Frostwing research project

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Icewing

Icewing programme 2011-2015

• Generic Airbus type DLR-F15 three element airfoil with wing tank cooling
• Wind tunnel testing of fluid effects
• Wind tunnel testing of real frost effects
Frostwing

• The FAA and Trafi have signed year 2015 a three year framework agreement of research co-operation on aircraft anti-icing fluids and Cold Soaked Fuel Frost (CSFF).

• The research is performed in Helsinki by Arteform Oy together with NASA and National Land Survey of Finland

• The present research plan contains the following themes:
  - Laser scanning of CSFF on wing model
  - 3D photogrammetry of CSFF on wing model
  - Wind tunnel tests of CSFF on wing model
  - Wind tunnel tests of anti-icing fluid on wing model
  - Wind tunnel tests of secondary wave on wing model
  - Study of anti-icing fluids on a flat plate wind tunnel model
  - CFD computations of anti-icing fluids on a flat plate model
Arteform Wind Tunnel

- Low speed closed circuit wind tunnel with 2x2 m test section
- Turbulence level <0.28 % at a wind tunnel speed of 60 m/s
- Temperature controlled cooling system in the test section and wing model for frost generation before the test
Common Research Model

• CRM is a generic long range, twin engine configuration for future Transonic Transport aircraft

• HL-CRM is the High Lift configuration of the aircraft (ref. AIAA Paper 2016-0308)
CRM Wing model

- The section was taken in the vicinity of the wing MAC in a direction representative for the upper surface local flow conditions.

- In take-off configuration the slat deflection is $22^\circ$ and the flap deflection $10^\circ$. 

![Diagram of CRM Wing model](image-url)
• Aerospace aluminum construction with 1,5 mm skin thickness
• Slats and flaps in carbon fiber
• Coolant liquid in the wing tank with heat exchangers
• Wing tank temperature monitored with thermo elements
Example of laser scan result

• The painted frost scan was aligned to clean wing surface scan to extract quantitative information.
Example of photogrammetry

Photogrammetry result sectional cut

Frost surface photogrammetry

March 2017 measurement
• More data on Trafi web page: https://www.trafi.fi/en/aviation/aviation_and_the_environment/icewing_-_research_on_aircraft_wing_de_anti-icing_fluids

• Trafi is interested in co-operation with other research organizations

Thank you!