Faculty Engineering Technology
Program Mechanical Engineering

University of Twente.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of his MSc thesis assignment

Bart Bramer

will give a presentation, entitled:

Development of Diffuser Concepts for High-Pressure Applications

Date: Thursday May 31, 2012

Time: 14:00

Room: Carré 2 M

Summary:
In various industrial applications centrifugal compressors are used to deliver a high static pressure, which can range up to 1000 bar. In such compressors, at relative low flow rates, rotating stall may occur. Rotating stall is an unstable flow phenomenon which initiates undesirable sub-synchronous vibrations. When a compressor operates in rotating stall conditions, the accompanying dynamic loads could damage internal components, bearings and seals, leading to fatigue or resonance phenomena, reducing the lifespan of the compressor. The present study, performed at Siemens A.G. in Duisburg, presents flow structures, prediction methods and suppression methods for rotating stall in diffuser channels typical for high pressure applications. Rotating stall prediction criteria are examined for an isolated diffuser, reconstructed from literature data. Various diffuser concepts from the literature are analyzed, i.e. diffusers which attempt to acquire large working ranges by preventing the presence of rotating stall. The most promising rotating stall suppression configurations, with a reasonable penalty in performance, are low-solidity vaned diffusers and radially grooved diffuser concepts.
A typical high pressure, low-solidity vaned diffuser has been investigated by numerically simulating the flow through a compressor stage utilizing *Ansys 13.0.* An optimization of low-solidity diffusers is performed using a multi-objective function, containing both pressure recovery and compressor efficiency. An optimized diffuser geometry has been obtained by employing an evolutionary stochastic optimization algorithm, which varies the parameters that define the geometry of the diffuser vanes. The optimized low-solidity vaned diffuser features a better performance than a reference vaned diffuser in term of stage efficiency and pressure recovery.

Assessment committee: **Chairman:**
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