Faculty Engineering Technology
Program Mechanical Engineering

University of Twente.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of his MSc thesis assignment

Twan Verweij

will give a presentation, entitled:

Adaptive Finite-Element Method for solving the Kinetic Equation of Condensation

Date: Friday March 9, 2012

Time: 14:00

Room: Zuidhorst 286

Summary:
The numerical prediction of the droplet size distribution in single-component condensation is most accurately obtained with the kinetic equation. This equation is a balance equation for the droplet size distribution. This equation has to be solved for every single droplet size in the distribution, which results in an extremely large system of (10^8) equations.
In the past a number of attempts have been made to reduce the computational effort to solve for the droplet size distribution. One of these is the splitting of the droplet size distribution in a limited number of so-called bins, which greatly reduces the number of equations to be solved, but at the cost of an interpolation error. Other attempts have been made by utilizing moments of the droplet size distribution. This Method of Moments (MoM) predicts the droplet-size averaged properties of the condensating flow. The main difficulty of the MoM is finding a proper way of solving its inherent closure problem. As a consequence the error cannot be estimated beforehand, i.e. the accuracy of the method is difficult to assess.
Therefore a new approach has been devised to approximate the droplet size distribution, based on the Galerkin finite-element method, enhanced with an adaptive node triangulation algorithm in order to increase its accuracy. This algorithm adapts the location of the nodes in the size distribution to the solution of the system of ODE's using the equi-distribution principle, a method previously used for (continuous) grid adaptation.
The method is applied to a model advection problem and a model diffusion problem for a variety of imposed initial and boundary conditions. Finally, in order to complete the proof of concept, the adaptive finite element method is applied to a nucleation pulse experiment.

Assessment committee:
Prof.dr.ir. H.W.M. Hoeijmakers (chairman)
Dr.ir. R. Hagmeijer (mentor)
Dr.ir. A.H. van den Boogaard
Dr.ir. D.S. van Putten
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d.d.