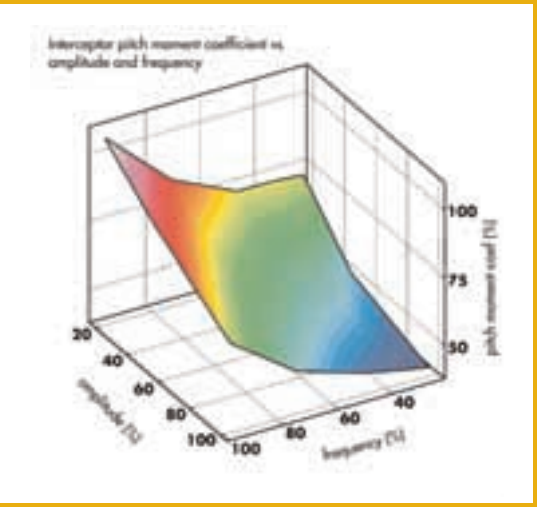

(Figure 1) Amplitude and frequency dependence of the pitch moment due to interceptor oscillations.

An outline of the HSF-ARCoS (Advanced Ride Control System development for a High Speed Ferry) project, with a special focus on MARIN's role in the development of numerical models and tank testing.

MARIN plays key-role

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PMM tests under heel angel.

MARIN, along with other leading companies, is playing a key-role in the HSF-ARCoS project which is designed to limit seasickness and strain to cargo lashings on high-speed ferries operating in relatively unprotected waters.

A high-speed ferry designed by Dutch shipyard Van der Giessen-de Noord N.V. in co-operation with Advanced Multihull Designs of Australia will be the recipient of the HSF-ARCoS system. The RoPax ferry, with a length of about 140 m and a design speed range of 40 to 50 knots, is set to operate in relatively unprotected waters which makes it an ideal candidate for such a system.

The operability of the ferry should not be drastically limited by its behaviour in a seastate; it is mainly determined by waves introducing accelerations which can cause seasickness and inflict high loads on cargo lashings.

The HSF-ARCoS project, which is partially funded by the Dutch Ministry of Economic Affairs, has been initiated by Van der Giessen-de Noord N.V. Other participants are Imtech Marine & Industry, Det norske Veritas, as well as MARIN. Imtech Marine & Industry will develop ARCoS, while DnV acts as a general consultant and it will validate experimental and calculation results.

Report gives an overview of MARIN's involvement in the project, with a special focus on the development of numerical models and tank testing.

Wasco and Gulliver prove useful tools

MARIN's first task was to perform operability analyses for the vessel, with and without ARCoS. Two routes were considered, one crossing the Irish Sea between England and Ireland and one from Northern France to Ireland.

Two tools were used - Wasco and Gulliver. Wasco performs an analysis based on global wave statistics and provides the average sustained speed and inoperability percentages, while the Gulliver tool

in HSF-ARCoS project

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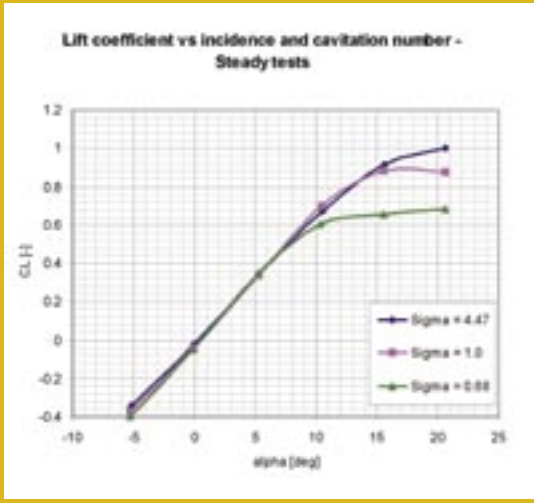
uses actual hindcast data for wind and waves and produces time domain results. These results can be analysed to produce a wealth of operability data, for instance the variation in trip duration due to both voluntary and involuntary speed reductions. Such data may be of high interest to operators for scheduling routes.

A second task was the setting-up of a mathematical model for the ARCoS equipped ferry design. It is a time domain model based on a strip theory analysis of the ship's motions. It will be used by Imtech to design the ride control system. Control surfaces include fin stabilisers, T-foils, trim flaps and interceptors. The ride control system will be integrated with a manoeuvring system, actuating steerable waterjets and possibly also trim flaps and interceptors.
Furthermore, the integration of a wave feed forward module is part of this study. This module translates, for instance, local wave height information into instantaneous wave excitation forces which are then fed into the controller to enhance its effectiveness.

Dedicated model tests

Dedicated model tests have been carried out in order to derive the characteristics of trim flaps and interceptors for use in the mathematical model. Hereby the ship model was towed in a captive mode while the control surfaces were oscillated with varying amplitude and frequency to establish the forces exerted on the model. Figure I shows the amplitude and frequency dependence of the pitch moment due to interceptor oscillations. Following these tests, drift angle and PMM tests have been performed to derive a mathematical model for manoeuvring. Steering forces due to a set of waterjets were measured as well.
With respect to the characteristics of T-foils it was deemed necessary, in view of the high speed, to determine cavitation effects. Cavitation observations and force measurements have been obtained for a generic T-foil model in the cavitation tunnel. Figure 2 shows that cavitation effects can be significant indeed.



(Figure 2) Cavitation effects.

The control surface and manoeuvring models are also included in a non-linear time domain simulation tool, which will subsequently be linked to the Imtech ride control system running on a separate computer. This enables Imtech to test the control system prior to model testing in MARIN's Seakeeping and Manoeuvring Basin later this year. During the model tests the control surfaces of the free running ship model will be connected to the developed ARCoS computer. Both seakeeping and manoeuvring tests will be carried out as a part of this project.

In a final stage of the project resistance tests will be carried out to obtain the optimum mean settings of the control surfaces used.

MARIN

Steering and control devices.

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