Faculty Engineering Technology
Program Mechanical Engineering

UNIVERSITY OF TWENTE.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of his MSc thesis assignment

Pim Bullee

will give a presentation, entitled:

Development of an ice accretion code suitable to mixed-phase icing conditions

Date: **Friday December 18, 2015**

Time: **10:00**

Room: **Horst Building Room N.109**

Summary:

Ice accretion on aircraft engines can be caused by supercooled liquid droplets and mixed-phase or glaciated icing conditions. The effects of a mixed icing environment consisting of both supercooled liquid droplets and solid ice crystals are less well known and documented than the effects of the supercooled liquid environment. The results from an investigation of a collection of engine power loss events indicated that it is very likely that ice particles can enter and accrete in the core of the engine, compromising its performance and power output.

Current ice accretion models only model the supercooled droplet environment and are unable to cope with mixed-phase icing conditions. In this research a thermodynamic model is proposed, able to predict the ice shape created on a 2D aerofoil subject to mixed-phase icing conditions. The input for the model is the catching efficiency which is a measure for the amount of droplets and particles impacting a specific location on the surface. The surface itself which is discretized in a number of control volumes. The droplets and ice particles impacting the surface enter the control volume and either freeze to the ice layer on the surface or move into the liquid water film on top of the ice layer. The water film flows downstream into the adjacent control volume.

For every control volume a mass and energy balance is solved, from which the equilibrium surface temperature and the mass rate of freezing is determined. From this mass rate the ice shape on the surface can be determined. During the calculation of the ice layer the effects of mass evaporation, aerodynamic heating and erosion caused by the ice crystals present in the flow are taken into account. The basis for this model is the Messinger model which is a one-dimensional equilibrium energy balance, employing the equilibrium temperature of an insulated and unheated surface to study ice growth.

The results from the model proposed in this research will be compared to the outcomes of wind tunnel experiments and to the results from mixed-phase icing codes proposed in literature.

Assessment committee:

Prof.dr.ir. C.H. Venner	(chairman)
ir. E. Norde	(mentor)
Dr.ir. E.T.A. van der Weide	(mentor)
Dr.ir. A.K. Pozarlik	(external member)

Chairman,

d.d. 20/11/2015