--------  ----  ---
```

☐ Warnings(0/0) ☐ Errors(0/0) ☐ ModeHist ☑ LifeEvents(4/8)

Behavior Life Events:

```
Iter  Time     bhv-name                bhv-type       Event  Seed
----  -------  ----------------------  -------------  -----  ------------------------------
748   288.578  avdcollision_avd_gilda  AvoidCollision spawn  name=avd_gilda # contact=gilda
1     81.804   station-keep            StationKeep    spawn  helm_startup
1     81.803   waypt_return            Waypoint       spawn  helm_startup
1     81.803   loiter                  Loiter         spawn  helm_startup
```

Figure 9: **The `helmplot` window**: used for analyzing the helm state and behavior modes.

For each behavior, the behavior name is listed, along with the elapsed time since the behavior has been in that mode. If the behavior is configured with the `updates` parameter, then the number of successful vs attempted updates are also listed. If the behavior does not have the `updates` parameter set, then `n/a` will instead be listed in that column as with the station-keep behavior in the figure below. For active, behaviors, the present priority weight and number of pieces is also shown.

8.4 Behavior Warnings, Errors, Mode History and Life Events

The bottom pane of the *HelmPlot* window may have one of four content modes, selectable with the check-box shown.

- *Behavior Warnings*: In this mode, all behavior warnings, in the form of messages written to `BHV_WARNING`, will be listed in chronological order with the most recent at the top. One handy feature is that the existence of possible future warnings can be see in the check-box label. In parentheses, `(a/b)` indicates that *a* warnings are shown in the list out of *b* warnings total for the mission.
- *Behavior Errors*: In this mode, all behavior errors, in the form of messages written to `BHV_ERROR`, will be listed in chronological order with the most recent at the top. In the check-box label, in parentheses, `(a/b)` indicates that *a* errors are shown in the list out of *b* errors total for the mission.
- *Mode History*: In this viewing mode, all helm mode changes will be listed in chronological order with the most recent at the top.

- *Life Events*: In this viewing mode, all helm life events (behavior spawning and deaths) will be listed in chronological order with the most recent at the top.

8.5 Additional Buried but Useful Hot-Keys in the HelmPlot Window

There are a few hot-key functions available that may not be apparent from simply interacting with the window:

- The `'+'` key: will increase the font size in the browser pane, and the font size of any scoped variable.
- The `'-'` key: will decrease the font size in the browser panes, and the font size of any scoped variable.
- The `'UP'` and `'DOWN'` keys: will tilt the rendered objective functions.
- The `'LEFT'` and `'RIGHT'` keys: will rotate the rendered objective functions.

The above hot-keys are in addition to the time control hot-keys listed in Section `sec_alv_time_replay` and Section 3.1.

9 The VarPlot Window For Viewing Variable Histories

The *VarPlot* window renders the full history of one or more chosen MOOS variables, allowing the user to see the present value, recent postings, and upcoming pending postings. This holds for both numerical and string variables.

9.1 Launching the VarPlot Window

The *VarPlot* pop-up window is launched from the `alogview` main pull-down window as shown in Figure 10, by choosing a vehicle name, and MOOS variable name. Separate windows can be opened for different vehicles, variables, or even for the same vehicle and variable. Although one variable is chosen upon launch, any number of variables can be inserted later from the VarPlot pull-down buttons

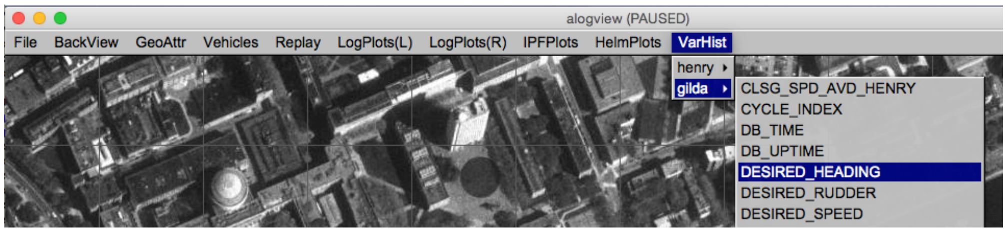
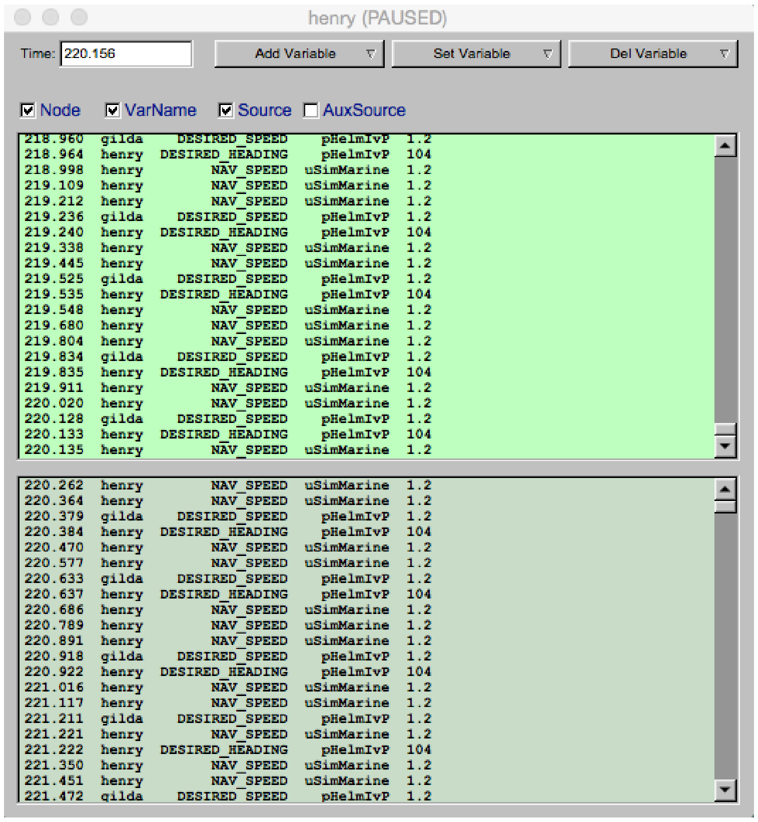


Figure 10: **The `VarPlot` pull-down menu**: is used for first selecting a vehicle and variable name, and launching the *VarPlot* window.

A newly launched pop-up window loads the variable history information from disk into the `alogview` memory space. For some (larger) missions and some computer configurations, the larger memory footprint will begin to be noticed in terms of application responsiveness. Likewise, the internal data structure updates, conducted each time the current time is changed, increases for each pop-up window. This may result in a slower streaming rate when in replay. Closing the pop-up window releases the memory and should immediately boost responsiveness and playback rate.

9.2 Viewing the Variable History in the VarPlot Window

The *VarPlot* window contains two primary panes. The top pane shows everything in the past, up to the most recent post. The bottom pane shows everything in the future, starting with the next pending post. The ”current time” can be regarded as being in between the two panes.



