Faculty Engineering Technology
Program Mechanical Engineering

UNIVERSITY OF TWENTE.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of his MSc thesis assignment

Adnan Rajkotwala

will give a presentation, entitled:

Coupling Methods for Dynamic Well Reservoir Interaction

Date: Friday August 28, 2015

Time: 13:00

Room: **Horst Building Room ZH 286**

Summary:
Accurate simulation of multiphase flow of oil and gas in reservoirs and wells in the petroleum industry is important for safe and proficient operation. In these well-reservoir systems, transient phenomena can occur due to changing natural phenomena or due to changes in the control parameters of the production facility, leading to unwanted flow instabilities. In this thesis work, the focus is on simulating coupled well-reservoir systems to understand such instabilities.

The project has been carried out in the multiphase flow team at Shell Technology Centre, Amsterdam. Shell's in-house single phase, one dimensional, implicit well and reservoir simulators are used. Different coupling mechanisms (partitioned/monolithic) have been studied, based on how the information is passed between the well and the reservoir, and a systematic study of the stability and accuracy of the resulting coupled system has been performed.

Firstly, a temporal order of accuracy analysis shows that an explicit coupling of the two implicit codes suffers from a deteriorated order of accuracy. An improved scheme is obtained by higher order reconstructions of the transfer of the interface conditions, based on insights from the field of fluid structure interaction. This approach is especially advantageous when two black box solvers are coupled, and is much faster than the implicit partitioned approach.

Secondly, the stability of various coupling approaches has been considered. Linear stability analysis shows that the explicit coupling of the two implicit codes is conditionally stable. The cause of instability is due to the time lag in the transfer of the interface conditions leading to unphysical mass accumulation or depletion. A sensitivity study has been carried out to understand the effect on stability of various geometrical, operational and numerical parameters of the coupled well-reservoir system. Finally, an analytical expression for the time step size restriction has been obtained from a simplified well-reservoir model which closely agrees with the results of the sensitivity study.

Assessment committee: **Chairman,**

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Prof.dr.ir. H.W.M. Hoeijmakers	(mentor)
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