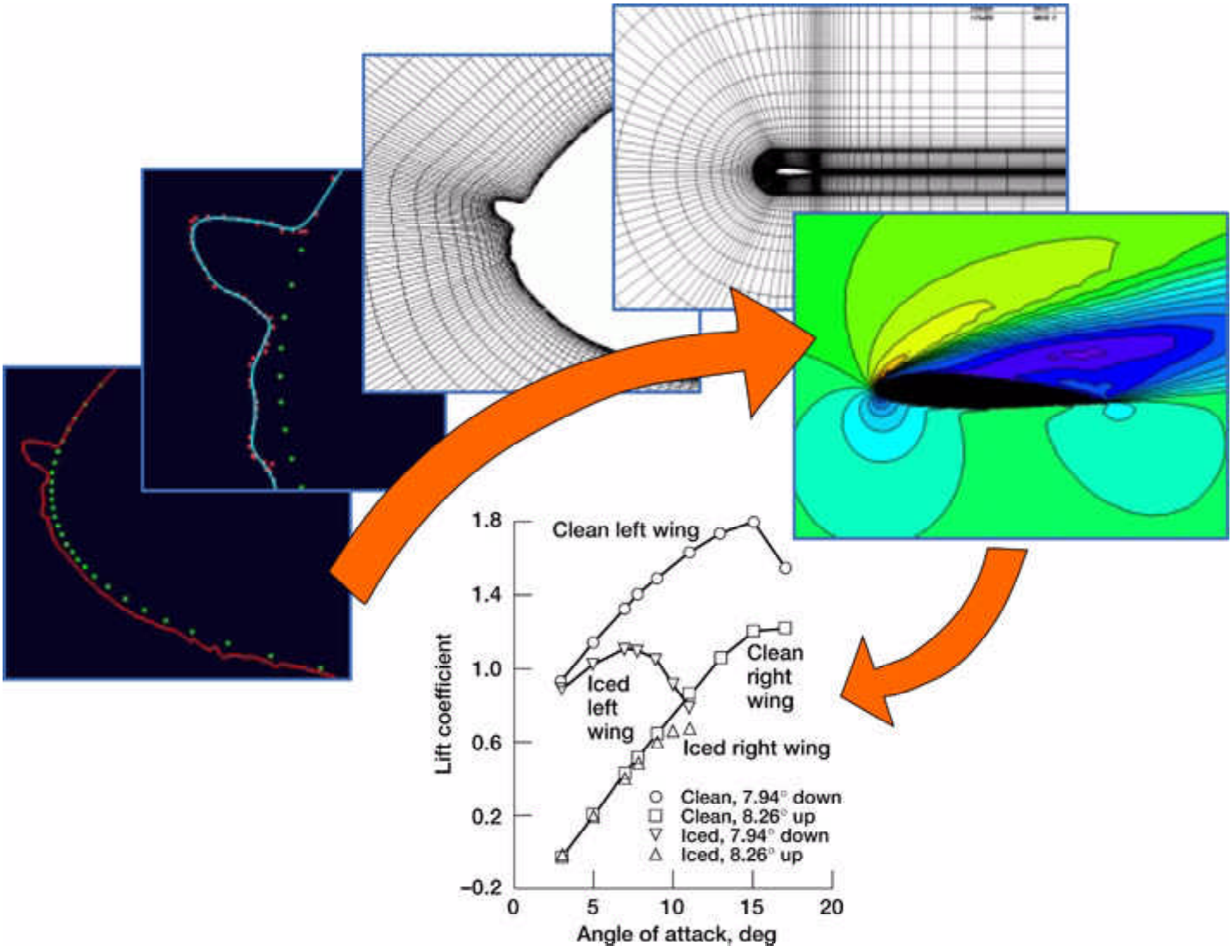
Interactive Software System Developed to Study How Icing Affects Airfoil Performance (Phase 1 Results)

