Faculty Engineering Technology
Program Mechanical Engineering

UNIVERSITY OF TWENTE.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of his MSc thesis assignment

M. Goossens

will give a presentation, entitled:

Analysis and Validation of Wind Turbine Noise Prediction Methods

Date: **Wednesday November 18, 2015**

Time: **14:00**

Room: **Horst Building Room NH115**

Summary:
The amount of noise produced by wind turbines remains an important issue for manufacturers of wind turbines. A significant part of wind turbine noise is the aerodynamic noise produced by the rotor blades. For the design of wind turbine blades, it is therefore important to be able to predict the aerodynamic noise generated by the rotating blades.

From literature, six airfoil (self-)noise sources have been identified relevant for wind turbine blades. The state-of-the-art (semi-) empirical equations describing these noise sources have been implemented in Matlab, resulting in a noise prediction method for airfoil (self-) noise.

To predict rotor blade noise, the blade is divided into a number of radial sections. For each section, the definition of the geometry is known, as well as the angle of attack and the effective flow velocity. Using this data, the noise prediction method is then able to predict the noise generated for each of the blade sections. Summing the predicted noise of all blade sections then results in the prediction of the level of the total aerodynamic blade noise. For validation, the predicted blade noise levels have been compared with noise levels that were obtained from field measurements of wind turbine noise.

The accuracy of the noise prediction method was further analyzed by comparing self-noise predictions with data from acoustic wind tunnel measurements on two airfoils. The acoustic measurements were performed previously by using a microphone array, allowing the localization and quantification of the airfoil noise sources.

As part of the present study, acoustic measurements have been performed in the Silent Wind tunnel facility of the University of Twente, utilizing an acoustic array. The main incentive of these experiments has been to determine whether the Silent Wind Tunnel is suitable for measuring airfoil self-noise. To this aim, measurements have been performed on a DU97- flat-back airfoil and on a wind turbine airfoil from industry. The DU97 – flat-back airfoil has a chord of 0.25m and a trailing edge thickness of 10% chord. The airfoil from industry has a chord of 0.35m and a relatively sharp trailing edge.

For predicting blunt trailing edge noise, the present noise prediction method was found to have its limitations and therefore requires further investigation. From literature, two models to predict blunt trailing edge noise have been found. The acoustic measurements on the DU97 – flat-back airfoil have been found valuable for validating which one of the models for blunt trailing edge noise implemented in the noise prediction method give better results. Finally, it was found that, for most Reynold numbers and angles of attack considered, the Silent Wind tunnel in the configuration used is not suitable for measurement of self-noise of the wind turbine airfoil with the sharp trailing edge.

Assessment committee:
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d.d. ________________