Faculty Engineering Technology
Program Mechanical Engineering

University of Twente.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of his MSc thesis assignment

Niels A. Platenkamp

will give a presentation, entitled:

Optimization of Pump Designs using Surrogate Models

Date: Wednesday January 16, 2013

Time: 14:00

Room: **ZH 286**

Summary:
The process of designing a centrifugal pump is complex. Designing such a pump can be achieved by design iterations using flow simulations based on potential flow methods or on methods solving the Reynolds Averaged Navier Stokes (RANS) equations. In an engineering environment optimization to increase the performance is usually done by varying one design parameter at a time. The skill and experience of the engineer greatly influences this process and the resulting design might be far from the best solution. Over the years, several automated optimization routines have been developed to assist the engineer to obtain good designs. So far the utilization of these tools has been mostly limited to the hydraulic design of the impeller, not incorporating losses occurring in other parts of the pump.
In this study an optimization routine is created for optimizing pump designs. A Genetic Algorithm coupled to a RANS method is employed to find the global optimum within the created design space for a given objective function. A surrogate model is implemented to speed up the design process and to limit the number of CFD evaluations required. A surrogate model is the use of mathematical models to approximate the objective function in the design space, so that the genetic algorithm can rapidly find the global optimum without having to carry out a large number of computationally expensive CFD calculations. In the present study several surrogate models have been evaluated. Based on accuracy and usability in optimization, the best model has been chosen.
Two optimization routines have been developed and results have been compared. The first optimization routine represents the standard design optimization of the impeller. It limits the optimization to the hydraulic efficiency of the design only. The second optimization routine incorporates losses that occur in other parts of the pump into the optimization. To achieve this, the pump performance has to be evaluated at multiple flows, increasing the computational cost of the optimization. The results of both optimization methods are compared and evaluated. From this it can be concluded whether optimization including losses is worth the increased computational effort.

Assessment committee: **Chairman,**

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