Swing-Wing Inline-Fuselage Transport Design Studies at Supersonic Flight Conditions

Swing-wing transports—with a wing that may be swept and then returned to its original position during flight—offer improved aerodynamic performance across all flight regimes, shorter field lengths, and steeper and quieter climb. This conceptual transport aircraft would spend much of its time in supersonic cruise, so careful shaping to enhance performance (lift to drag ratio) and reduce drag will improve range and safety, and reduce weight and fuel burn.

In support of NASA's Fundamental Aerodynamics Supersonics Project, we are developing technologies for multidisciplinary analysis and design tools to enable better vehicle performance (such as efficiency, environmental, civil competitiveness, productivity and reliability) in multiple flight regimes and within a variety of transportation system architectures.

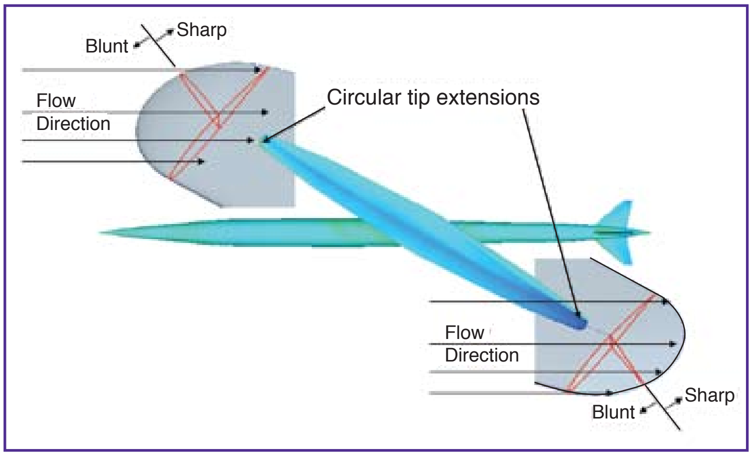
We have demonstrated aerodynamic shape optimization for improved supersonic performance and 3-axis vehicle trim on a Swing-Wing Inline-Fuselage Transport (SWIFT) at Mach 1.45. Substantial improvements in the aerodynamic efficiency and vehicle trim have been achieved using a design framework that is built from the following capabilities:

- Wing and body surface shape perturbation
- Component intersection and mesh clean up
- Automatic three-dimensional mesh generation
- Robust parallel inviscid flow solver
- Constrained sequential quadratic programming

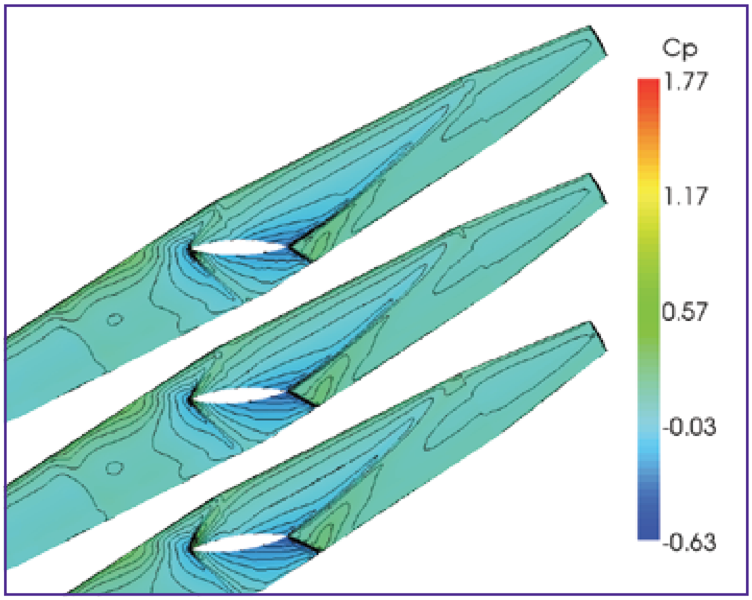
Each design strives to minimize a smoothly varying function of aerodynamic forces and moments. The surface is controlled by many design variables, such as wing camber, thickness, twist, and body radius and camber. Function gradient computations take advantage of many processors at a time, and the flow solver maps well to 64 processors.

Our work involves building up a more mature numerical design framework that has many applications, enabled by the massive computational power available at the NASA Advanced Supercomputing facility.

For more information, see "Swing-Wing Inline-Fuselage Transport Design Studies at Supersonic Flight Conditions," Susan E. Cliff, Scott D. Thomas, and Veronica M. Hawke, AIAA-2009-7073.



Wing tip extension geometry.



Effect of the pivot yaw angle on the lower surface pressures Mach 1.5, alpha 5.0 degrees. Top to bottom: a) 1-degree rotation, b) 5-degree rotation, c) 8-degree rotation.

Scott D. Thomas, NASA Ames Research Center
Scott.D.Thomas@nasa.gov