WORK PACKAGE 1.1
TUG ASSISTANCE

EFFORTS WP* 1.1 Tug Assistance aims at improving the realism of the simulation of tug handling in ports and terminals for the benefit of training of pilots and tug masters in safe handling of ever increasing ship sizes, new and more powerful and complex tug types, increased traffic in ports and other challenges to the operators. Furthermore, an increased realism in the simulations will accelerate the training of new mates as a valuable supplement to on-board training.

The Work Package has three main objectives.

- Development of a tug simulator for selected critical functionalities
- The validation of these functionalities by experienced tug masters
- Application of the simulator in case studies in one or more of the participating ports, with focus on the cooperation between tug master and pilot.

Furthermore, the results of WP1.2 and 1.3 are integrated into the tug simulator.

WP1.1 – The Results

- Implementation of stereo vision system for improved depth perception at close distance from assisted ship, with improved visual effects
- Realistic simulation of the effect of wave action on the bollard pull, taking into account the wave height, period and relative direction
- A realistic model of a Rotor Tug equipped with three individually controllable azimuthing thrusters
- A full 3-D collision and fender module, which detects collisions at arbitrary points of the tug with the assisted ship and calculates the fender forces in three directions
- Implementation of lee zones for wind, current and waves moving with the assisted ship
- Integration with the Portable Pilot Unit and Onboard Display Unit developed in WP1.2.
- Integration with the Port ECDIS developed in WP1.3
- A portable tug simulation system, which may be carried to the involved ports for demonstration

* Work Package

Tug simulation

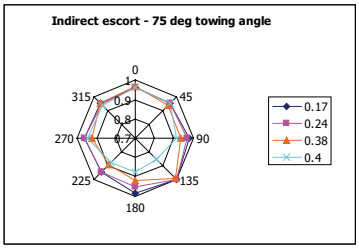
Advanced tug simulators are being increasingly used for training of tug masters and pilots and for navigational studies of new ports and terminals. The days are gone where the tug effect is just added as a vector force acting on the assisted ship and controlled by the simulator instructor. Modern state-of-the-art tug simulators are sophisticated, fully equipped tug bridges with realistic 6-DOF models behaving closely matching that of the real tug.

Yet, there is still room for increasing the realism of even the most sophisticated tug simulator, and this is one of the objectives of this Work Package of the EFFORTS project.

Depth perception

The lack of depth perception in simulators implies that it is impossible for the tug master to accurately judge the distance between the tug and the assisted ship when the tug approaches the ship to pick up a line or to push on the side. These operations are critical for the safety of the tug, so the ability to judge the distance as accurately as in the real situation would be a great asset. Several systems were tested, including projection solutions, monitors and head mounted displays (see photo). The latter system, produced by Cybermind, was judged to be the best, even though it still suffers from a too narrow field of view to be fully acceptable. Other methods to improve the judgement of distance are being tested, including e.g. the use of different textures on the models.

Wave and lee effects



The relatively small tug and the large assisted ship behave very differently in waves. Therefore, the correct simulation and visualisation of wave motion response of the involved ships is very important, including the effect of the larger ships bow wave on the smaller tug. An improved solution of these effects is developed under the project, as well as the effect of the wave action on the tug's bollard pull, which has a direct effect on the tug's ability to assist the larger ship. The presence of the larger ship will influence the action of wind, current and waves on the tug, depending on the relative position of the tug. This effect is also developed under this project.

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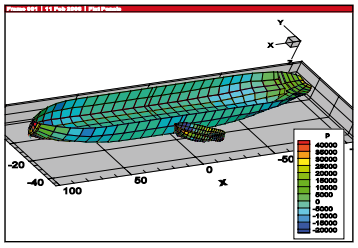
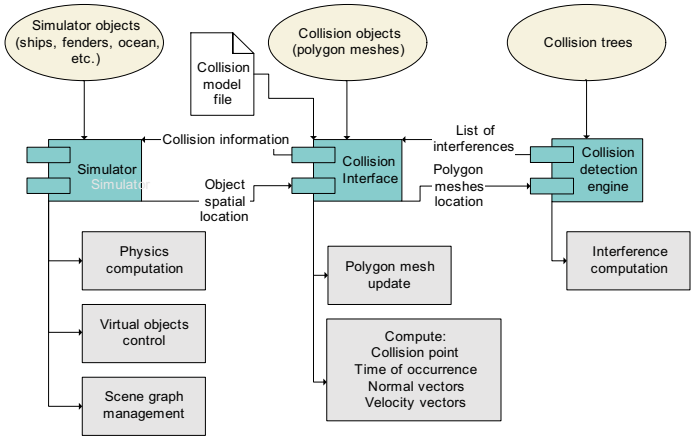
Ship-ship interaction



When a tug is operating close to a large assisted ship it is influenced by the pressure and wave field generated around it, so-called hydrodynamic interaction forces. These forces may be large and sometimes cause dangerous situations for the tug. The aim is to implement a real-time calculation of the interaction forces by a potential flow solver linked to the simulator. The code has been developed for deep water and fixed surface and a parametric study has been performed to assess which gridding is necessary to generate sufficiently accurate results. Calculation results have been compared to model measurements of the interaction forces and look good except for some cases, which display the shortcomings of the potential flow and fixed surface assumptions. Further work is being done to try to overcome these.

Collision and fendering

When tugs work in waves and push the side of the large assisted ship, large vertical friction forces may be generated which may destroy the tug's fender. Such forces are not considered in present day's simulators. A fender simulation module is developed, which determines both the push force and the longitudinal and vertical friction force. In addition, the collision module will detect a collision where other parts of the tug than the fender will be in contact with the assisted ship. A side result of this module is that it may be used to simulate a grounding and a salvage operation.



Integration with PPU, ODU and Port ENC

The Portable Pilot Unit is becoming more and more used by pilots worldwide, so it will be a natural element to include in the simulator training of pilots. Therefore, the PPU has been integrated to the FORCE Technology simulators and is being used regularly in training. The Onboard Display Unit, which is also being developed in WP1.2 will assist the tug master in judging the scene of operation and will also assist him in judging the distance between his tug and the assisted ship. Present day's simulators often include a bird's eye view on the bridge for exactly that purpose and the introduction of the real equipment will make this even more realistic. The Port ENC dataset developed for the Port of Hamburg has been implemented in the simulator.

Demonstration simulator

A portable simulator system comprising two tug bridges (e.g. ASD and Rotor tug) and an assisted ship's bridge has been developed for testing and demonstration of the developments in the EFFORTS project. The system uses the head mounted displays for the tugs and a monitor for the visual display on the assisted ship. The system may be demonstrated at the participating ports. It requires only that a model of the specific port is implemented, either using a standard ENC dataset or a Port ENC dataset if this is available.

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