

COLLOQUIUM

Group: Engineering Fluid Dynamics

As part of his MSc thesis assignment

T.A. Berk

will give a presentation, entitled:

Experimental Study on Aerodynamic Load Control using Synthetic Jet Actuators

Date: Friday October 10, 2014

Time: 14:00

Room: Horst Building HT-500B

Summary:

The present study addresses the use of piezoelectric driven synthetic jet actuators as aerodynamic load control devices in a 2D NACA0018 blade. Such load control devices can be integrated in for instance wind turbine blades to alleviate load fluctuations and therewith reduce fatigue damage. The utilization of flow control devices like synthetic jets can be favorably compared to the application of blade pitching due to smaller response times, expected lower power requirements and the exclusion of wear and tear on the wind turbine pitch bearings, specifically for the blades of present-day large wind turbines.

Synthetic jets are so called zero-net mass-flux devices because during their actuation cycle they ingest and subsequently eject equal amounts of air. This gives synthetic jets a huge benefit over continuous jets since no external supply of air is required.

In the present study, a synthetic jet actuator from literature has been redesigned in order to fit it as close as possible to the trailing edge of a 2D blade with a NACA0018 airfoil section. The jet exits in the direction perpendicular to the surface of the airfoil from a narrow slot, parallel to the trailing edge, at $x/c = 0.975$. First, a prototype version of this redesigned actuator was constructed and the jet velocity was measured using hot-wire anemometry. Results show a frequency response of the jet velocity similar to the response of the original actuator on which the current design is based. The measured maximum jet velocity is slightly lower than that for the original actuator.

Next, a 2D NACA0018 blade fitted with a module containing ten spanwise distributed actuators has been designed and constructed. Compared to the prototype actuator the hot-wire anemometry tests for the installed actuators show slight differences in the jet velocity's frequency response. These are probably caused by small imperfections in the production process of the module containing the synthetic jet actuators.

Wind tunnel tests have been performed to measure the obtainable change in the lift curve of the blade, i.e. the lift coefficient as function of the angle of attack of the wing, within some range of the actuation parameters. This indicates the load control performance of the blade equipped with synthetic jets.

Assessment committee:

Prof.dr.ir. H.W.M. Hoesjmakers (chairman/mentor)

Dr.ir. G.R.B.E. Römer

Dr.ir. C.H. Venner

Dr.ir. H. de Vries

Chairman,

d.d. _____