Faculty Engineering Technology
Program Mechanical Engineering

UNIVERSITY OF TWENTE.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of his MSc thesis assignment

R. van de Vondervoort

will give a presentation, entitled:

Prediction of Aerodynamic Performance and Noise Production of Axial Fans

Date: **Friday April 10, 2015**

Time: **14:00**

Room: **Horst Building - N109**

Summary:
Low-speed axial fans are employed in a wide variety of industries, mainly to displace large quantities of air with a low pressure difference. An important constraint on the use of these fans is the noise emitted to the far-field. In applications like cooling towers and condensers, the axial fan forms the main source of noise. To reduce this noise, historically a large number of prototypes were constructed and trial-and-error experiments were performed to design silent fans. This approach is very time-consuming and expensive. Therefore, a prediction of the emitted noise levels of new designs using computational fluid dynamics and computational aeroacoustics is preferred. The objective of this study is to investigate a suitable prediction technique for broadband aerodynamic noise.

Most currently available methods for broadband noise prediction are based on computationally expensive Large Eddy Simulations or Direct Numerical Simulation methods. The current study focuses on the applicability of a hybrid method, combining the computationally less expensive Reynolds-averaged Navier-Stokes (RANS) method and the Stochastic Noise Generation and Radiation (SNGR) method.

The first step in this hybrid process is the prediction of the aerodynamic performance using a steady-state RANS computation, as incorporated in the commercial computational fluid dynamics package NUMECA Fine/Turbo. The results of this aerodynamic performance prediction are in good agreement with the experimental results, obtained at the Howden test facility.

Using the results of the validated RANS computation as input, the second step is the reconstruction of the turbulent velocity fluctuations with the SNGR method, incorporated in the NUMECA Fine/Acoustics FlowNoise module. This method stochastically reconstructs the turbulent noise sources consistent with the Von Kármán-Pao energy spectrum. Once these noise sources have been reconstructed, the propagation of noise through the fan duct is computed using a finite element acoustical method. Finally, using a boundary element method radiation analysis, the sound pressure level at the far-field microphone is obtained. These computational results are compared to experimental results.

Assessment committee:
Prof.dr.ir. C.H Venner (chairman)
Dr.ir. N.P. Kruyt (mentor)
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d.d. 6/03/2015