



A Discussion of TVG

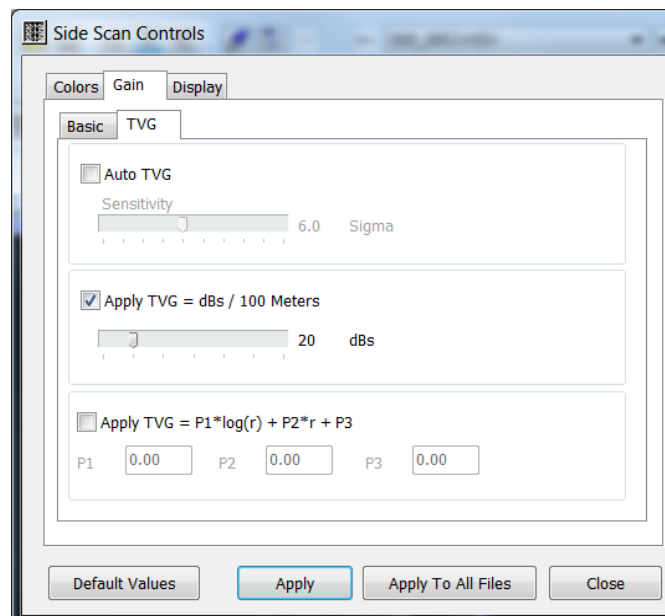
By Dave Maddock

Time-Varied Gain (TVG) is a method used to compensate for signal loss in echosounder data. As the range of an imagery sample increases, so does the applied gain. We use this technique throughout HYPACK® to improve the quality of imagery waterfalls and mosaic final products. This article will survey the implementation of TVG in the relevant HYPACK® programs, how they differ, and under what circumstances you would use each mode.

TVG IN SIDE SCAN

SIDE SCAN SURVEY and HYSCAN (SIDE SCAN TARGETING AND MOSAICKING) share a common toolkit for image manipulation—including TVG, which is accessible under the “Gain” tab within the Side Scan Controls window. Three flavors of TVG are available for side scan: Auto TVG, dBs/100m, and raw equation.

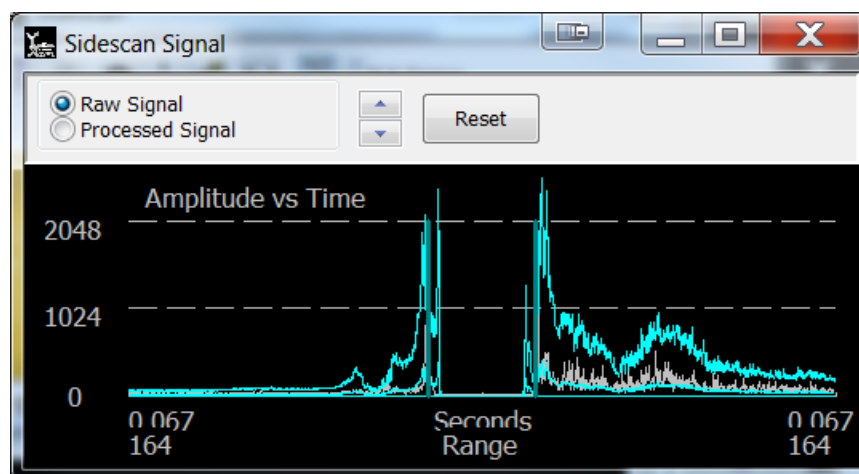
FIGURE 1. TVG Options in HYSCAN



Auto TVG is a proprietary algorithm which automatically varies the high & low saturation limits across the swath based on the average amplitude of the signal at each across-track point. The sensitivity of the algorithm can be adjusted with the slider, which expands or contracts the saturation envelope around the signal. (See figure below.)

dBs / 100 Meters applies a specified gain (in dBs) per 100 meters of range.

You will find that one or the other of the above methods works better with your sonar, depending on the model. Because of the linear nature of the gain multiplier in the “per 100 meters” mode, it works best with imagery with linear signal loss as a function of side scan range. On the other hand, Auto TVG will



