ating element can be used to accelerate the spreading angle of the particle flow, as a result of turbulent mixing, for more complete particle coverage throughout the flow stream.

The concept provides the additional advantages of unlimited choice of solid particles, including somewhat sharp and abrasive particles; no need for an outside pressurized gas feed source; complete containment and enclosure of the flow environment; and the ability to be used in non-standard (temperature and pressure) environments and closed systems. Additionally, the rate of particle flux and the upper cut size of particles delivered to the flow can be controlled. The particles can also be released and distributed over a broad cross-section of the flow duct/pipe.

*This work was done by Juan H. Agui of Glenn Research Center, and R. Vijayakumar of Aerfil. Further information is contained in a TSP (see page 1).*

*Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steven Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18837-1.*

# Analysis of the Effects of Streamwise Lift Distribution on Sonic Boom Signature

## The objective is to find ways to reduce sonic booms.

*Dryden Flight Research Center, Edwards, California*

Investigation of sonic boom has been one of the major areas of study in aeronautics due to the benefits a low-boom aircraft has in both civilian and military applications. Current Federal Aviation Administration regulations prohibit supersonic flight over land due to potential effects the sonic boom may have on structures and humans.

This work conducts a numerical analysis of the effects of streamwise lift distribution on the shock coalescence characteristics. A simple wing-canard-stabilator body model is used in the numerical simulation. The streamwise lift distribution is varied by fixing the canard at a deflection angle while trimming the aircraft with the wing and the stabilator at the desired lift coefficient. The lift and the pitching moment coefficients are computed using the Missile DATCOM v. 707. The flow field around the wing-canard-stabilator body model is resolved using the OVERFLOW-2 flow solver. Overset/chimera grid topology is used to simplify the grid generation of various configurations representing different streamwise lift distributions. The numerical simulations are performed without viscosity unless it is required for numerical stability. All configurations are simulated at Mach 1.4, angle-of-attack of 1.50, lift coefficient of 0.05, and pitching moment coefficient of approximately 0. Four streamwise lift distribution configurations were tested.

The pressure signatures are measured at 1.6 body lengths below the aircraft on the symmetry plane of the aircraft. The results to note are the relative location and the strength of the shocks for different configurations. Correlating between the amount of positive lift generated by a lifting surface and the shock location, it is clear to see that shock of the lifting surface that generates more positive lift "arrives" at the measurement point in front of the shocks of lifting surface that generate less positive lift. This observation is valid for all three lifting surfaces. This is clearly evident when comparing the shocks of the wing and canard for different configurations. The observation is not as clear in the stabilator; however, it is still valid when examining a magnified view of the plot. This shows that lift can directly influence the local Mach angle of shocks. In addition, an observation can be made that the shock of the wing that generates more positive lift is stronger compared to shocks generated from wing with less positive lift.

From the above observation of relationships among the lift, shock strength, local Mach angle, and shock location, it can be reasoned that the shock coalescence can be mitigated if all shocks generated on the aircraft are of equal strength. The shocks of such configuration would propagate at a same angle, which would prevent shock coalescence. Therefore, instead of producing two strong sonic booms, it would produce multiple, weaker sonic booms.

*This work was done by Paul Yoo of Dryden Flight Research Center. Further information is contained in a TSP (see page 1). DRC-009-025*

# Rad-Tolerant, Thermally Stable, High-Speed Fiber-Optic Network for Harsh Environments

*Goddard Space Flight Center, Greenbelt, Maryland*

Future NASA destinations will be challenging to get to, have extreme environmental conditions, and may present difficulty in retrieving a spacecraft or its data. Space Photonics is developing a radiation-tolerant (rad-tolerant), high-speed, multi-channel fiber-optic transceiver, associated reconfigurable intelligent node communications architecture, and supporting hardware for intravehicular and ground-based optical networking applications. Data rates approaching 3.2 Gbps per channel will be achieved.

The high-speed 3.2-Gbps components, coupled with their Intelligent Node architecture, or universally with other architectures, will allow for orders of magnitude increases in the levels of automated onboard science data processing. Pure hardware processing capabilities have been achieved with the flexibility of reprogrammability utilizing FPGA control chips in the Intelligent Node architecture. Rad-tolerant versions of the current FPGA being evaluated are available through Xylinx. Due to the high-speed designs and partnerships