LEWICE3D Droplet Impingement and Ice Accretion Software

Domestically distributable, royalty-free software to analyze and reduce icing risk for aircraft

In-flight ice accretion is a weather-related hazard that has the potential to cause the reduced performance or even failure of various aircraft components. In response, engineers at NASA’s Glenn Research Center have developed LEWICE3D, a domestically distributable software tool. LEWICE3D simulates how the water droplets from a cloud impact and grow ice on an arbitrary aerodynamic geometry in flight. This simulation allows for icing-related analysis and design (such as the placement and extent of ice protection systems) to be addressed earlier in the design process, which both increases efficiency and reduces costs. By improving the effectiveness of design and certification efforts, this software helps ensure the safety of airplanes by preventing potential accidents caused by exposure to icing. LEWICE3D may be accessed with a Software Usage Agreement at no charge in the 2017/2018 NASA software catalog.

BENEFITS

- Cost-saving: In addition to being available free of charge, LEWICE3D allows changes to be made early in the design process, before expensive flight tests are conducted.
- Accurate: The software calculates the growth of ice on specific 3D shapes based on input of geometry, aerodynamic conditions, and icing conditions.
- Wide-ranging: LEWICE3D simulates a broad array of conditions and identifies ice accretion shapes and location for all current aircraft certifications.
- Efficient: Computational resources can be scaled with problem size to maintain simulation speed.
- Proven: LEWICE3D is one of the most extensively tested ice accretion prediction tools available.
**THE TECHNOLOGY**

Glenn's innovators have added three-dimensional ice accretion modeling capability for the proven simulation suite. As a software tool, LEWICE3D computes parameters associated with icing risk by integrating with state-of-the-art, third-party fluid flow solutions for Computational Fluid Design software. The three main components of LEWICE3D compute: 1) water droplet trajectories, 2) collection efficiency (i.e. droplet impingement), and 3) resulting ice shapes. LEWICE3D takes advantage of the nature of the droplet trajectory to allow the user to scale computational resources with problem size, thus ensuring optimal simulation time. In addition, the software provides simulations of not only the standard icing envelope but also Super-cooled Large Droplet icing conditions. The LEWICE3D results have been validated by an extensive database of ice shape profiles and have shown a strong modeling correlation for the conditions of greatest interest to the aviation community. This comprehensive validation has made the LEWICE3D software the most accurate tool available for predicting ice accretion.

**APPLICATIONS**

The technology has several potential applications:

- Analysis of aircraft susceptibility to ice accretion
- Ice protection system design
- Design of aircraft, rotorcraft, UAVs, jet engines, nacelles, probes, and detectors
- Aircraft certification

**PUBLICATIONS**

This software is available via Open Source release at:

https://software.nasa.gov/software/LEW-19433-1

For more information on this and other NASA Glenn software, please contact the Glenn Software Release Team at:

grc-sra-team@mail.nasa.gov

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The LEWICE3D software can help predict both droplet impingement and ice accretion, such as this scallop formation on the leading edge of a swept wing in the NASA Icing Research Tunnel.

Glenn's novel software offers a highly reliable prediction of collection efficiency (color contours) and the resulting ice shape (at discrete cuts) along a wing, as shown above.