Faculty Engineering Technology
Program Mechanical Engineering

UNIVERSITY OF TWENTE.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of his MSc thesis assignment

M. Haspels

will give a presentation, entitled:

Predicting the Motion of an Elongated Bubble Moving in a Liquid-Filled Channel employing a 1D Two-Fluid Model

Date: Thursday January 29, 2015

Time: 10:00

Room: **Horst Building Room OH-114**

Summary:
The bubble drift velocity is the velocity of an elongated bubble that moves into a stagnant liquid in a pipe or channel. Accurate prediction of the bubble drift velocity is required for predicting the flow behaviour of two-phase flows in industrial applications, such as the flushing process of pipelines
Previous research validated the use of CFD for the simulation of elongated bubbles moving in 2D and 3D viscous flows. However, in the petrochemical industry, simulation tools for 1D flows are often used because of their lower computational costs. The goal of the present study is to investigate the effect of viscosity on the motion of an elongated bubble by developing a numerical method for such a 1D two-fluid model. This research has been carried out in Shell's multiphase flow team at the Shell Technology Centre Amsterdam.

The 1D two-fluid model is discretised in space by employing the finite-volume method on a staggered grid, using a high-resolution scheme for the convective fluxes. Implicit time integration is conducted utilizing the Backward Euler and BDF2 scheme. A method has been developed to handle local single phase flow regions, i.e. transitions from two-phase flow to single phase flow and vice versa. The numerical method is verified by simulations of the classical dam-break problem and by employing the Method of Manufactured Solutions.

The predictive capability of the method to simulate elongated bubbles moving in an inviscid liquid is assessed by considering the Benjamin bubble, an exact solution to the Navier-Stokes equations for inviscid, incompressible flow.
It is concluded that the Benjamin bubble is not a solution to the two-fluid model. In its standard form the two-fluid model cannot predict the correct bubble drift velocity. This finding is in contrast to the results from 2D CFD which does predict the Benjamin bubble solution.
Therefore an improved two-fluid model has been investigated, with which the Benjamin bubble can be predicted successfully. Subsequently, the effect of viscosity on the bubble is investigated by constructing a new friction model based on introduction of velocity profiles in the liquid and in the gas. The bubble drift velocity obtained by this new two-fluid model is then compared to the bubble drift velocity as predicted by 2D CFD results.

Assessment committee:

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d.d. _______________