LIGHT AND SOUND

Lowering subsea structure 'reference frame' onto deployment vessel, complete with vertical and horizontal flanges © DOF Subsea

SUBSEA METROLOGY GUIDANCE IS BEING UPDATED WITH THE LATEST TECHNIQUES, INCLUDING ACOUSTICALLY-AIDED DYNAMIC LASER MAPPING. JUDITH PATTEN REVEALS WHAT YOU CAN EXPECT IN THE NEW VERSION OF S 019 LATER THIS YEAR

Put simply, subsea metrology is the process of acquiring accurate and traceable dimensional data for, primarily, the design and fabrication of 'rigid spool pieces' or 'flexible subsea jumpers' in the offshore oil and gas industry, each of which is used to connect subsea infrastructure. Commonly, these will be used to link subsea trees or manifolds to flowlines, thus enabling the transport of hydrocarbons from the reservoir to processing facilities.

The objective of subsea metrology is to accurately determine the horizontal and vertical distance between subsea assets' connection points, as well as their relative heading and attitude. Metrology data is then used to design and fabricate the interconnections.

Simon Barrett of DOF Subsea, who has worked with the International Marine Contractors Association (IMCA) to update its *Guidance on Subsea Metrology (S 019)*, says the aim of accurate subsea metrology is to "measure twice and cut once" – errors in the fabricated dimensions will be costly and overall fit, the ability to create pressure-tight joints and the working life of interconnections all rely on accurate metrology.

The original S 019 has done sterling work since it was launched in 2012. It underwent technical revision last year and is being prepared for republication online later this year – proof of how fast techniques are developing and being used.

When S 019 was originally published, photogrammetric survey provided the most accurate measurements, but was limited to good visibility; inertial navigation system (INS) was also relatively new to the offshore industry. Today, we can look back on some exciting developments that combine INS with other metrology techniques, thus providing flexibility to suit the task in hand.

New metrology techniques continue to come to the fore and IMCA is keen to ensure that users of the guidance are fully informed. Techniques set up to take measurements remotely can reduce the time an expensive vessel has to be on station.

Many will be surprised to hear that LiDAR can now be used subsea. Indeed, it is rated to water depths of up to 3km – a significant breakthrough. The data can also be analysed in the same format as onshore dimensional control 3D lasers, too. As a result, it is being used by an increasing number of the major operators and new material in S 019 now covers LiDAR.

A new technique

Work undertaken by DOF Subsea, together with subsea technology companies Sonardyne, 2G Robotics and Seatronics (an Acteon Company), in December successfully demonstrated a new underwater surveying technique – acoustically-aided dynamic laser mapping using INS from a moving remotely operated vehicle (ROV). This uses a LiDAR scanner fitted to a moving ROV to create highly detailed, point cloud images of subsea assets and environments. By combining the

LiDAR data with precise underwater acoustic and inertial navigation information, it is now possible to generate centimetre-resolution engineering models from which accurate measurements can be instantaneously and repeatably captured. Point cloud images can be overlaid on top of each other (the normal procedure is four runs, two in each direction) to produce accurate images.

Importantly, turbidity (visibility) affecting operations is minimal as the ROVs can fly close to the objects being mapped far below the surface of the sea. What's more, getting so close means that the rolling, pitching or yawing of the vessel far above has no effect on measurements. The data produced is logged instantly for the surveyors working on the accompanying vessel.

The technique could significantly shorten the time needed to map underwater structures and offshore sites and S 019 will reflect these latest findings. "This new procedure is important in the cost-conscious project-oriented offshore oil and gas world," explains Nick Hough, IMCA's technical adviser – HSSE, offshore survey and ROV. "The adoption of a smart combination of proven technology can reduce data acquisition (and hence vessel time) to around two hours, compared to between six and eight hours per metrology using traditional data acquisition methods such as well-proven acoustic long baseline (LBL) metrology to acquire various subsea measurements.

"Initially scanners were limited to fixed locations on the seabed – the December demonstration proved there is an opportunity for mobile scanners and this needs to be reflected in our guidance."

The latest guidance

Hough adds: "It is essential that IMCA guidance keeps pace with technological leaps forward such as this. The publication aims to provide guidance to help surveyors and surveying organisations, vessel personnel, project engineers, fabricators and client organisations to make sure the task is done by the most accurate and cost-effective means and – most importantly – is done correctly."