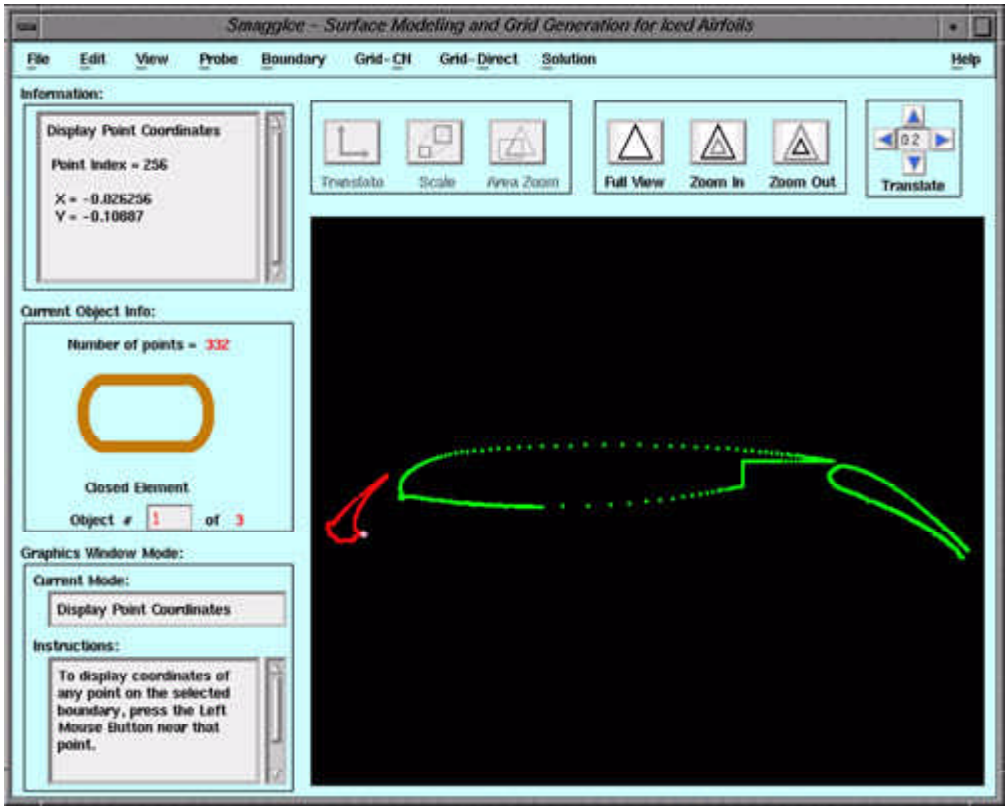
SmaggIce (Surface Modeling and Grid Generation for Iced Airfoils), which is being developed at the NASA Glenn Research Center at Lewis Field, is an interactive software system for data probing, boundary smoothing, domain decomposition, and structured grid generation and refinement. All these steps are required for aerodynamic performance prediction using structured, grid-based computational fluid dynamics (CFD), as illustrated in the following figure. SmaggIce provides the underlying computations to perform these functions, as well as a graphical user interface to control and interact with them, and graphics to display the results.



Process of predicting icing effects on airfoil performance.

But why do we need SmaggIce? Can't we just use existing CFD tools to predict how icing will affect airfoil performance? Highly irregular ice shapes with sharp corners or segments with very high curvature present a considerable challenge in the grid-generation process. This increases the time and effort required by engineers and scientists when they try to apply existing CFD tools to aircraft icing problems. SmaggIce has special features such as smoothing, explicit local and global control, and relevant grid topology to create the high-quality grids that are required for complicated ice shapes. With SmaggIce, CFD can be a robust tool for predicting the effects of icing on airfoil performance.

SmaggIce, a UNIX-based platform-independent software package, is being developed in planned phases that make it available to the aircraft icing community at the end of each phase. Phase 1 has been completed. The 1.0 Beta release became available in October 1999, and the 1.0 release will be available in February 2000. Phase 1 results contain two types of software tools: interactive ice shape probing and interactive ice shape control. SmaggIce's ice shape probing tools enable users to measure the physical characteristics of ice, and its ice shape control features allow users to examine input geometry data, to correct or modify any deficiencies of such data, and to systematically smooth the ice to a level that allows grids to be generated that are appropriate for accurate CFD analysis. The SmaggIce main window (see the following screen capture) includes the Menu Bar, Information, Current Object Info, Graphics Window Mode, View Manipulations, and Graphics Drawing Area.



SmaggIce main window.

In Phase 2, the code will be extended to define and decompose domains, discretize perimeters, generate field grids, and check, control, and refine grid quality. In Phase 3, the SmaggIce code will be tied closely to a flow solver, and the whole process—from iced airfoil geometry to aerodynamic performance prediction—will be tested and demonstrated.

Bibliography

Baez, M.; Vickerman, M.; and Choo, Y.: SmaggIce User Guide SmaggIce Version 1.0. NASA/TM—2000-209793, 2000.

Vickerman, M., et al.: SmaggIce: Surface Modeling and Grid Generation for Iced Airfoils—Phase 1 Results. AIAA Paper 2000-0235 (NASA/TM—1999-209678), 2000.

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