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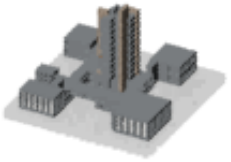

Subdepartment **Engineering Fluid Dynamics - CTW**
Department **Mechanical Engineering**

As part of his / her masterassignment

Timon Kruijk

will hold a speech entitled:

Evaluation of the Stanford SU² code as an optimization tool for problems involving rotating flows

Date: 30-10-2015
Time: 13:00 hr
Room: Horst Building Room HT900

Summary:

Aerodynamic shape optimization is paramount in lowering operating costs by calculating more efficient designs of aerofoils, wings and many other applications. Nowadays this field of work mostly consists of solving mathematical problems, which can be solved in CFD using different types of algorithms. In open-source CFD programmes the flow and adjoint solvers, parametrization, optimization, deformation, mesh adaptation and several other tools are usually not integrated very well or are not fully available. In the Stanford University Unstructured (SU²) suite of codes these components have been neatly integrated, such that in theory the shape of a geometry can be optimized by a single command line and using only a mesh file and a configuration file. This research focussed on testing the workability of SU² by first considering the theory behind optimization and then looking at how this is applied in the software suite.

The first step was to see how easy it is to reproduce some tutorial test cases, provided by Stanford University itself. The considered geometries here were the NACA0012 aerofoil (2-D) and the Onera M6 aeroplane wing (3-D). They have both been tested for steady flow, the NACA0012 aerofoil has also been subjected to an optimization case concerning a rotating flow. All analyses have first been tried using the Euler equations, when successful it has been tried again using the Reynolds-Averaged Navier-Stokes (RANS) equations in combination with a Spalart-Allmaras turbulence model. Reproducing the test cases sometimes proved to be more difficult than expected, especially for more complicated flow situations. The next step has been to see where problems arose in doing this. It turned out that there are several problems concerning the adjoint analysis and with the way how forces are defined, which resulted in the failure of the optimization process. Finally, it has been investigated how well the SU² optimization tool is able to handle 3-D, rotating flows, possibly with periodic boundary conditions. It turned out that the optimization process is not as stable as advertised, some considerations concerning convergence issues are given. In conclusion, some positive results have been obtained. However, solving such complex problems is not yet as easy as is aimed for in SU² and therefore there is plenty of future work to be done.

Assessment committee: chairman,

Prof.dr.ir. C.H. Venner	(chairman)
Dr.ir. E.T.A. van der Weide	(mentor)
Dr.ir. H.J.M. Geijselaers	(external member)
Dr.ir. R. Hagmeijer	(internal member)

(Signature)

d.d.