# Streamer Positioning for Advanced 3D and 4D Applications

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**Summary**

Correlated positioning errors can have a detrimental impact on the resolution of 3D surveys. The potential impact on 4D is even more serious. These problems can be addressed by the use of more rigorous DigiRANGE II fully cross braced acoustic positioning networks, and through the use of advanced on-board systems, such as ORCA.

## Overview

In this paper, we will review the

- history of marine streamer positioning
- accuracy of current marine positioning systems
- impact of correlated positioning errors on 3D and 4D seismic data

We will then discuss cost effective strategies to mprove positioning accuracy, with minimum impact on operational efficiency and streamer noise.

## History

In the mid-1980's, the standard technology for streamer positioning was based on tangent measurements (provided by magnetic compasses) at discrete points along each cable. This allowed for an estimate of the cable shape (and hence an estimate of the receiver locations) at the time of each shot. At that time, most acquisition contracts were written to contain specifications that the distance between compasses along each cable would be 300 meters to allow for adequate streamer shape estimation. In the 1990's, the ability to place limited acoustic networks near the front, middle and tail end of the streamers led to a significant improvement in positioning accuracy. Further incremental improvements in positioning accuracy have occurred as the result of continuous improvement in measurement techniques (better compass calibrations and more reliable acoustics). New algorithms for detecting and eliminating random and systematic errors in the measurement data (multipathing/reflections, velocity variations and residual compass biases) have lead to further improvements. The next step in this evolution in streamer positioning techniques is the arrival of third generation acoustic systems, capable of providing full acoustic cross bracing along the entire length of the cable. The evolution of streamer positioning is schematically shown in Figure 2.

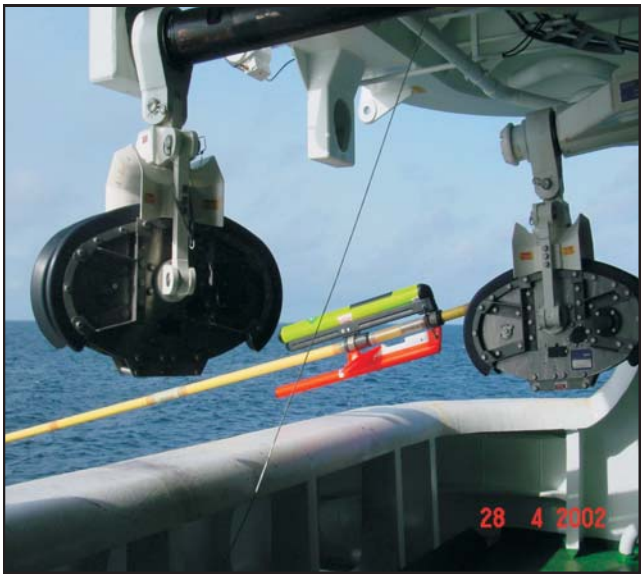


**Fig-1.** Integrated magnetic heading sensor and cable leveling device ("bird") mounted on towed streamer

## Accuracy of current systems

For in-water positioning networks typically used today, some rules of thumb can be applied : -

- Receiver errors are smallest at the ends of the cable, where acoustic networks tie receiver locations directly to surface GPS observations. Due to the complexities of acoustic propagation around the propellers and the energy source, the errors are usually the least at the far end of the cable.
- Errors tend to increase as the distance from the GPS points increases
- If a mid cable acoustic network is present, errors are reduced in the area of the mid cable network.

The magnitude of the errors depends on a number of factors, including : -

- Performance of measurement devices
- Density and geometry of measurements (streamer length)
- Environmental conditions (acoustic and compass degradations can degrade in poor weather)
- Survey location (probability of reflected acoustic signals increases in difficult water bottom conditions, and with significant thermal gradients.)
- Data processing techniques

The standard deviations (calculated using Concept Systems GeoMatrix software) shown in Figure 3 are based on some fairly conservative estimates of measurement noise