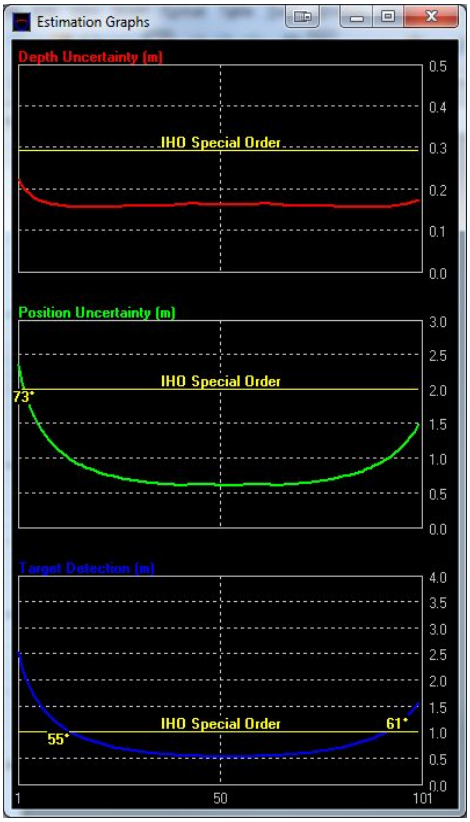
Total Propagated Uncertainty: A Primer — Part 3, Target Detection

By Dave Maddock



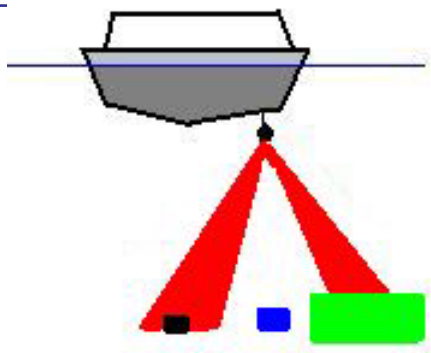
Welcome to the last in a multi-part series on Total Propagated Uncertainty (TPU). TPU is a method used to quantify the uncertainty of survey measurements developed by Rob Hare of the Canadian Hydrographic Service. HYPACK® can calculate and display TPU in several places—in a survey-planning calculator, during data acquisition in HYPACK® SURVEY and HYSWEEP®, and in post-processing tools like MBMAX (64-bit HYSWEEP® EDITOR).

Part 1 of the primer appeared in the January 2015 issue of *Sounding Better!*. It introduced the concepts of TPU and discussed the factors pertaining to vertical uncertainty (TVU). Part 2, from the May 2015 issue, covered the horizontal components (THU). This final part will cover the last aspect of the suite of TPU calculations—target detection.

The target detection component determines the smallest size target capable of being detected. HYPACK® has built-in support for the TPU accuracy standards published by the US Army Corps of Engineers (USACE) and the International Hydrographic Organization (IHO), but only the IHO standards have a minimum target size component. The algorithm uses the beam footprint, beam spacing, ping rate, and vessel speed to determine the smallest target that the configuration is capable of detecting reliably.

Beam footprint is the area of the seafloor ensonified by a given beam.

FIGURE 1. *Beam Footprint*



Often the across-track and along-track dimensions of the footprint are different (across-track is usually finer), so we are concerned with the worse of the two—remember, we want to determine reliable detection. Figure 1 shows a simple, 2-beam sonar with a large beam footprint shown in red. The small black box might not be detected by its beam because it is smaller than the beam footprint; however, the larger green box is sure to be detected.

Potential targets can also fall in between beams or pings. In our example case, the blue box will not be detected at all because it is small enough to fall in between two beams. Hence, the algorithm also considers beam spacing. Finally, ping rate and vessel speed determine the along-track distance between pings. Just like beam spacing, potential targets can fall within this distance and avoid detection.

The good news regarding target detection is that the uncertainty is not cumulative as it is with TVU and THU. Rather, we simply take the worst case of all of the above. In practice, target detection limit is usually determined by along-track factors.

For best results, ping rate and survey speed should be adjusted to insure that the gap between pings does not exceed the along-track beam width your equipment theoretically supports.