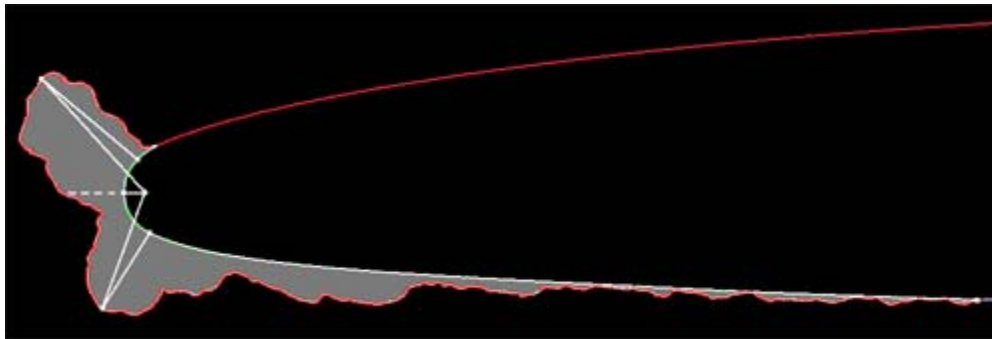


# SmaggIce 2D Version 1.8: Software Toolkit Developed for Aerodynamic Simulation Over Iced Airfoils

SmaggIce 2D version 1.8 is a software toolkit developed at the NASA Glenn Research Center that consists of tools for modeling the geometry of and generating the grids for clean and iced airfoils. Plans call for the completed SmaggIce 2D version 2.0 to streamline the entire aerodynamic simulation process--the characterization and modeling of ice shapes, grid generation, and flow simulation--and to be closely coupled with the public-domain application flow solver, WIND. Grid generated using version 1.8, however, can be used by other flow solvers. SmaggIce 2D will help researchers and engineers study the effects of ice accretion on airfoil performance, which is difficult to do with existing software tools because of complex ice shapes. Using SmaggIce 2D, when fully developed, to simulate flow over an iced airfoil will help to reduce the cost of performing flight and wind-tunnel tests for certifying aircraft in natural and simulated icing conditions.

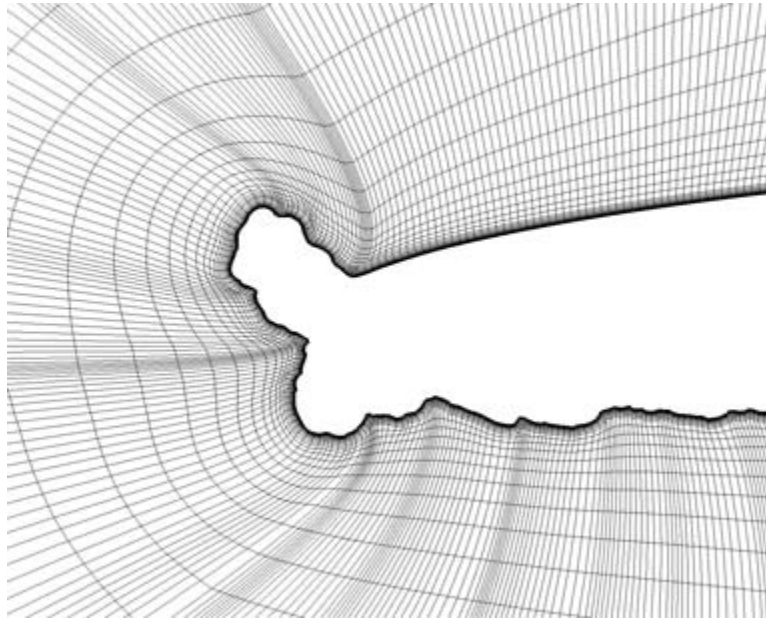


*Iced airfoil showing ice characteristics: integrated ice area, horn height, and horn angle.*

The preceding figure shows a sample glaze ice accreted on a business jet airfoil. SmaggIce version 1.8 provides tools that (1) examine input data for possible errors (such as tangling introduced during data acquisition), (2) allow users to smooth ice shapes to the level that they desire for their computational fluid dynamics analysis, and (3) control the point density and point distribution over the iced airfoil for grid generation. Ice shapes are numerous, and they affect airfoil performance. Version 1.8 provides tools that measure ice-shape characteristics--such as horn height, angle, and location, and integrated ice area--allowing researchers to examine their effect on aerodynamic performance. SmaggIce also allows users to specify the size and location of simple, primitive ice shapes for parametric study.

Ice shapes pose difficulty in generating the good-quality grids that are essential for predicting ice-induced complex flow. Version 1.8 provides the tools needed to create high-quality grids. Many tools are uniquely tailored for ice, including dividing the flow domain into blocks to set up the grid structure prior to grid generation, making changes to

the grid-density distribution, and merging and smoothing multiblock grids. The use of a thin, tightly controlled block that wraps around the iced airfoil is an example of a unique feature available for handling difficult ice geometries. The shapes of block edges can be changed with control points by representing the edges as NURBS (Nonuniform Rational B-Splines) curves. The following figure shows a sample grid generated by prerelease SmagIce version 1.8.



*Grid over iced airfoil.*

To streamline the icing aerodynamic simulation process, developers plan to tie version 2.0 closely to WIND so that users can not only proceed easily from grid generation to flow simulation, but also can graphically overlay the grid on the solution to more effectively modify the grid on the basis of the solution. Details of SmagIce 2D version 1.8 and plans for version 2.0 are reported in reference 1.

## Reference

1. Vickerman, M., et al.: SmagIce: Further Progress in Software for Gridding 2D Iced Airfoils. AIAA-2005-1369, 2005.

**Find out more about this research at <http://icebox-esn.grc.nasa.gov/ext/design/smaggice.html>**

**Glenn contact:** Mary B. Vickerman, 216-433-5067, [Mary.B.Vickerman@nasa.gov](mailto:Mary.B.Vickerman@nasa.gov)

**Authors:** Dr. Yung K. Choo and Mary B. Vickerman

**Headquarters program:** Aeronautics Research

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