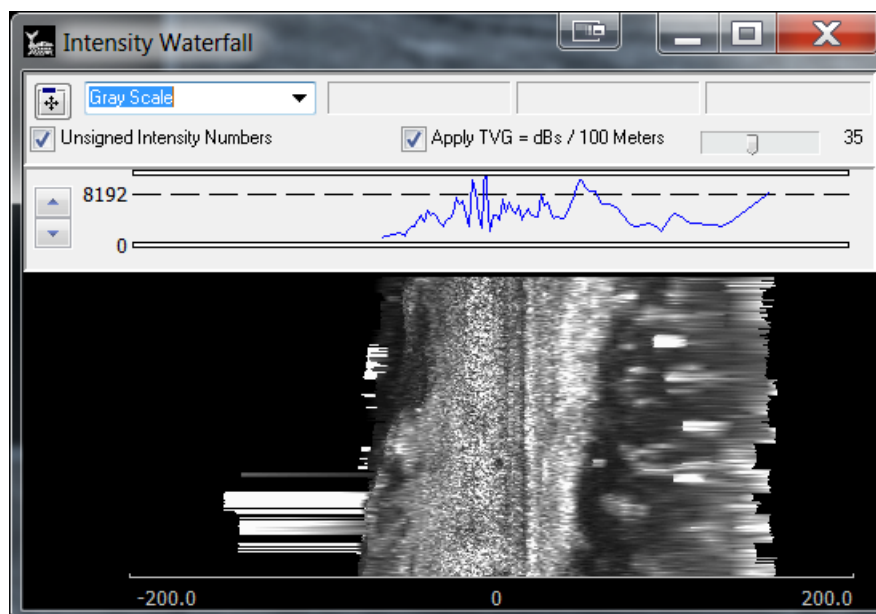
provide a better result if attenuation is more severe or uneven—for example, with side scan sonars that have minimal on-board pre-processing features. A convenient rule of thumb is that if your side scan has on-board capabilities such as a pressure, heading, or motion sensor, bottom tracking, or other sensors, the linear TVG is likely the better option for you; in other cases, you may see better results with Auto TVG.

The third TVG option is to use a **custom equation** where you can specify the constants P1, P2, and P3 to manually adjust the applied gains. P1 is scaled logarithmically as a function of range, P2 is linearly applied, and P3 is a flat gain applied equally across the swath. This option is for the scientists!

TVG IN MULTIBEAM IMAGERY

HYSWEEP® offers all the same processing options for side scan data coming from a multibeam system that HYPACK® provides for traditional side scan.

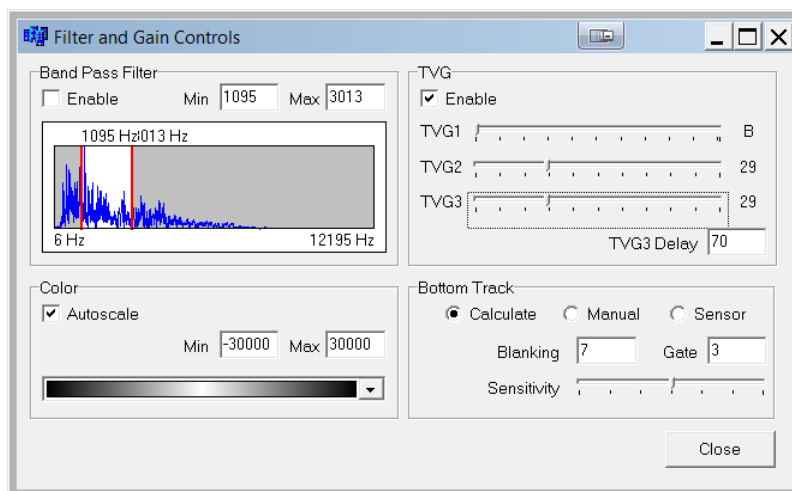
For average backscatter or snippets imagery—that is, imagery correlated to the multibeam bathymetry—the intensity waterfall display includes the “per 100 meters” TVG capability as well.



Post-processing backscatter or snippets imagery into a final mosaic is done with GEOCODER™. GEOCODER™ uses a similar, but distinct, method to compensate for signal loss: Angle-

Varied Gain (AVG). AVG determines how much gain to apply by considering beam angle rather than range or across-track offset, both of which are determined by acquire time and sound velocity.

FIGURE 2. TVG controls during Sub-bottom Acquisition



TVG IN SUB-BOTTOM

Finally, TVG is used during sub-bottom acquisition and processing. Because of the more extreme attenuation of the signal as it penetrates into the sea floor, HYPACK® offers more advanced TVG options for this kind of data.

Three cumulative TVG curves can be specified during acquisition. The first (TVG1), is applied to the entire time series, starting from 0 seconds and going to the last imagery sample. Since this curve will amplify the bang pulse and any noise in the water column, take care with this option in shallow water. If the slider is moved all the way to the left (so it displays a value of “B” as displayed below), it will blank out the water column. Note that the bottom track should be correct before using this mode or TVG2, discussed next.

The second curve (TVG2), applies from the bottom track point down. It will not amplify water column noise, but because it begins right at the bottom detection, it will not amplify the shallowest areas of penetration very much, relatively speaking.

TVG3 offers a third gain curve to use in very deep water surveys. It will begin at the point (in milliseconds) specified by the “TVG3 Delay” option. By tweaking each TVG curve, you can compensate for the signal loss and get meaningful displays during survey, for quality control and targeting purposes.

Finally, note that all of the above options apply *for display only*. They will not affect the data as it is logged to HSX or SEG Y and can be changed as needed during post-processing.