



# The Next Iteration of Interferometry in HYSWEEP®

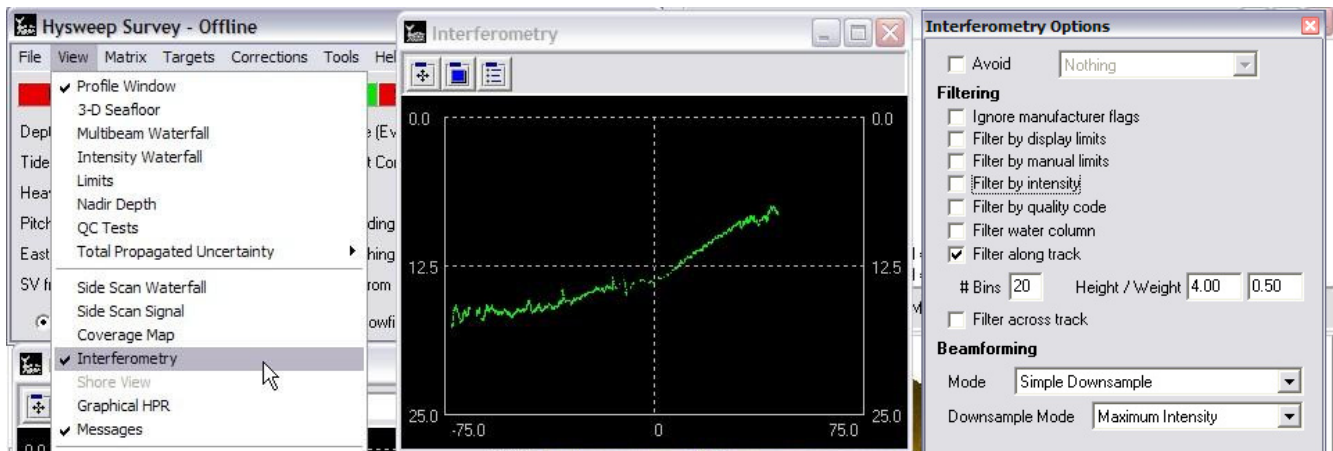
By Dave Maddock

The HYPACK® 2010 release includes new routines for real-time processing of interferometry data. In 2009 and earlier, HYSWEEP® included drivers for the GeoAcoustics GeoSwath, SEA SWATHplus, and Benthos C3D sonars. With 2010, we now support the Edgetech 4600 sonar. This system is the fourth interferometer integrated into HYSWEEP® and I thought it was about time we make a common interface for the display and real-time processing of such data that all interferometry drivers can use. The common interface incorporates several driver tweaks from prior versions and makes them usable for all of the above systems, including filtering routines from the IFFilter program (was GeoSwath only) and a simple downsample beamforming option (was C3D only). The following is a summary of these new features.

As you may know, HYSWEEP® has an internal limit of 1440 beams per ping for multibeam data. Of course, interferometry provides us many more points than that. Our task then is to intelligently reduce this data to something manageable by HYSWEEP® which we accomplish through a combination of filtering and down-sampling.

- The “Interferometry” window displays all the points before any decimation. Points flagged as bad or filtered will be colored red; good data is colored green. It will also show any filter boundaries in blue if any are enabled.

**FIGURE 1.** HYSWEEP® Interferometry Window (center) and Options (right)



Clicking the third button on this window will open the “Interferometry Options” window. This controls how HYSWEEP® will process the data. The processing chain moves from the top of the form to the bottom. Once a point is flagged, it is ignored in the rest of the chain.

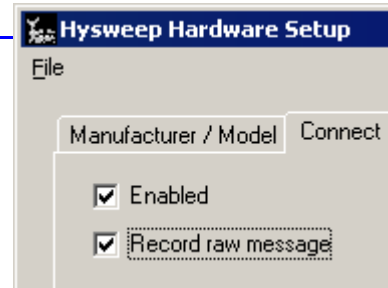
---

---

## DRIVER CHANGES

FIGURE 2. Recording in the Manufacturer's Format

Since control of the filtering and beam-forming process is now built into HYSWEEP®, IFFilter is no longer used for real-time filtering and the setup forms in HYSWEEP® HARDWARE have been removed in most cases. The settings previously available there can now be found in the “Interferometry Options” dialog and can be changed without restarting HYSWEEP®. For drivers which support also logging to the manufacturer’s raw file format (eg. RDF, SXI, K8E), you can enable this feature by checking “Record raw message” on the “Connect” tab in HYSWEEP® HARDWARE.



---

---

## PROCESSING OPTIONS

- **Avoid.** These options allow you to skip some of the processing if the data is already sufficiently thin (ie <1440 points). “Avoid Any Processing” will try to do nothing if it can. “Avoid Downsampling” will filter, but try not to beamform.

