Aeroacoustics

The global focus on reducing aircraft noise has brought continuing attention to the field of aeroacoustics. Progress has occurred in some larger projects and also in the planning of newer programs.

Growing interest in a supersonic business jet (SBJ) has resulted from advances in sonic boom mitigation technology that may allow supersonic flight over populated areas. At least two teams have announced SBJ efforts. One team, led by Supersonic Aerospace International with Lockheed Martin Skunk Works as the primary aircraft designer, plans to develop an SBJ by late 2012. A second group, led by Aerion, intends to develop an SBJ that would fly subsonically over populated areas.

As part of a Boeing/NASA project, testing of aeroacoustics interaction between engine and airframe took place in Boeing's aeroacoustics facility.

Various noise reduction concepts motivated by propulsion airframe integration considerations were studied in a Boeing/NASA project. Fan nozzles with certain azimuthally varying nonsymmetric distributions of chevrons were found to be particularly successful and became part of the Quiet Technology Demonstrator-2 flight test project. This testing was successfully completed in August by a partnership comprising Boeing, General Electric, Goodrich, and NASA. The tests also examined variable-geometry chevron nozzles, an acoustically smooth inlet, and landing gear noise reduction technologies. The concepts were evaluated via community noise and interior noise measurements, both of which showed significant reductions.

A highly integrated aircraft with embedded engines is the result of the first conceptual design of the Silent Aircraft Initiative, a joint project of the University of Cambridge and MIT. The design provides good shielding of forward-propagating engine noise and leaves space for extensive acoustic liners. Other highlights are an engine bypass ratio about twice that of current technology and a variable-area exit nozzle to reduce the bypass ratio in cruise and to improve fuel efficiency. Work is in progress to increase the fidelity of noise estimates.

Continuing efforts focus on mitigating the individual components of aircraft noise. On the fan noise side, using a scaled version of the GE-90 fan stage, tests at NASA Glenn showed that a variable-area nozzle on the fan stream provided a 2-dB reduction in the effective perceived noise from all three certification points. Honeywell Aerospace is continuing development of the Quiet High-Speed Fan design. An engine-scale version of the fan will be tested as a part of the NASA/Honeywell Engine Validation of Noise and Emissions Reduction Technology program. This effort includes extensive diagnostics work for engine noise sources.

On the jet noise side, the University of California, Irvine, and NASA are jointly evaluating the effect of offsetting the fan stream to shield noise from the higher speed primary jet. The optimum configuration for offsetting fan stream needs to be developed. A joint technology development by Pratt & Whitney and United Technologies Research Center culminated in a new exhaust noise suppressor for the JT8D-200 engine. The team successfully evaluated a new mixer-tailpipe nozzle configuration that is now being offered by Aviation Fleet Solutions and Pratt & Whitney as part of a noise reduction system for the JT8D-200-powered MD-80. A Pennsylvania State University/Boeing program is trying to optimize beveled nozzles for noise reduction through detailed unsteady flow measurements and large-eddy simulations.

On the airframe noise side, the Air Force, along with Lockheed Martin and General Electric, has performed a full-scale flight demonstration of the first airborne active flow control system to manipulate the wake behind an external pod. The team achieved this by using small electrically controlled piezoelectric synthetic jet actuators. At the University of Florida there is now an open-jet anechoic wind tunnel, a newly upgraded facility suitable for airframe noise studies.

by **Jayanta Panda** and the AIAA Aeroacoustics Technical Committee