NASA Langley's
Optimal Flow Control Design

For quieter and more environmentally friendly transport aircraft.

In support of the Blended-Wing-Body aircraft concept, researchers at NASA's Langley Research Center have developed a new flow control hybrid vane/jet design for use in a boundary-layer-ingesting (BLI) offset inlet in transonic flows. This inlet flow control is designed to minimize the engine fan-face distortion levels and the first five Fourier harmonic half amplitudes while maximizing the inlet pressure recovery. This concept represents a potentially enabling technology for quieter and more environmentally friendly transport aircraft.

Benefits

- Experimental results showed an 80% reduction of $DPCP_{avg}$, the circumferential distortion level at the engine fan-face
- Hybrid approach leverages strengths of vane and jet flow control devices, increasing inlet performance over a broader operational range with significant reduction in mass flow requirements
- Minimal distortion level requirements are met using vanes alone, avoiding engine stall and increasing robustness of this hybrid inlet flow control approach

partnership opportunity

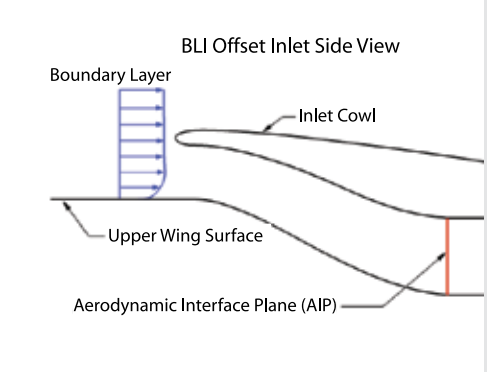

Figure 1. BLI inlet side view of the flush-mounted S-shaped diffuser inlet ingesting a 30% large boundary layer

Applications

- Aerospace – flush-mounted boundary-layer-ingesting inlets

The Technology

An optimum vane design was found by minimizing the engine fan-face distortion, DC60, and the first five Fourier harmonic half amplitudes while maximizing the total pressure recovery. The optimal vane design was then used in a BLI inlet wind tunnel experiment at NASA Langley's 0.3-meter transonic cryogenic tunnel. The experimental results demonstrated an 80% decrease in $DPCP_{avg}$, the reduction in the circumferential distortion levels, at an inlet mass flow rate corresponding to the middle of the operational range at the cruise condition.

Even though the vanes were designed at a single inlet mass flow rate, they performed very well over the entire inlet mass flow range tested in the wind tunnel experiment with the addition of a small amount of jet flow control. While the circumferential distortion was decreased, the radial distortion on the outer rings at the aerodynamic interface plane (AIP) increased. This was a result of the large boundary layer being distributed from the bottom of the AIP in the baseline case to the outer edges of the AIP when using the vortex generator (VG) vane flow control.

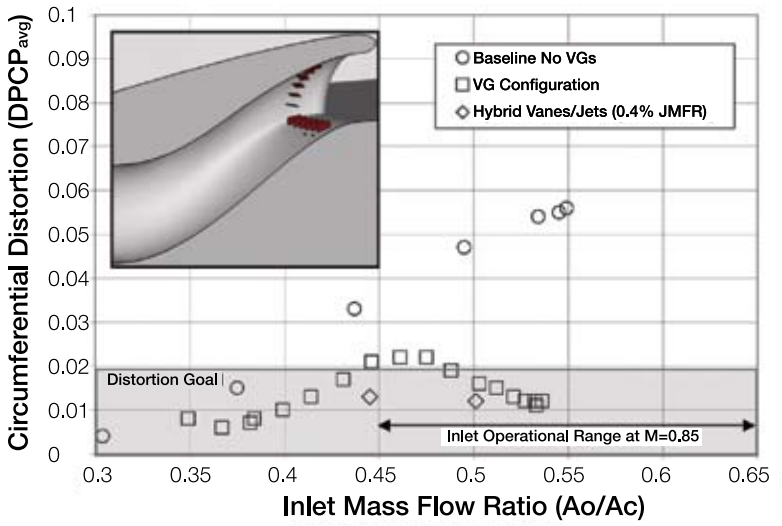

Figure 2. Combined vane and jet control effect on distortion reduction in BLI inlet text for M=0.85, P_t=30 psia, T_t=80°F, configuration 11 vortex generators with four jets

For More Information

If your company is interested in licensing or joint development opportunities associated with this technology, or if you would like additional information on partnering with NASA, please contact:

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