FIGURE 3. Avoid Options

- **Filtering.** This section provides ways to remove noise. Typically one need not use all of these. Points can be flagged on the basis of depth, offset, intensity, or quality code. If the sonar pre-flags bad points you have the option to honor or ignore these.

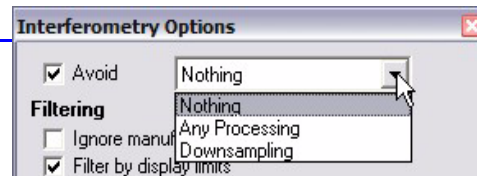


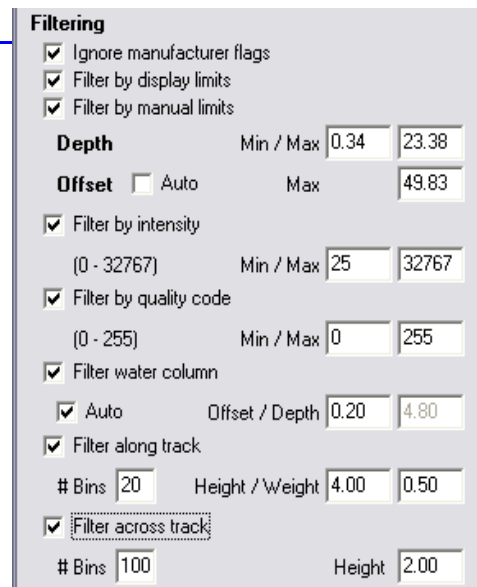
FIGURE 4. Filtering Options

**Display limits** filters based on the depth, offset, and angle limits specified in the view options.

**Manual limits** allows you to specify limits that are not tied to your viewing limits. You can also set your offset limits to be a multiple of water depth.

**Intensity and quality code** simply filter by a specified min/max. Note that the drivers will scale intensity to a 0—32767 range and quality code to a 0—255 range. The meaning of these vary somewhat depending on the sonar.

The **water column filter** can track a single beam echosounder depth and reject points with a range less than that value.



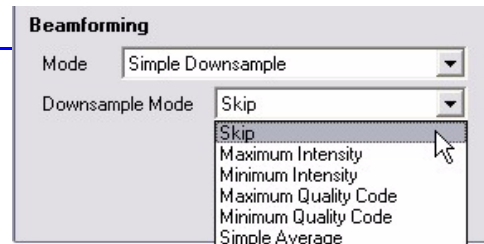
---

The **along track filter** makes N bins across track of a specified height. Those samples falling within the bin are flagged good and affect the depth of the bin by a specified weight. The lower the weight, the slower the filter reacts to change.

The **across track filter** works similar to the along track, but it does not remember bin depth from ping to ping. This filter is meant to be used with the along track filter but with a smaller height.

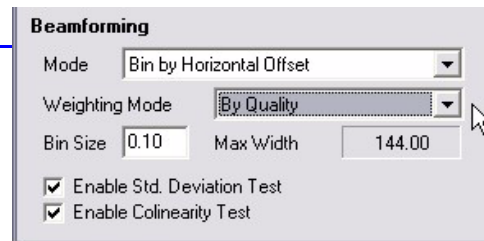
- **Beamforming**. Two modes of beamforming are provided: simple downsampling and binning.
  - **Simple downsample** will take the results of filtering and downsample to 1440 beams. You can opt to select by intensity, quality code, or average.

**FIGURE 5.** Simple Downsampling Options



- **Binning by horizontal offset** is the method used by the GeoSwath, C3D, and SWATHplus drivers in 2009. Given a bin footprint size, it will form a beam for each bin by averaging the good points in each bin, optionally weighted by intensity or quality. In this mode, the beam quality is set to the bin point count. Also provided for this mode are standard deviation and colinearity tests which, if failed, set the beam quality to 1.

**FIGURE 6.** Binning Options



Note that these modes can be seen as opposites. In the first case, the entire swath coverage will be retained, but the beam footprint will be necessarily reduced to compensate. In the latter, footprint resolution is guaranteed at the expense of a swath width limited to  $1440 * \text{bin size}$ . Also, simple down-sampling will retain vertical features such as quay walls while binning will average them out.

The result of this processing is what will be displayed in the rest of the HYSWEEP windows and logged to the HSX.

---

---

## *THE INTERFEROMETRY DISPLAY*

*FIGURE 7. Sample Interferometry Window*

The display window allows you to view the raw interferometry points and the enabled filters. In this example, the manual limits, water column, and along track filters are enabled. Manual limits and water column (if not automatically tracking a SBES depth) show handles which can be clicked and dragged to modify the filter.

The along track filter can be reseeded to the current SBES depth (or raw nadir of multibeam if no SBES) by simply turning it off and on again. However, double-clicking a point on the display will force the corresponding bin to that depth. This is handy for helping the filter “lock on” to the bottom.

Finally, right-clicking provides a simple menu to quickly turn on/off the filters.