```
218.960  gilda    DESIRED_SPEED    pHelmIvP  1.2
218.964  henry  DESIRED_HEADING    pHelmIvP  104
218.998  henry        NAV_SPEED  uSimMarine  1.2
219.109  henry        NAV_SPEED  uSimMarine  1.2
219.212  henry        NAV_SPEED  uSimMarine  1.2
219.236  gilda    DESIRED_SPEED    pHelmIvP  1.2
219.240  henry  DESIRED_HEADING    pHelmIvP  104
219.338  henry        NAV_SPEED  uSimMarine  1.2
219.445  henry        NAV_SPEED  uSimMarine  1.2
219.525  gilda    DESIRED_SPEED    pHelmIvP  1.2
219.535  henry  DESIRED_HEADING    pHelmIvP  104
219.548  henry        NAV_SPEED  uSimMarine  1.2
219.680  henry        NAV_SPEED  uSimMarine  1.2
219.804  henry        NAV_SPEED  uSimMarine  1.2
219.834  gilda    DESIRED_SPEED    pHelmIvP  1.2
219.835  henry  DESIRED_HEADING    pHelmIvP  104
219.911  henry        NAV_SPEED  uSimMarine  1.2
220.020  henry        NAV_SPEED  uSimMarine  1.2
220.128  gilda    DESIRED_SPEED    pHelmIvP  1.2
220.133  henry  DESIRED_HEADING    pHelmIvP  104
220.135  henry        NAV_SPEED  uSimMarine  1.2
```