The new revision of S 019 includes six pages of information on subsea laser scanning metrology. But it does not advocate 'out with the old, in with the new'. For example, some newer methods may be unsuitable when at depth, in poor visibility or in high currents. So, there will continue to be times when earlier techniques continue to be most suitable. These include:

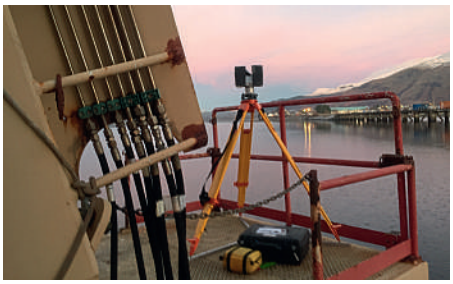
- Diver taut wire metrology – essentially a tape measurement of the direct distance between hubs (the first procedure used)
- Digital taut wire – a more sophisticated version of the diver's tape measurements

As a result, the new S 019's 'methods' section includes descriptions of these techniques, as well as of LBL acoustics, photogrammetry, INS metrology, acoustic-inertial metrology, SLAM (simultaneous localisation and mapping) metrology, and subsea sonar metrology. Other sections look at subsea metrology planning and preparation and subsea metrology deliverables, and there's a glossary that demystifies acronyms. The introduction also lists some of the most common terminology associated with subsea metrology, and appendices provide typical examples of metrology brackets and laser scanning targets and a comparison of subsea metrology systems.

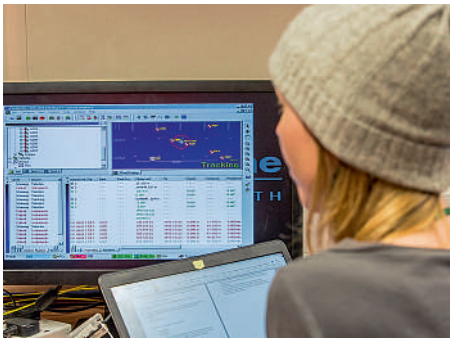
Like all IMCA guidance, S 019 will be available free-of-charge on the IMCA website (www.imca-int.com) and you are invited to provide feedback, in readiness for future revisions that take account of new developments in the coming years.

IT IS ESSENTIAL THAT IMCA GUIDANCE KEEPS PACE WITH TECHNOLOGICAL LEAPS

Judith Patten is principal at JPPR

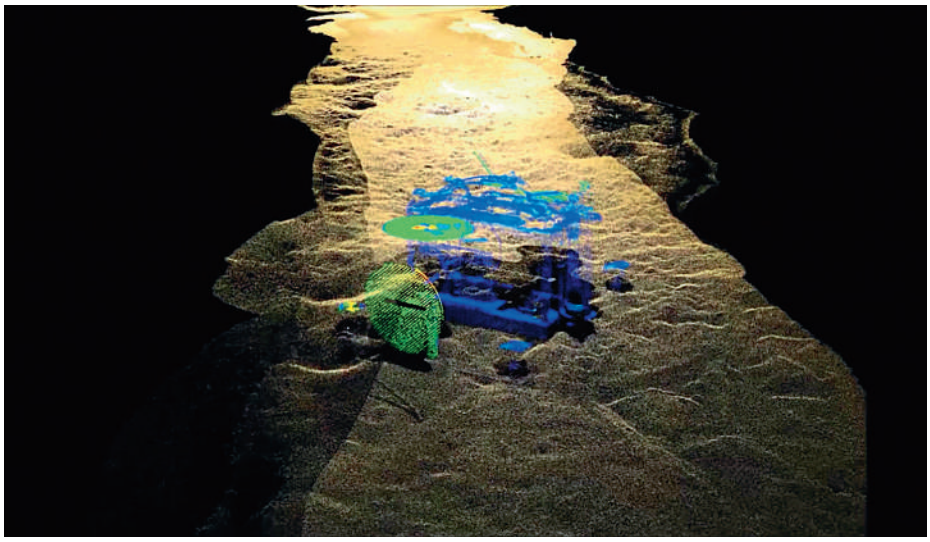


Surface laser mounted on a Tripod 'Faro' used for dimensional control survey of ROV © DOF SubseaSurface laser mounted on a Tripod 'Faro' used for dimensional control survey of ROV © DOF Subsea



Surveyor monitoring incoming data, 'Fusion' Sonardyne software © DOF Subsea

Picture from the ROV starting to scan structure © DOF Subsea



Point cloud image looking at the target (blue 'structure' and green 'flanges') © DOF Subsea