Faculty Engineering Technology
Program Mechanical Engineering

UNIVERSITY OF TWENTE.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of her MSc thesis assignment

Marlies Verbruggen

will give a presentation, entitled:

Development and Verification of a Ffowcs Williams-Hawkings Method for Jet and Propeller Noise

Date: Friday June 19, 2015

Time: 14:00

Room: **Horst Building Room N109**

Summary:
In order to compute the noise of aircraft or aircraft components, NLR has developed computational aeroacoustic (CAA) methods. These methods include the computation of the generation of sound as well as the propagation of sound to the far-field. To compute the far-field sound, the flow domain is divided in a near-field and far-field domain, separated by a control surface. When the solution on the control surface is known, the far-field sound can be computed using a boundary integral method describing the sound propagation through a uniform flow.

At NLR, the Kirchhoff method is used to compute the far-field sound. However, the accuracy of the solution degrades when the flow outside the control surface is not purely linear, which is the case for the sound field of a jet and that of a propeller. In order to overcome this and other disadvantages, another boundary integral method will be investigated, namely the Ffowcs Williams-Hawkings method. Since the Ffowcs Williams-Hawkings equations contain non-linear source terms, this method is expected to provide more accurate results when the flow outside the control surface is not purely linear.

In this study the retarded time formulation of the Ffowcs Williams-Hawkings equation, written in the time domain, is used, with the pressure chosen as field variable. This form of the equation is discretized and rewritten to include an observer in a uniform flow and simplified for the cases of the sound field of a jet and that of a propeller.

The method is verified applying the method to various test cases, namely a stationary monopole, a stationary monopole in a uniform flow, multiple monopoles in a uniform flow and a plane wave radiating from an annular duct with an infinite center body.

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