Practical solutions to chal

Now approaching its 15th year, the CRS manoeuvring group has become a front runner in addressing steering and manoeuvring issues and coming up with practical solutions. Report looks at how the group has steered a path to success.

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For many years the CRS manoeuvring group has investigated the various aspects of steering and manoeuvring and as the group has existed for nearly 15 years, the focus of attention has shifted constantly in a bid to answer the market demand of the time. Available technology has been matched with market demand and as such, the group has established itself as a front runner in the development of practical manoeuvring solutions. At the same time, the group has kept in contact with other international groups as ITTC and the IMO. Although the group is, in principle non-permanent, new projects are raised continuously, always providing fresh projects.

Manoeuvring tests on a segmented model.

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Meeting the challenges

Initially, the group started by investigating the course-keeping abilities of ships with pram-type afterbodies. After this, a rudder design manual was developed – a guide for ship designers on the required size, shape and type of rudders, related to the ship design they were working on. A Manoeuvring Prediction Program (MPP) followed very quickly after that.

A key issue was to develop well-validated software so that members could judge whether the software was applicable to the design under consideration. After a study on the validity of the predictions for full block vessels, it was decided to embrace the (at that time new) cross-flow, drag theory. The aim here was to improve the prediction accuracy for full block vessels. A series of segmented model tests on various vessels was carried out and this led to an improvement in this theory.

The next challenge concerned the manoeuvrability prediction of twin screw vessels. Special attention was paid to the design of skegs and the minimum required rudder areas, as well as heel angles. Eventually, the investigation found that the propeller-rudder-hull interaction was extremely important for twin screw vessels (open shaft or twin gondola). Model tests, again, gave much insight into the fundamentals of this physical phenomenon.

Twin screw to podded vessels

Podded vessels were next on the agenda. Until then full-scale and model-scale tests had largely concentrated on cruise ships and ferries. However, the group wanted to investigate other vessel types. Two aspects were considered: the hull-to-pod interaction and the different hull shapes that can be deployed for podded vessels. Besides the application of model tests, also CFD (RANS) was used as a tool to investigate the flow around the vessel. By combining the CFD, model tests and full-scale results, enough insight was obtained to be able to create a good prediction tool. An extensive set of

lenging steering problems

Millennium while performing manoeuvring trials. Courtesy ALSTOM Marine Yves Guillotin.

full-scale measurements was brought together by the members (in total involving 12 podded vessels) so that the manoeuvring predictions could be validated. The results corresponded very well and the predictions could accurately discriminate between course stable and course unstable vessels. Lastly, a new, more advanced theory was embraced to calculate the hydrodynamic lift coefficients of arbitrary hulls. The impact of hull form details on manoeuvrability can effectively be brought into account. The influence of shallow water is also considered to a certain extent, using relatively simple approximations, valid for a limited water depth but not in extreme shallow water.

Validation of the theory

But above all, the most important point of attention for the working group has always been the validation of any theoretical findings. Validation studies are carried out on a large series of vessels, typically 50 to 100 vessels. Prior to any new development, its relevance is checked with a conceptual study and the success or failure is checked with a validation after the theoretical development. This approach has always ensured that the tool remained practical for the users and that no unnecessary expensive theoretical investigations are carried out. The circle of increasing accuracy and validation is repeated continuously, which makes the research very cost-effective.

Attention to low speed manoeuvrability

The most recent development is the study of low speed manoeuvring capabilities. A tool has been developed to quantify low speed manoeuvrability and to determine which aspects should be studied and later developed. The tool has been benchmarked against full-scale, trial results obtained on the Millennium class of cruise vessels. Results have been encouraging and the scope of work has increased to include a larger variety of ship-types and operational scenarios. In the coming years, this study will be completed.

Practical solutions

By having members present from both the theoretical and practical side of the industry, from research institutes, ship yards, operators to classification societies, a practical application of the available knowledge has always emerged. Undoubtedly, this is one of the strongest points of the collaborative research in the manoeuvrability group. For the CRS manoeuvring group theory is not enough, the group prides itself on offering practical, pragmatic solutions, that can be put into use by CRS members. MARIN