COMBINING INDEPENDENT DATA SETS TO PRESENT THE FULL PICTURE

Hydrographic Survey Data Integration

The next step in the presentation of hydrographic survey data is the integration of separate data sets into navigable three-dimensional models. Software tools now available allow contractors to produce geo-referenced presentations of various data sets including bathymetry, sonar imagery and sub bottom information. By combining these data sets together into a three dimensional model the contractor can provide the end user with tools that allow informed decisions to be rapidly made about the suitability of an area for the proposed purpose. These presentations also provide the contractor and end users with a powerful tool for gauging the quality of the datasets.

In recent years there has been significant development in the software tools for the processing, verification and presentation of bathymetric data. This has been partly necessitated by the huge data collection capabilities of modern multibeam echo sounders. During this time it has also become common practice to record and interpret side scan sonar and sub bottom profiler data digitally. This article looks at methods of combining these data sets together to create informative and intuitive interactive models.

Bathymetric Data Integration

Traditional methods of processing multibeam data have been based around a part to the whole approach. Lines of data have been processed and cleaned individually and then combined together with neighbouring lines to produce a model of the seabed. Increasingly this process is being reversed and data processing methodology is working from the whole to the part. The entire survey data set is being subjected to statistical cleaning processes; where the cleaning algorithms are tuned to the sensor type, water depth and seabed conditions. Once the data has been cleaned the resulting model is often examined in three dimensions. Alternative colour wash drapes can be selected to enable the contractor to highlight sections requiring more detailed analysis. By draping a standard deviation or seabed gradient colour wash display over the three-dimensional bathymetric model, areas that may require additional attention or verification can be easily determined. (See Figure 1).

As well as being a valuable tool for the processing of multibeam data these presentation methods also provide great benefit to non-specialist end users. Previously these end users may not have been able to gain an accurate impression of the seabed relief and data quality from standard presentations, such as contour plots and colour washes. By allowing the end user to interact with the data set in three dimensions the user can develop a far greater understanding of the sea bed and make more informed decisions on the suitability of an area for the proposed purpose.

The end user does need to be aware that these presentations can also highlight any small deficiencies in the data set. Inherent problems due to the dynamic nature of the survey environment, waves and tides, can become visible when the data is viewed in certain angles. Problems with inaccuracies in tide measurement and application can create steps between adjacent survey lines, these may only become visible by artificially illuminating the data in an across track direction; they may not be visible when viewing in an along track view. These features are often very small and well inside system error budgets, but are visually accentuated when a seabed is flat and featureless.

Side Scan Sonar and Bathymetric Data

Traditionally, side scan sonar data and bathymetric data have been processed and interpreted or modelled following separate detached methodologies. Often the first opportunity to compare the two data sets was when the separate charts were produced.

However side scan sonar data and multibeam bathymetric data can be used to complement the interpretation and modelling of the respective data sets. By having access to the side scan sonar data during the processing of the multibeam data, areas of unusual or suspect relief, discovered during the multibeam processing, can rapidly be compared to the side scan sonar to verify whether a feature is true or perhaps a series of erroneous soundings caused by aeration in the water column.

For the geophysicist the modelled multibeam bathymetry data set can greatly assist in the interpretation of the sonar data. Typically the absolute positioning of the hull-mounted sensor (multibeam sounder) will be up to an order of magnitude higher than that of any towed sensor (sonar fish). Key common features from both data sets can be used to accurately tie the positioning of the sonar data to that off the bathymetry. This can be performed as a block shift or as rubber sheeting, warping the sonar data digitally to fit the bathymetry.

Where side scan sonar interpretation is not being performed digitally the bathymetry may be useful for the accurate determination of sediment boundaries. In shallow water the changes in seabed sediment (texture) are often visible in a shaded relief map of the bathymetry model. Often these changes in sediment also coincide with a change in bathymetric relief.

If the side scan sonar interpretation has been carried out digitally and a sonar mosaic created, it is possible to drape this sonar image over a three dimension bathymetric model. This type of visualisation fusses the two data sets together and provides the contractor with an additional tool to verify the accuracy of the modelling of the bathymetric data and provide a direct comparison of the positional accuracy of the sonar sensor. For the purpose of a route survey the proposed route could also be superimposed on the surface and any additional database information such as existing sub sea infrastructure added. The presentation would then allow the end user to quickly and

accurately make decisions about the suitability of the area for the proposed purpose (See Figure 4).

Subbottom Data and Bathymetric Data Intergration

The presentation tools discussed previously have all been methods of displaying information about the surface of the seabed, whether this was information derived from the bathymetry or from a sonar image of the seabed. There are also software products that allow sub bottom information to be presented in a visualisation combined with seabed surface information. By combining the data the end user is able gain a better understanding of the inter-relationships between the separate survey data sets.

One method of presenting the sub bottom information is to display the data as a geo-referenced vertical profile. The data is converted into real world units enabling the profile to be displayed in the correct location and scale under the seabed model. The profiler data is presented in a traditional format that will be familiar to most in the hydrographic industry, but has the unique advantage of being displayed relative to the surrounding bathymetry (See Figure 4).

Processed and Interpreted seismic data can also be combined with seabed surface bathymetry to create a multi-layered 'sandwich' model. The interpreted and depth converted geological horizons can be modelled and combined, in a visualisation suite, with a bathymetric model to create a multi-surface three-dimensional view. Previously when presented in two dimensions this data could be spread over numerous charts, one for each horizon. This made it difficult for the end user to gain an overall impression of the geological conditions. However, by presenting all of the models together in a stack it becomes very simple to gain an understanding of the deeper geology (See Figure 5).

Summary

Recent advances in software and computing power has changed the ways in which bathymetric data can be processed and presented. The new tools allow the contractor and the end user to have higher confidence in the quality of the data acquired and the processing techniques.

Combing independent data sets together and creating integrated visualisations of an entire survey provides the end user with a fast and convenient tool for gaining an accurate and broad understanding of the bathymetric and geological features.

The three dimensional visualisations provide the contractor and end user with qualitative tools for inspecting the data. However these presentations are often difficult to use for quantitative purposes and should be seen as complementary to standard, two dimensional, charts. Charts will remain very informative methods of presenting data especially in areas with complex features.

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