National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Aerospace

Advanced Over-the-Wing Nacelle Transport Configuration

Novel aircraft wing design reduces drag and community noise

NASA's Langley Research Center has developed a new aircraft design with the engine nacelle over the wing, improving engine ground clearance and freeing landing gear design. While previous over-the-wing designs have produced unacceptably high drag conditions, the new NASA design reduces drag on the wing. By optimizing the nacelle design and the wing leading edge location, NASA's design confines the shock to the leading edge of the wing. Also, placing the exhaust nozzle over the wing reduces noise to the communities below.

BENEFITS

- Decreased interference drag enables decreased cruise drag compared to current jet transports with engine nacelles mounted under the wing
- The unique platform, coupled with the fuselage and limited nacelle shaping promotes two-dimensional flow in the channel between the fuselage and the nacelle
- Provides easy clearance for large bypass engines
- Decoupled landing gear and engine placement enables shorter landing gear and/or more placement options
- Reduces community noise by wing shielding of engine exhaust sources to lower hemisphere. Current simulations indicate a cumulative effect of 6 EPNdB
- No pylon is needed - engine is mounted directly to wing, in slipper fashion, reducing wetted area, and easing subsystem integration

THE TECHNOLOGY

NASA developed the novel configuration to address the drag penalties associated with traditional over-the-wing nacelle designs. The novel features of the wing design include the unswept inboard wing section between the fuselage and the nacelle with an extended chord. The chord is extended so that it is almost in line with the front face of the nacelle, promoting near two-dimensional channel flow between the nacelle and the fuselage that pulls the standing shock wave farther forward. Confining the shock naturally enhances the leading edge suction and eliminates the shock traditionally located near the trailing edge. The net effect is reduced compressibility-based interference drag, as shown in Figure 1. Figure 2 shows the distribution of the drag coefficient, multiplied by wing chord, for the over-the-wing nacelle (OWN) compared to an under-wing nacelle (UWN) and a wing with no nacelle at all.

Noise is reduced because the engine nozzle is tangential to the wing upper surface and near the middle of the wing chord to put the exhaust noise source in the best position to be shielded from the community by the wing below it. The configuration has been assessed using both inviscid Euler and viscous Navier-Stokes computational fluid dynamics (CFD) methods.

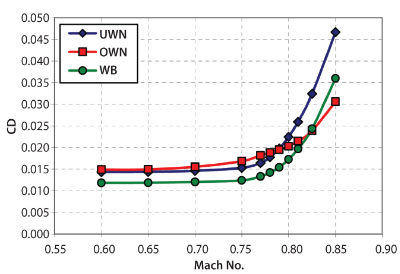

FIGURE 1 - Cd*c distributions for wing-body, UWN, and OWN configurations

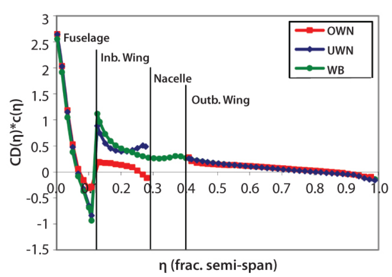

FIGURE 2 - Drag rise as a function of mach number for wing-body, UWN, and OWN configurations

APPLICATIONS

The technology has several potential applications:

- Aerospace - The new design is appropriate for twin-engine jet aircraft that reach transonic speeds, including those in the following classes:

  -- Business jets

  -- Commercial aircraft

PUBLICATIONS

Patent No: 7,883,052

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