PhD positon:
Computional Fluid Dynamics- Numerical Modelling of the dynamics of vortex cavitation on ship propulsors and pump impellers

The challenge

You will work on the development of a numerical simulation method capable of accurately predicting the dynamics of cavitating vortices from ship propellers and pump impellers. It is believed that the only way to accomplish this goal is to use the Large Eddy Simulation (LES) methodology for the modelling of the turbulence occurring in three-dimensional, unsteady, cavitating vortical (swirling) flows. Based on earlier work on numerical simulating unsteady (sheet) cavitation performed in the group Engineering Fluid Dynamics, a thermodynamic (energy-based) cavitation model will be used.

In this approach the governing equations are identical to the equations of the flow of a compressible fluid, augmented with equations of state which include phase transition due to cavitation. Hence it is not necessary to use interface tracking, which a a tremendous advantage in terms of complexity of the computational method, especially for implementation on parallel computing platforms, the target machines to perform the numerical simulations in this project.

Your research tasks will include the following:

- To apply energy-stable and/or symmetry-preserving discretization techniques to inviscid cavitating flows around three-dimensional hydrofoils.
- Implement the Large Eddy Simulation filtering and validate it for turbulent cavitating vortical flows.
- Carry out predictive simulations for industrial relevant geometries identified and defined in direct collaboration with the participants from industry in the project.

Background

Project

Cavitation is a phenomenon which has a negative impact on performance as well as lifetime of ship propulsors and pump impellers. Furthermore, it can lead to uncomfortable noise levels for both the crew and passengers. As it is (probably) not possible to avoid cavitation completely, it is important to understand the physical mechanisms causing cavitation such that its negative impacts can be controlled. At the moment these physical mechanisms of (vortex) cavitation are not well understood and the aim of this research is to increase this knowledge. If successful this can lead to more efficient ship propulsors and pump impellers.

Involved parties

This project is financially supported by SenterNovem within the Maritime Innovation Research Program, IOP Maritime. It is a collaborative project involving TU Delft, IHC Merwede (designer and manufacturer of dredger ships), Wartsila (designer and manufacturer of ship propulsion systems) and Flowserve Corporation (designer and manufacturer of centrifugal pumps).

Research group

The Group Engineering Fluid Dynamics (EFD) of the Faculty of Engineering Technology (CTW) of the University of Twente, the Netherlands (http://www.ts.ctw.utwente.nl/) is embedded in IMPACT (Institute of Mechanics, Processes and Control Twente, see http://www.universiteittwente.nl/research/impact), one of the the interdisciplinary Spearhead Institutes of the University of Twente, and participates in the J.M. Burgers Center for Fluid Mechanics (JMBC), the research school for fluid mechanics in the Netherlands (http://www.jmburgerscentrum.org).

Profile

You are a dedicated researcher who would like to contribute to decrease the noise levels in ships. You have an MSc or comparable degree in engineering or applied mathematics, preferably combined with demonstrated skills in the fields of fluid mechanics, CFD and mathematical modelling. You will are required to have a good command of the English language. You like to work in a team. Programming experience in C++ and MPI will be advantageous.

Offer

We offer you a temporary position for a period of four years. Gross monthly salary for the PhD position ranges from € 2.042,- gross per month in the first year up to € 2.612,- gross per month in the fourth year.

In addition to this, we offer a holiday allowance (amounts to 8%), an end-of-year bonus of one month salary, and other fringe benefits.

Information

For more information please contact prof.dr.ir. H.W.M. Hoeijmakers: e- mail: h.w.m.hoeijmakers@utwente.nl or dr.ir. E.T.A. van der Weide, e-mail: e.t.a.vanderweide@utwente.nl

Application

To apply for this position please send your statement of professional interests, full curriculum vitae, and names and addresses of references to e- mail: personeelszaken@ctw.utwente.nl.

Applications will be considered until the position is filled. Screening of applicants will start on December 15, 2010. Nominations and applications will be considered until the position is filled.