Adding value to marine geophysics with visual interpretation

ALISON JAMES MCIfA and MARK JAMES MCIfA, MSDS MARINE

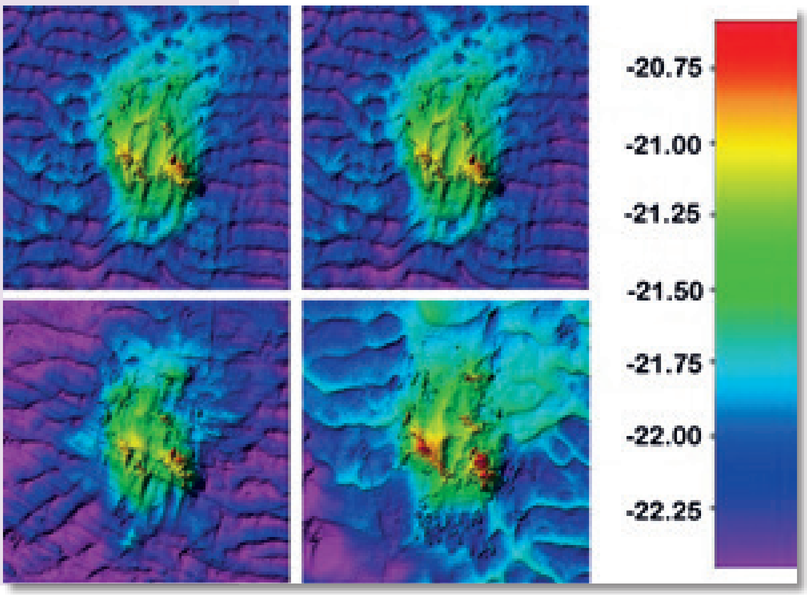
This article explores ways in which archaeologists can add value to their marine geophysical surveys by ensuring surveys are adapted to enable new ways of visual interpretation. It builds on the experiences of MSDS Marine, which is well known for its marine geophysics capability.

The world of maritime archaeology is by its very nature under water, out of sight and perhaps out of mind for the majority of the population. For this reason, MSDS Marine has been working with its geophysical data to find new methods for visual interpretation and public presentation.

Primarily, remote sensing within marine archaeology consists of four sensors: Sidescan Sonar (SSS), Multibeam Echo-Sounder (MBES), Magnetometer (MAG) and Sub-Bottom Profiler (SBP). The aim for all marine geophysical surveys is that during the collection, processing and interpretation stages the data and accuracy are of the highest standard possible, that surveys are repeatable and that the outputs are suitable for archaeological assessment, analysis and presentation. Remote sensing surveys can be specified and undertaken for a number of reasons, including: prospection, either over a wide area or localised to a feature such as a wreck looking for anomalies such as debris; the establishment of an accurate position of a site; condition assessment and monitoring; and to support the creation of public engagement resources. This latter point is considered in greater detail in the next article. Each sensor collects and presents data in different ways, so not every sensor is suitable for every job. Contractors should work with their clients during the planning phase to establish the most appropriate sensor (or combination of sensors) for the task.

In this article we focus on multibeam bathymetry over other geophysical techniques. Its use as a tool to identify wrecks and their extent on the seabed is well established. It offers a highly engaging image that can be readily understood by many people in a way that other geophysical techniques such as sub-bottom profiling and sidescan sonar survey can't. The following two case studies look at ways it can be used outside of the normal hydrographic survey.

Figure 1: Top left clockwise, 2015–2018 multibeam bathymetry of the Rooswijk protected wreck site clearly showing the rapidly shifting, mobile sands



CASE STUDY: MULTIBEAM AS A TOOL FOR COMPARATIVE ANALYSIS

MSDS Marine has undertaken repeat geophysical and hydrographic survey over the site of the *Rooswijk* during 2015 (multibeam), 2016 (multibeam, sidescan, magnetometer and sub-bottom), 2017 (multibeam) and 2018 (multibeam). The works were undertaken in advance of, during, and after the fieldwork phase of the *#Rooswijk1740* project running between 2016 and 2018.

The Goodwin Sands, where the *Rooswijk* lies, is a highly dynamic environment with rapidly shifting mobile sands. In order to monitor the sand levels over and around the main site of the *Rooswijk,* a high resolution multibeam survey was planned that would be repeatable with equipment, methods, datums, and processing so that the excavation could be planned when the sand overburden was lowest, future sand movements predicted, and the level of environmental risk to the site monitored. The surveys also allowed the project team to prioritise the areas to be excavated and the data provided base maps to be used as an underlay for the diver acoustic tracking. The data in Figure 1 is presented to the same datum and colour scale and clearly shows the changes to the site over the four-year period.

