Motion/Ride Control systems

MARIN answers

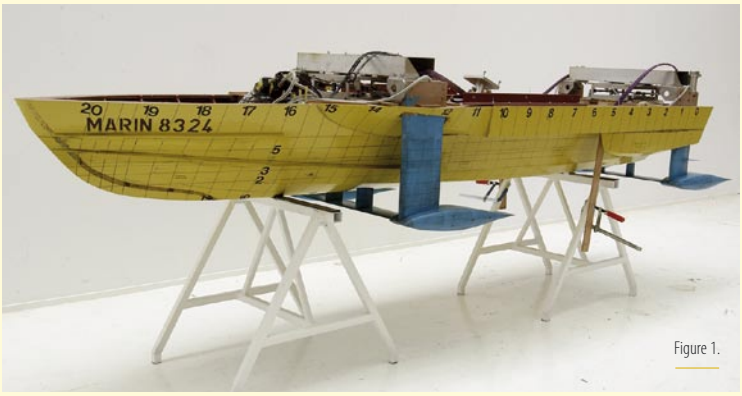

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Figure 1.

Due to development in industrial countries and world population growth, the need for high-speed passenger transport and time-sensitive goods has increased. At the same time, there has been increasing demand for improved comfort levels for passengers and crew and for safety of navigation and operation.

Frans van Walree &
Frans Quadvlieg
F.v.Walree@marin.nl
F.Quadvlieg@marin.nl

Advances in naval architecture, manufacturing technology, material development and high-speed computing, have enabled the development of high speed water transport. As a result of this, MARIN has witnessed during the last decades an increasing demand for research and concept development on motion and/or ride control systems, especially for fast ships. How is MARIN meeting this demand?

For MARIN, these developments have imposed a number of challenges and requirements in terms of experimental facilities, instrumentation and for the development of numerical tools.

A major breakthrough in experimental facilities was the opening of the Seakeeping and Manoeuvring Basin, back in 1999. This facility enables high-

for fast ships

increasing demand

speed testing in calm water and in "high-quality" waves. Testing is particularly efficient for stern quartering seas where issues such as course-keeping, broaching, dynamic stability and surfing/bow diving, are important.

Crucial development – the ride control system

A development vital to performing model tests on fast ships is the ride control system. Actuation mechanisms must be small enough to fit into the model-scale control surface and must have sufficient power to accurately and quickly respond to control actions. In-house developments in electrical control technology have enabled MARIN to meet requirements in this respect. Advances in PC technology have enabled the development of high-speed control loops that minimise the time delay between motion sensing and control surface actuation. As time runs faster at model-scale than at full-scale, this is an important requirement. Finally, performing model tests with the ride control system exactly as it is used on the real ship is made possible because of the modular design of MARIN's measurement and steering system. This option is used increasingly frequently by control system manufacturers, when the systems are complex and when confidentiality issues play a role.

Structural loads

As has been the case in the past, fast ships need to be as light as possible and the lightest structure will always be the preferred option. To obtain engineering data for construction, more and more models are equipped to measure structural loads. To obtain engineering data for construction purposes, models are equipped to measure hydrodynamic loads by means of an instrumented beam mounted in the segmented model.

Pre-model test calculation tools

On the numerical side, advances in computation methods and computer speed have led to the availability of a range of computer programs, each with their own specific use for the various stages in ship design and for preparations of model test programs. Computer programs range from SHIPMO (strip theory) and PRECAL (frequency domain panel method) which gives a quick insight into the motion characteristics with basic motion control systems such as fins, to more advanced semi non-linear time domain methods, such as PRETTI and PANSHIP. The last method includes fins, T-foils, interceptors, trim flaps and steerable water jet propulsors and is capable of including interaction between control surfaces and the hull. The time domain method FREDYN, developed within the Cooperative Research Navies group, is one of the few methods which allows for course-keeping and manoeuvring in waves in extreme conditions, with motion/ride control system assistance.

An example of a PANSHIP application is given in Figures 1 to 3, which show a Blended Wing Body (BWB) model which is a Navatek design for Northrop Grumman Ship Systems, with movable cross foil flaps, strut

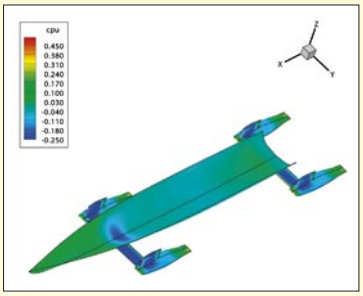

Figure 2.

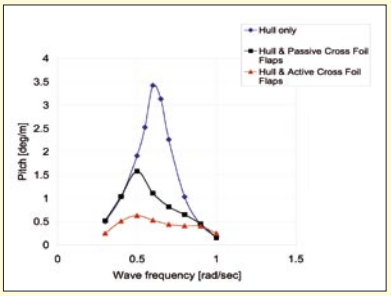

Figure 3.

rudder flaps and steerable water jets. The merits of the ride control system for high-speed head sea conditions are depicted in Figure 3, while the detailed pressure distribution plot in Figure 2 shows the interaction effects between the BWB and the hull bottom. These results have been obtained from PANSHIP simulations.

MARIN certainly sees a healthy future for its high-speed tools as demand continues apace. A development which started in 1965 with MARIN's High-Speed Basin, continued in 1999 with MARIN's new Seakeeping and Manoeuvring basin. The continuous amount of work in the basin for fast ships demonstrates that there is a big demand from the industry for the engineering of ride control systems for fast ships. The combination of the Seakeeping and Manoeuvring Basin, advanced ride control systems at model scale and powerful prediction tools, allows MARIN to fulfil the needs of the industry.