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A MORPHING TRAILING EDGE FLAP SYSTEM FOR WIND TURBINE BLADES

Helge Aagaard Madsen, Thanasis Barlas, Tom Løgstrup Andersen

Technical University of Denmark, Denmark

hama@dtu.dk ; tkba@dtu.dk ; toan@dtu.dk

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Summary: Research on trailing edge flaps for wind turbine blades during the last 10 years comprising numerical studies have shown substantial potentials for load alleviation on the blades as well as on other turbine components by using a trailing edge flap system. Fully exploited this will lead to reduced cost of energy from wind turbines. However, a very important precondition is the adaptation of adequate functional principle and technology of the flap systems. The unambiguous requirement from the wind turbine industry is that the flap system is robust, reliable and does not add new costly requirements for service and replacements. One promising flap technology is the so-called “Controllable Rubber Trailing Edge Flap” (CRTEF) developed at DTU (former Risoe) from 2006-2009 and patented in 2006. The functionality is simple as the flap deflection is controlled by pressurized air or a fluid in a number of voids in the flap made of elastic material. Prototypes tested in the laboratory and on a blade section in a wind tunnel from 2007-2010 demonstrated the functionality and the aerodynamic performance. A time constant of about 100ms was obtained which only limits the maximum obtainable load alleviation on a MW size wind turbine marginally.

In a recent research and development project INDUFLAP from 2011-2014 the flap system has been further developed in corporation with the industrial partners Hydratech Industries (DK) and Rehau (DE). A new trailing edge flap design with spanwise voids (channels) and with a chord of 15cm suitable for a 1m chord blade section was developed. It was then manufactured by extrusion and glued together with a load carrying part with a connector part that allows an easy mounting on the blade section. After tests in the laboratory the flap was mounted on a 2m long blade section mounted on a newly developed test rig. A 10m long boom with the blade section was mounted on a 100kW turbine hub where the original blades were taken down. It means that the flap system was tested under realistic rotating conditions with real inflow. A summary of the above research will be presented in the paper.