Faculty Engineering Technology
Program Sustainable Energy Technology

University of Twente.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of his MSc thesis assignment

Irfan Zafar

will give a presentation, entitled:

Numerical Investigation of Boundary Layer Characteristics for Transitional Flow over 2D Airfoils

Date: Wednesday October 19, 2011

Time: 14.00

Room: Zuidhorst 286

Summary:
In order to improve the accuracy of current aerodynamic design tools for wind turbines, a new tool is being developed at Energy research Center of the Netherlands (ECN). This design tool solves integral boundary layer equations for the region where viscosity is effective. In order to close the integral boundary layer equations, so-called closure relations are required. These closure relations are given in terms of boundary layer parameters such as displacement thickness and momentum thickness. The aim of the current study is to determine these boundary layer parameters from Navier-Stokes solutions for various flow types. These boundary layer parameters will be used to improve the existing closure relations for the integral boundary layer equations.

The study is carried out using a commercial CFD software package, ANSYS-CFX for solving the Reynolds-averaged Navier-Stokes equations and ICEM-CFD for generating the meshes. Numerical simulations have been carried out for the 2D flow about airfoils in steady incompressible flow, for conditions in which in the boundary layers the flow transitions from laminar to turbulent. As a first step the accuracy of the numerical method has been demonstrated by performing numerical simulations on several grids for the NACA 0012 airfoil for fully turbulent flow conditions at various angles of attack. As a next step, the built-in transition model is used to predict the location of the laminar to turbulent flow transition region. Furthermore, from the numerical solution of the Navier-Stokes equations the boundary layer thickness is determined by using various flow variables such as vorticity and total pressure. Using this result, the boundary layer parameters, e.g. displacement thickness and momentum thickness, are determined. The results are compared with experimental data and with numerical results obtained from XFOIL, a potential flow method, coupled with an integral equation boundary-layer method.

Assessment committee:
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