```
220.262  henry        NAV_SPEED  uSimMarine  1.2
220.364  henry        NAV_SPEED  uSimMarine  1.2
220.379  gilda    DESIRED_SPEED    pHelmIvP  1.2
220.384  henry  DESIRED_HEADING    pHelmIvP  104
220.470  henry        NAV_SPEED  uSimMarine  1.2
220.577  henry        NAV_SPEED  uSimMarine  1.2
220.633  gilda    DESIRED_SPEED    pHelmIvP  1.2
220.637  henry  DESIRED_HEADING    pHelmIvP  104
220.686  henry        NAV_SPEED  uSimMarine  1.2
220.789  henry        NAV_SPEED  uSimMarine  1.2
220.891  henry        NAV_SPEED  uSimMarine  1.2
220.918  gilda    DESIRED_SPEED    pHelmIvP  1.2
220.922  henry  DESIRED_HEADING    pHelmIvP  104
221.016  henry        NAV_SPEED  uSimMarine  1.2
221.117  henry        NAV_SPEED  uSimMarine  1.2
221.211  gilda    DESIRED_SPEED    pHelmIvP  1.2
221.221  henry        NAV_SPEED  uSimMarine  1.2
221.222  henry  DESIRED_HEADING    pHelmIvP  104
221.350  henry        NAV_SPEED  uSimMarine  1.2
221.451  henry        NAV_SPEED  uSimMarine  1.2
221.472  gilda    DESIRED_SPEED    pHelmIvP  1.2
```

Figure 11: **The `VarPlot` window**: used for scoping on a set of MOOS variables into the past and upcoming in the future.

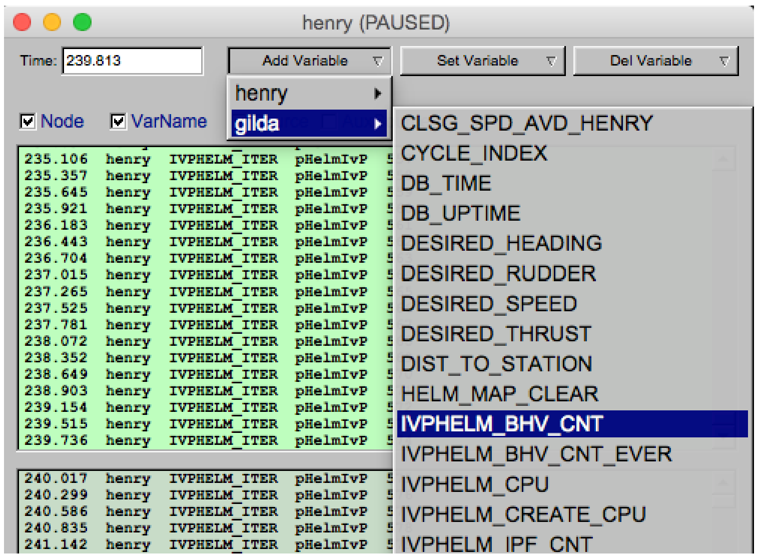
Each variable posting has six components, separated into six columns in both panes:

- *Time*: The timestamp of the posting. This is always shown in the first column.
- *Node*: The node, i.e., vehicle name is shown in the second column. Since the scope may contain values across nodes, this can be useful to see. If only scoping on one variable, or if all variables are from the same node, then this column can be hidden by toggling the `Node` check-box.
- *Variable Name*: If scoping on only one variable, this third column may be hidden to provide more visibility to the other columns.

- *Source*: The source, i.e., MOOS App that generated the posting, is shown in the fourth column. This may be toggled on or off.
- *Auxiliary Source*: The auxiliary source is shown in the fifth column. Most MOOS apps do not make postings with an auxiliary source. The helm does however, and this typically indicates the particular behavior that produced the posting.
- *Variable Value*: The last column is just the value of the posting. This column cannot be hidden.

9.3 Adding and Removing Variables from the History List

Upon launching the *VarPlot* window, a single variable is chosen. After launching, additional variables may be added (from any vehicle) from the `Add Variable` pull-down menu button as shown in Figure 12. The `Set Variable` button presents the same set of choices, but will essentially remove all previously selected variables and replace it with the chosen one. The `Del Variable` button will remove the selected variable from the current set of variables.



