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Aagaard Madsen, Helge; Buhl, Thomas; Na, Li; Andersen, Peter Bjørn; Bak, Christian; Gaunaa, Mac; Hansen, Morten Hartvig

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DESIGN AND TEST OF A CONTROLLABLE RUBBER TRAILING EDGE FLAP

Helge Aagaard Madsen (Risø DTU, Department of Meteorology, Denmark)
Thomas Buhl, Denmark (1) Li Na, (1) Peter Bjørn Andersen, (1) Christian Bak, (1) Mac Gaunaa, (1) Morten Hartvig Hansen, (10)
(1) Risø DTU, Department of Wind Energy

We have developed a new controllable trailing edge flap which is based on the principle of controlling the pressure in suitable designed voids within the elastic flap. The flap with a chord of 150 mm is manufactured in silicone rubber and has a number of conical voids in chordwise direction. Tests of the dynamics of the flap are presently ongoing in a test rig. Later in 2008 the flap will be mounted on a NACA0015 1 m chord airfoil section model with pressure tabs and tested in a wind tunnel.

Background and motivation

A number of numerical studies within the last few years have shown a big potential for reduction of dynamic aerodynamic loads using a trailing edge flap. The studies indicate that much faster control can be obtained with flaps compared with normal pitch of the whole blade as the mass of the flap can be made substantially lower than the blade. The big challenge is however, how to obtain the flapping mechanism.

New design

We have developed a new controllable trailing edge flap which is based on the principle of controlling the pressure in suitable designed voids within the elastic flap. Based on a large number of non-linear FEM simulations on different designs and considerations on how to manufacture the flap we have come to a design which gives a satisfactory response and which can be manufactured. The present flap design, manufactured in silicone rubber, has a number of conical voids in chordwise direction and so far pressurized air has been used to activate the flap.

Test results

The dynamic response of the flap is important for the capability of reducing aerodynamic loads. This is tested in a rig where a laser based transducer is used to measure the deflection of the flap at different chordwise positions when pressure is applied to the voids. Later in 2008 the flap with a chordwise length of 150 mm will be mounted on a 1 m chord NACA0015 wind tunnel model with a span of 1.9 m. Test of the aerodynamic performance will be carried out in the VELUX wind tunnel with an open test section at wind speeds up to 40 m/s and will comprise measurement of pressure distribution for different steady and dynamic pressures applied to the flap.
The measured aerodynamic performance will finally be used to simulate the potential load reduction for a MW turbine.