

PrISM - Propeller Ice Shed Measurement

FFG Insights 2025

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Vienna, 12. November 2025

The PrISM project has received funding from the Federal Ministry of Austria for Innovation, Mobility and Infrastructure (BMIMI) as part of the Austrian Aeronautics Programme TAKE OFF via the Austrian Research Promotion Agency (FFG) under grant agreement FO999886890.

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Consortium Partners:

- **AeroTex GmbH**
 - Consortium Leader, Numerical simulation
 - Test Planning, Management and Reporting
- **Austrian Institute for Icing Sciences**
 - Impact Energy Measurement, 3D Ice Shape Scanning
- **Rail Tec Arsenal GmbH**
 - Adaptation and Improvement of the Rotor Rig
 - Icing Wind Tunnel
- **Dowty Propellers**
 - Test Article Design and Manufacture
 - Supporting numerical simulations

 **AeroTex GmbH**


Austrian Institute for Icing Sciences


RAIL TEC ARSENAL


a GE Aerospace company

Background of the project

- **Ice accretion on the propellers** of CS-23 commuter and CS-25 aircraft has two main negative consequences:
 - ***Aerodynamic performance degradation***
 - Nominal thrust penalty of up to around 11% recorded in Appendix C icing conditions
 - Potentially larger degradation due to large droplet conditions
 - ***Risk of shed ice damage***
 - Impact against fuselage or other components

Aim of the project

- **PrISM Goals:**
 - Establishment of robust empirical shed criteria for unheated and heated blade surfaces for large propellers
 - Generation of a comprehensive database of 3D large-scale propeller ice accumulations under both Appendix C and Appendix O icing conditions
 - Characterisation of spinner ice accretion shapes and shed criteria
 - Validation of numerical tools for ice shed impact energy

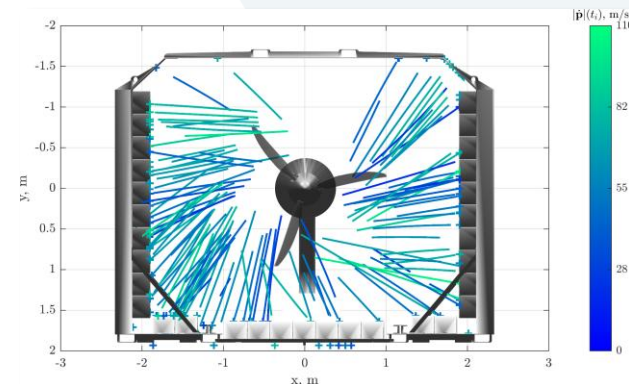
Project results

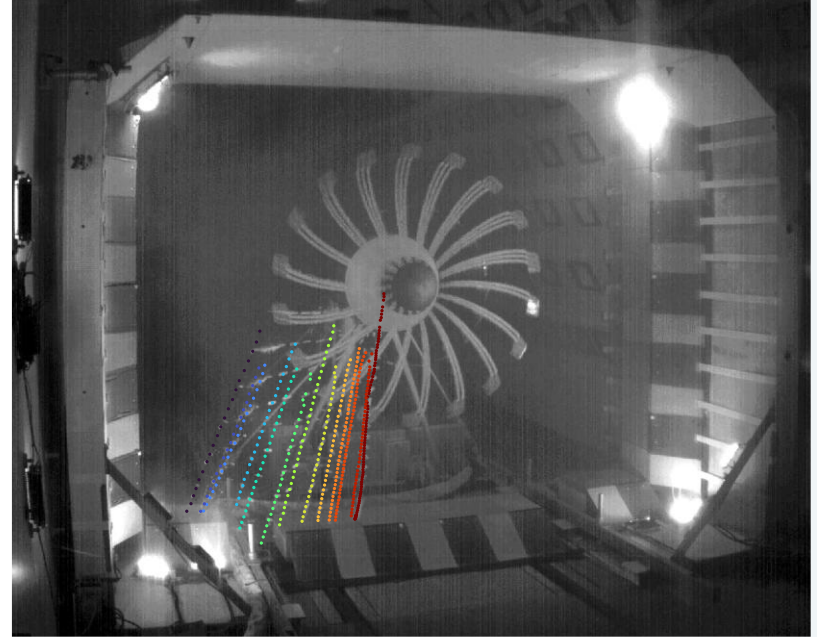
- **WP2: Test Article Design & Manufacture**
 - A propeller representative of a large transport aircraft (especially with regards to de-icing and ice shedding) was designed and manufactured by Dowty
 - Limitations of the test facility were considered
 - Using open-source airfoils so that results can be published



