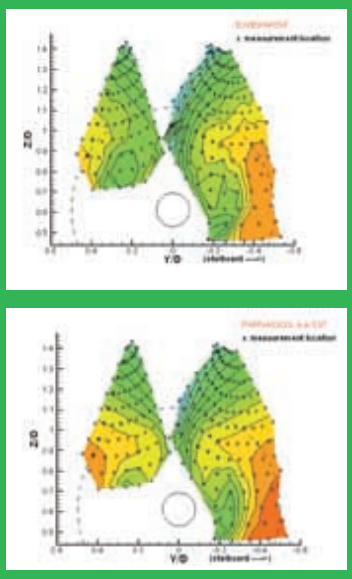
December 2005 saw the successful conclusion of the three-year European Full-scale FlOw Research and Technology (EFFORT) project, a 5th Framework EU project initiated and coordinated by MARIN. Principal objective was to validate CFD predictions of viscous flow and wake field of ships by comparison with experimental data for full-scale. Such data being scarce, new measurements of wake fields of two ships at full scale have been done.



Axial wake field for one of the existing cases, as measured (top) and as computed using PARNASSOS (bottom).

Full-scale CFD validation project completed

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EFFORT pays off

Full-scale flow measurements were conducted by MARIN, for 'Nawigator XXI', a single-screw research vessel of the Maritime University of Szczecin, and 'Uilenspiegel', a hopper dredger of Dredging International; a twin-screw vessel with bossings, exposed shaft hoses, shaft support struts and ducted propellers. A dedicated LDV system was used, operating through windows flush-mounted in the hull. As usual, these measurements were not without problems, due to environmental conditions and other complications; but the data obtained form a valuable addition to existing material.
Parallel model experiments were carried out, including pitot measurements by HUT, PIV measurements by CTO and wave pattern measurements using a laser sheet technique by NTUA.

On the CFD front, RANS computations were requested for full-scale Reynolds numbers. For some methods this was a challenge in itself, the extreme grid density at the hull surface causing problems with convergence or stability. However, most codes passed the test and could be further extended and applied. Developments were done on modelling the propeller action, comparing turbulence models and including the wave pattern. An internal EFFORT workshop compared results and stimulated improvements of the accuracy and applicability of several codes.

All model and full-scale experimental data, for the two new ships and five existing ones, were then used to study the achievable level of accuracy of the predicted wake fields at full-scale, to decide on the best turbulence models and to find out desired extensions of the methods. Finally, the codes were used in case studies for practical applications, in cooperation with the industrial participants.

Several of the CFD codes were found to predict the full-scale flow relatively accurately, provided dense grids were used. For MARIN, the validation confirmed that its PARNASSOS code consistently gives good wake field predictions, with no obvious deterioration for full-scale flows. Already some further improvement has been achieved by a change of turbulence model; while for a case like the dredger, incorporation of propeller ducts is a desired step. The full-scale predictions for practical projects, already frequently made, thus may play an even larger role soon.

EFFORT certainly lived up to its name; ambitious goals were set at the start and not all could be achieved. But definitely an important contribution has been made to the practical use of CFD for prediction of the full-scale viscous flow and propeller action.

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