Faculty Engineering Technology
Program Mechanical Engineering

University of Twente.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of his MSc thesis assignment

Friso Meindert Jan Bergsma

will give a presentation, entitled:

Development of Computational Fluid-Structure Interaction Method for Yacht Sails

Date: Thursday March 14th, 2013

Time: 12:00

Room: Waaier 3

Summary:
Currently most procedures for sail design (planform, camber, cloth selection) are based on experience. Mostly crude analytical models and models based on a regression of previous wind tunnel tests are used to predict the lift and drag forces on sails. In the analysis of the aerodynamic performance of sail designs only a few designers use computational methods, usually based on potential flow methods for predetermined shapes. Since the deformation of the sail due to aerodynamic loads can be substantial, improvements in the prediction of the aerodynamic performance of sails can be achieved by using Fluid-Structure Interaction (FSI) analysis.

In the present study an FSI method for sails has been developed. In this FSI method the pressure field around the sail is determined using CFD software ISIS, a computational method based on the Reynolds-Averaged Navier-Stokes Equations (RANSE). The computed pressure field serves as input for a basic structural model implemented in the FEA package Femap, which determines the deformation of the sail under aerodynamic load. In an iterative procedure the distribution of the surface pressure and the deformation of the sail attain a stable equilibrium. The aim of the FSI method is to determine the steady flying shape of the sail and to obtain the aerodynamic forces generated by the sail, taking into account the deformation of the sail.
Both a method for 2D sail sections and a method for 3D upwind sails are presented. These methods are capable of determining the steady deformation of the sail. The results of the method for 2D sail sections are compared with a set of experimental data. This shows that the deformed shape of a 2D mast and sail section compares satisfactorily with measured data for various combinations of slackness and angle of attack.

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