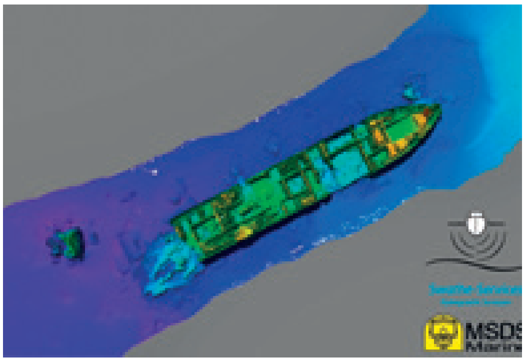
CASE STUDY: MULTIBEAM PROCESSING FOR A PUBLIC AUDIENCE

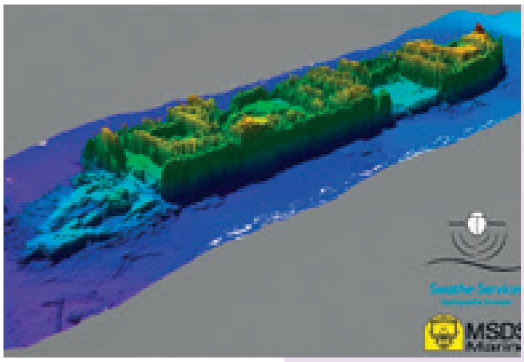
The standard approach to processing multibeam data is to average the data points out into a uniform grid, typically ranging from 30cm to 50cm dependent on the specification of the survey and the data density. This grid of data points is then used to create a three-dimensional surface that is coloured by depth. The images in

Figures 2 and 3 show a typical presentation of a wreck, in this instance the *James Eagan Layne,* the data of which was collected by Swathe Services and processed by MSDS Marine.

To visualise shipwrecks in a more accurate and arguably more understandable form, the methods of processing and visualisation need to be adjusted. From an accuracy and interpretation point of view the greatest concerns are the gridding of data and the application of a surface. These issues can be overcome by working solely with the point cloud data. Each line of data is corrected for height and position and then cleaned to remove erroneous points and suspect data. Data cleaning is generally undertaken in a number of programs as each has strengths and weaknesses dependent on the data collected. The lines of data are then combined to create the final point cloud for the site. Further processing work is then undertaken to present the data in a clear and visually impressive model – Figure 4.

As can be seen in Figure 4 the difference between a point cloud and a surface model is marked. The final visualisation aspect of the processing further increases the coherence and aids interpretation, both for archaeologists and the general public viewing the model. The resulting model can be presented in a number of formats including images, fly-through video, interactive models and in a web-based viewer.





Figures 2 and 3: The James Eagan Layne, multibeam bathymetry presented in the traditional way

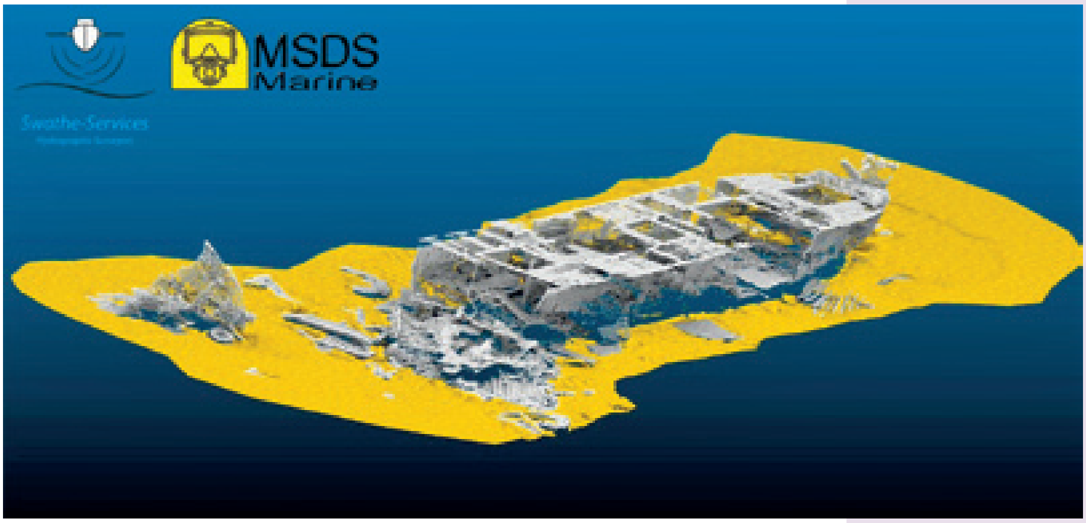


Figure 4: Point cloud model of the James Eagan Layne aimed at a public audience

CONCLUSIONS

Marine geophysical survey techniques offer a wealth of possibilities for archaeologists. Identifying the final uses of the survey allows the right approach to data collection to be selected. The technology available is evolving rapidly and the ways in which data can be collected are changing too. The development of Unmanned Survey Vessels (USVs), Figure 5, means that it is now possible to mobilise quickly and more cost effectively in some environments.

The success of the virtual dive trail scheme led by Historic England has shown that there is a demand from the public to engage with marine archaeology. Marine geophysics is leading the way in adding value to archaeological survey in new and interesting ways.

Figure 5: Images showing the work of MSDS Marine and Swathe Services developing unmanned survey vessels, from conception to end product