Project results

- **WP3: Impact Energy Measurement**
 - Kinetic energy of shed ice particles measured
 - 3D trajectory reconstruction of trajectories
 - Particle **position** and **velocity** over time
 - Particle capture system
 - Particle **mass** and **density**
 - More than 250 impacts recorded in 2 test campaigns

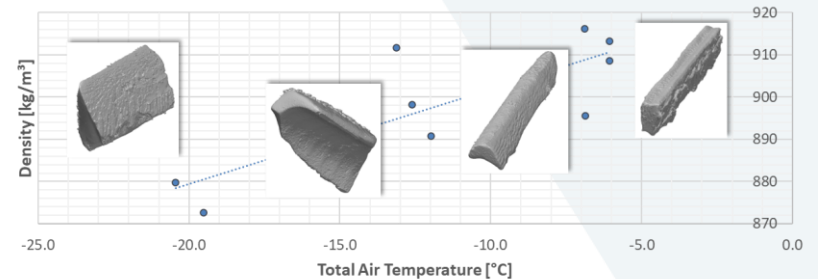
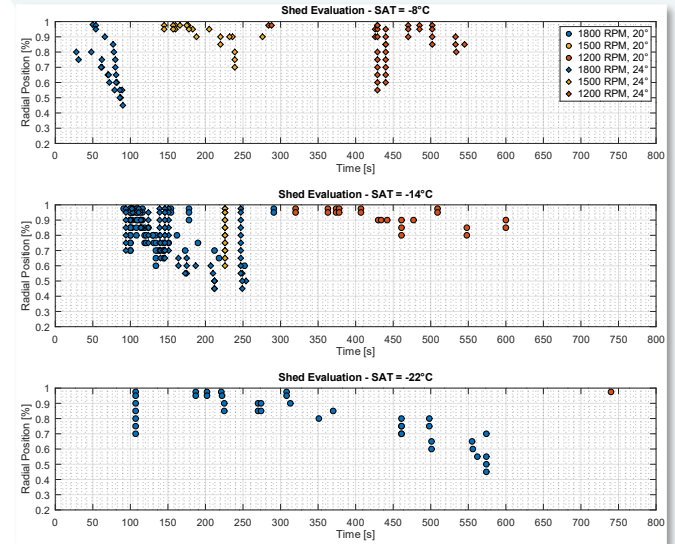




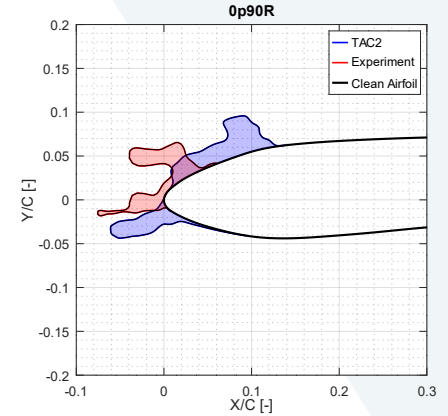
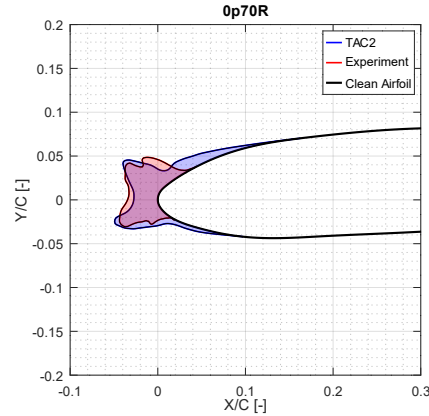
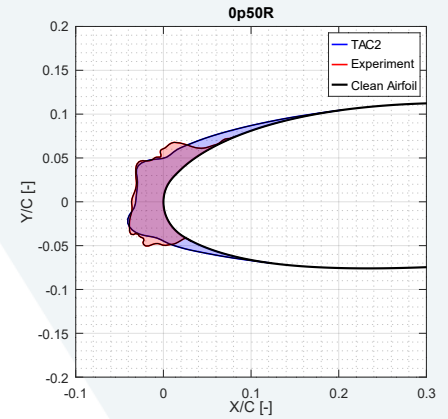
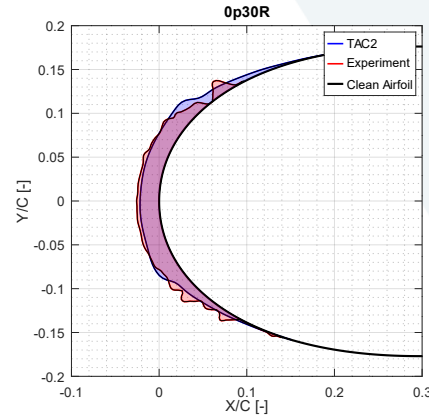


