Faculty Engineering Technology
Program Mechanical Engineering

UNIVERSITY OF TWENTE.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of his MSc thesis assignment

J.C. Willemsen

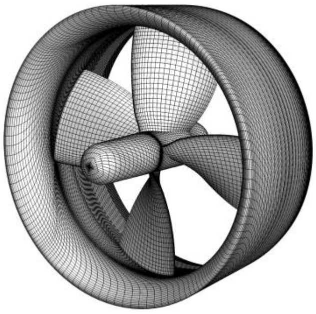
will give a presentation, entitled:

Improving Potential Flow Predictions for Ducted Propellers

Date: Friday December 13, 2013

Time: 09:30

Room: **Horstgebouw N.109**



Summary:
The advantages of propulsion systems using a thrust generating duct around a propeller are well known in naval architecture. A ducted propeller is often employed to increase the efficiency and thrust of a high loaded propeller. The accelerating duct can contribute to 50% of the propulsor total thrust at zero ship speed.

There is still a lack of fast and accurate hydrodynamic prediction methods for the design phase of ducted propellers. Model tests are expensive, while computations based on the Reynolds-averaged Navier-Stokes (RANS) equations require long CPU times, therefore these approaches are not yet routinely used in the design process of propulsors. Currently the design process is mostly based on the use of potential flow methods, like the MARIN Boundary Element Method (BEM) PROCAL. This method is efficient and is able to deliver accurate predictions of the forces acting on open propellers, but it is less accurate when viscous effects become important such as is the case for ducted propellers.

The goal of the present research is to investigate the flow around a ducted propeller using the MARIN in-house-developed RANS method ReFRESCO, with particular emphasis on the influence of the viscous effects such as boundary layers, tip vortices and flow separation on the duct. The results obtained with RANS are used to improve the prediction of PROCAL.

Finally a coupling between PROCAL and ReFRESCO is accomplished to include the viscous effects in an efficient way. The viscous flow over the duct is analyzed using ReFRESCO, in which the propeller action is represented by body forces added to the right-hand-side of the momentum equations. These body forces are obtained from a PROCAL computation for the ducted propeller in which the propeller is represented as a discrete number of blades. Results of this approach show a good agreement between experiments and the numerical simulations: the forces differ less than 1% around the design point of the ducted propeller.

Assessment committee:
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d.d. _______________