Motions of submerged structures

New underwater measurement system

Truss structure and underwater housing for K600 camera (Courtesy Krypton).

Motion measurements of submerged structures, such as underwater buoys, mooring lines, risers or flow lines, have always been somewhat problematic in model testing because accurate measurement systems are lacking.

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Underwater video camera recordings in combination with acceleration measurements are the conventional method for submerged models, but these techniques cannot always meet the required accuracy levels. Video images can only deal with the motions in one plane, whereas the accelerometers have difficulties with measuring slow oscillations or static offsets. In model testing the general trend is for more complex models, more measurements and higher accuracy. MARIN's new underwater motion tracking system directly addresses these issues.

Installation studies

The installation of offshore structures is another specific area where accurate underwater motion measurements on scale models are much needed. Subsea structures are hoisted down from installation vessels in increasingly deeper water. Accurate positioning of the structure on the seabed is paramount here but also the hoisting down itself or the passage through the free surface can be critical operations. The installation of a hybrid riser from a semi-submersible platform has been tested recently in the Offshore Basin for Petrobras. The free standing hybrid riser consists of a rigid riser, a submerged air can and a flexible jumper from the can to the production platform. The motions behaviour of the can and the riser during installation were thoroughly investigated.

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Installation model test of a hybrid riser from a semi-submersible.

Tracking systems

Measurements above water can be carried out with high precision in six degrees of freedom, using state-of-the-art motions tracking systems. MARIN uses the RODYM DMMrt system with three cameras fixed in one camera housing. A triangular target with three active LED markers on a model can be detected up to a four metre distance, with a accuracy of more than 0.1 mm and 0.1 degrees and a measuring rate of 250 Hz. Alternatively, a number of individual single markers can be detected with the same accuracy in three dimensions (no rotations).

The Krypton factor

Last year MARIN worked with Krypton Ltd. on the development of an underwater version of the active marker system. Fundamental research has been carried out on LED markers that can emit light of sufficient intensity for detection at larger ranges underwater. Other developments comprise the underwater housing for the camera, the cabling and proof-of-concept tests. The first prototype is now being built and will become operational in the second half of this year. One major development item is the placement of the underwater measuring system on the carriage (see illustration). MARIN