```
235.106  henry  IVPHELM_ITER  pHelmIvP  5
235.357  henry  IVPHELM_ITER  pHelmIvP  5
235.645  henry  IVPHELM_ITER  pHelmIvP  5
235.921  henry  IVPHELM_ITER  pHelmIvP  5
236.183  henry  IVPHELM_ITER  pHelmIvP  5
236.443  henry  IVPHELM_ITER  pHelmIvP  5
236.704  henry  IVPHELM_ITER  pHelmIvP  5
237.015  henry  IVPHELM_ITER  pHelmIvP  5
237.265  henry  IVPHELM_ITER  pHelmIvP  5
237.525  henry  IVPHELM_ITER  pHelmIvP  5
237.781  henry  IVPHELM_ITER  pHelmIvP  5
238.072  henry  IVPHELM_ITER  pHelmIvP  5
238.352  henry  IVPHELM_ITER  pHelmIvP  5
238.649  henry  IVPHELM_ITER  pHelmIvP  5
238.903  henry  IVPHELM_ITER  pHelmIvP  5
239.154  henry  IVPHELM_ITER  pHelmIvP  5
239.515  henry  IVPHELM_ITER  pHelmIvP  5
239.736  henry  IVPHELM_ITER  pHelmIvP  5
```

```
240.017  henry  IVPHELM_ITER  pHelmIvP  5
240.299  henry  IVPHELM_ITER  pHelmIvP  5
240.586  henry  IVPHELM_ITER  pHelmIvP  5
240.835  henry  IVPHELM_ITER  pHelmIvP  5
241.142  henry  IVPHELM_ITER  pHelmIvP  5
```

Figure 12: **The `VarPlot` window**: Any variable from any vehicle may be added any time after the window is opened.

9.4 Additional Buried but Useful Hot-Keys in the VarPlot Window

There are a few hot-key functions available that may not be apparent from simply interacting with the window:

- The `'+'` key: will increase the font size in the browser panes.
- The `'-'` key: will decrease the font size in the browser panes.

The above hot-keys are in addition to the time control hot-keys listed in Section `sec_alv_time_replay` and Section 3.1.

10 Command Line Usage for the alogview Tool

The alogview tool is run from the command line with one or more given .alog files and a number of options. The usage options are listed when the tool is launched with the -h switch:

```
$ alogview --help or -h
```

Listing 10.1: Command line usage for the alogview tool.

```
Usage:
  alogview file.alog [another_file.alog] [OPTIONS]

Synopsis:
  Renders vehicle paths from multiple MOOS .alog files. Replay
  logged data or step through manually. Supports several
  specialized pop-up windows for viewing helm state, objective
  functions, any logged variable across vehicles. If multiple
  alog files are given, they will synchronized. Upon launch,
  the original alog files are split into dedicated directories
  to cache data base on the MOOS variable name.

Standard Arguments:
  file.alog - The input logfile.

Options:
  -h,--help       Displays this help message
  -v,--version    Displays the current release version

  --bg=file.tiff  Specify an alternate background image.

  --lp=VEH:VAR    Specify starting left log plot.
  --rp=VEH:VAR    Specify starting right log plot.
                  Example: --lp=henry:NAV_X
                  Example: --rp=NAV_SPEED

  --nowtime=val   Set the initial startup time
  --mintime=val   Clip all times/vals below this time
  --maxtime=val   Clip all times/vals above this time

  --quick,-q      Quick start (no geo shapes, logplots)
  --altnav=PREF   Alt nav solution prefix, e.g., NAV_GT_

  --zoom=val      Set initial zoom value (default: 1)
  --panx=val      Set initial panx value (default: 0)
  --pany=val      Set initial pany value (default: 0)

  --geometry=xsmall  Open GUI with dimensions 770x605
  --geometry=small   Open GUI with dimensions 980x770
  --geometry=medium  Open GUI with dimensions 1190x935
  --geometry=large   Open GUI with dimensions 1400x1100
  --geometry=WxH     Open GUI with dimensions WxH

Further Notes:
  (1) Multiple .alog files ok - typically one per vehicle
  (2) See also: alogscan, alogrm, alogclip, aloggrep
      alogsort, alogiter, aloghelm
```

The order of the arguments passed to alogview do not matter. The --mintime and --maxtime arguments allow the user to effectively clip the alog files to reduce the amount of data loaded into RAM by alogview during a session. The --geometry argument allows the user to custom set the size of the display window. A few shortcuts, "large", "medium", "small", and "xsmall" are allowed.