Faculty Engineering Technology
Program Sustainable Energy Technology

UNIVERSITY OF TWENTE.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of his M.Sc. thesis assignment

Giridhar Ramanujam

will give a presentation, entitled:

Improving Aerodynamic Prediction Methods for Wind Turbine Airfoils

Date: Wednesday August 19, 2015

Time: 14:00

Room: Horst Building N109

Summary:
In the present study, methods for improving the prediction of drag for various types of wind turbine airfoils have been explored. The key issue addressed is the problem of the under-prediction of drag of thick airfoils as well as airfoils with a thick trailing edge, both of which are often used in wind turbine blades.

An improved formulation for the estimation of drag of thick airfoils has been derived. The under-prediction of drag by methods employing viscous-inviscid interaction, like XFOIL, can be quite significant for the thick airfoils used in wind turbine applications (up to 30% as seen in the present study). The improved formulation for drag prediction estimates the drag accurately for airfoils with reasonably small trailing edge thickness. The derivation for the correction of the drag is based on the difference between the actual momentum loss thickness, based on free stream velocity, and the one based on the velocity at the edge of the boundary layer. The improved formulation has been implemented in the most recent version of XFOIL (version 6.99) and RFOIL and the results are compared with experimental data, results from commercial CFD methods like ANSYS CFX and other methods like DTU-AED EllipSys2D and CENER WMB. The improved versions of XFOIL and RFOIL show good agreement with experimental data.

A similar approach is used for airfoils with a thick trailing edge as well. It has been found that solution methods considering only steady flow conditions, fail to accurately account for drag in case of thick trailing edges. This because effects of unsteady flow, such as vortex shedding, also contribute significantly to the drag. An empirical approach is needed to account for the excess drag observed for these airfoils if methods for steady flow are to be used.

In an auxiliary study, implementation of bypass transition in RFOIL to predict the location of transition for high free-stream turbulence levels has been presented. However, the results indicate that this approach does not perform well when integrated into RFOIL.

Assessment committee: **Chairman:**

Prof.dr.ir. C.H. Venner	(chairman)
Prof.dr.ir. H.W.M. Hoeijmakers	(mentor)
Dr. H. Özdemir	(mentor)
Dr.ir. R. Loendersloot	
Ir. A. van Garrel	

d.d.