Project results

- **WP4: Numerical Simulation**
 - Pre and Post test simulations performed
 - Validation data:
 - Ice Shedding
 - Ice Density
 - Ice Adhesion Strength
 - 3D Ice Shape
 - Areas for code improvement identified

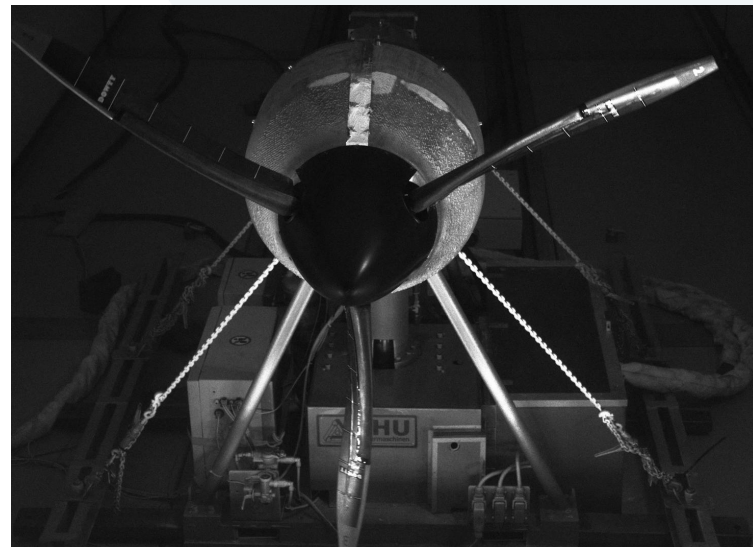


Project results



Project results

- **WP5: IWT Testing**
 - Upgraded propeller test rig
 - To provide wider operating range
 - **45 Icing Runs**
 - 28 unprotected
 - 17 with an active IPS
 - **28 High Resolution 3D Scans**
 - Propeller blades + Spinner
 - More than 250 individual ice shed events



Utilization of the project

- **AeroTex:**
 - Further development of validated numerical simulation capabilities
 - Experience in planning, managing, evaluating and reporting propeller IWT tests
- **AIIS:**
 - Evaluation of complex 3D ice shapes
 - Ice impact measurement system + evaluation tools
- **RTA:**
 - Updated propeller test rig -> new AGIROS rotor test rig
 - Go-to facility for tests on large scale propellers
- **Dowty:**
 - Experimental validation data -> development of IPS

Utilization of the project

- **Dissemination:**
 - Presentation of PrISM project at **SAE AC-9C Aircraft Icing Technology Committee (2022)** 'An Update on ongoing Austrian Icing Projects'
 - **Advisory board meeting** with EASA, FAA and experts (2022)
 - **Public workshop** at RTA and online (2024) with 94 people from 39 different organisations attending
 - Presentation of results at **Manufacturers Icing Certification Group (MICG)** meeting (2024)

Utilization of the project

- **Dissemination:**
 - 1 Master's Thesis
 - **3 AIAA papers**
 - *Experimental Icing Tunnel Testing of a Large-Scale Propeller*
 - <https://doi.org/10.2514/6.2025-3298>
 - *3D Reconstruction of Ice Shedding Trajectories on a Full-Scale Propeller Test Rig*
 - <https://doi.org/10.2514/6.2024-4351>
 - *Ice Shedding Trajectory Analysis and Impact Measurement on a Large-Scale Propeller Test Rig*
 - <https://doi.org/10.2514/6.2025-3299>

Further steps / follow-up projects

- **2 Research Projects:**
 - *PRECISE* -> NASA cooperation
(Space Act Agreement in place)
 - *NORIS* -> GE Aerospace cooperation
- **AGIROS Test Rig**
 - Linked to a commercial test
- **Commercial Propeller Testing**
 - 1 confirmed commercial propeller test at RTA (in 2025)
 - 1 further commercial propeller test in preparation

