MARIN

Challenging wind and waves

Linking hydrodynamic research to the maritime industry

Operability of Ballasting and lifting operations of Extreme Loads with Integrated hydrodynamiCS

OBELICS

Experience shows that for complex operations at sea the human factor can be a very important contribution to the success of an installation of a topside. On the one hand, the success of offshore heavy lifting and float over installation concepts depends on technical aspects of the ballasting systems, cranes, heave compensation systems, etc which are all subject to the risk of failure. On the other hand, all these systems are operated by offshore personnel, who play an important role in controlling the dynamics of the operation.

Manual operation of the cranes and tugger wire winches in combination with the ballast sequences have an effect on the dynamics of the load during the installation. The interaction with a Dynamic Positioning (DP) system may play a role as well. For critical operations failure modes of the equipment should be indentified and mitigation procedures should be developed and trained for by the operators.

Many of these operations will be carried out only once and the consequences of failure can be substantial. Therefore the JIP partners support the need for a virtual reality training environment that allows practicing different scenarios of the same installation project.

Objective

The main objective of the OBELICS JIP is to develop and validate a framework for ballast and lift operations of extreme loads, incorporating all the relevant dynamics of this offshore operation. This methodology is integrated and visualized in a real time environment to verify and/or practice these type of offshore operations.

This real time simulator may mainly be used for training purposes of (special) operations, although it is likely that it will also be applied as an engineering tool for the preparation (design) of these operations in the engineering phase of a contractors project.

The main challenge to achieve this goal is that the (hydro mechanical) physics of the motions of the crane vessel are modelled correctly and that the operating crew can interactively control what happens in the simulation, preferably in a realistic setting. This approach closes the gap between running fast time numerical simulations to investigate the downtime and the actual operation where on-site decisions by the crew can determine the success of an operation.

Background and expertise

MARIN has been developing and using hydrodynamic simulation software for many years. Specialized tools were developed for specific areas: coupled mooring analysis, Dynamic Positioning, multiple-body lifting operations, riser dynamics, (damaged) stability analyses and offloading operations. These hydrodynamic models are benchmarked against model test results or, when available, full scale measurements.

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The OBELICS JIP proposes to link the expertise in the hydrodynamics field to the operator scenarios and the human interfaces used in our real-time simulation technology. This will allow the participants to train their operational crews in an interactive and realistic environment.

Scope-of-work

In total four Work Packages (WP) are defined within this project. Within these work packages a number of tasks need to be fulfilled. These packages are specified as follows:

- WP1: Development of the Lift- and Ballast technology
- WP2: Development of three relevant reference Cases and accompanying scenarios
- WP3: Simulations and Operability
- WP4: Verification, Validation and Reporting

The real-time simulation framework has been designed around open architecture with high flexibility and modularity. The present technology is in use on MARIN's full mission simulators, but also on compact or even desktop versions installed with many of our clients. Interfacing with various applications and/or devices is strongly facilitated.

The following functionalities will be integrated in the existing framework:

- Ballasting technology & knowledge
- Lifting technology & knowledge
- Mooring towing & anchoring module
- Crane operation, visualization (using TreeC's VR4MAX)

Recently a flooding module has been developed in MARIN. This module has been extensively validated. It uses the Bernoulli equations for (in)compressible media to simulate the flow of fluid and air through the geometry. It is capable of handling air compression effects on the progress of flooding. This knowledge and technology will be strongly integrated in the development of the OBELICS ballasting module. A number of new features and functionalities shall be implemented. As a consequence the following components can be modelled by the user:

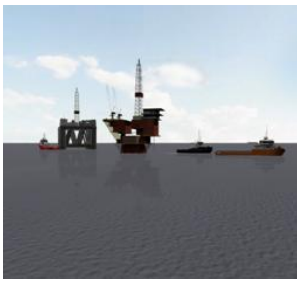
- Ballast tanks
- Valves
- Pumps
- Pipes
- Nodes

Furthermore a number of Graphical User Interfaces (GUI) will be implemented to actively control the operation:

- Generic GUI to handle ballasting operations
- Generic GUI to handle lifting tasks
- Generic GUI to introduce equipment failures

In close collaboration with all participants three cases will be developed, verified and validated. All partners in the project will assist in the development of the cases. This assistance can consist of the

implementation and verification of the developed software with existing engineering tools. Furthermore 3D content needs be prepared to create a realistic scenery for the real-time simulations.



Validation of the OBELICS modules is presently foreseen with available logged full scale data and feedback of operators on their experiences during the simulated scenarios.

Deliverables:

Presently the following project deliverables are specified within the JIP:

- Technology
  - Available as a facility at MARIN
  - Available in license free OBELICS simulator
- Reports on findings, results of verification & validation
  - Results of benchmarking and case findings
  - Applicable area for operability studies
  - Applicable area for operator guidance and training
  - Applicable for FMEA and mitigation training
- Right for a single license free OBELICS (desktop) simulator
- Description of the mathematical models of all developed modules

Participants

The following participants are involved in the OBELICS JIP:

- BigLift
- Heerema Marine Contractors (HMC)
- Jumbo
- MARIN
- Seaway Heavy Lifting (SHL)
- Smit
- Statoil
- Scaldis

More Information

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