In Situ Solid Particle Generator

This system enables filter testing, and fluid and gas dynamic research, in closed-system, non-standard, or extreme environments.

John H. Glenn Research Center, Cleveland, Ohio

Particle seeding is a key diagnostic component of filter testing and flow imaging techniques. Typical particle generators rely on pressurized air or gas sources to propel the particles into the flow field. Other techniques involve liquid droplet atomizers. These conventional techniques have drawbacks that include challenging access to the flow field, flow and pressure disturbances to the investigated flow, and they are prohibitive in high-temperature, non-standard, extreme, and closed-system flow conditions and environments.

In this concept, the particles are supplied directly within a flow environment. A particle sample cartridge containing the particles is positioned somewhere inside the flow field. The particles are ejected into the flow by mechanical brush/wiper feeding and sieving that takes place within the cartridge chamber. Some aspects of this concept are based on established material handling techniques, but they have not been used previously in the current configuration, in combination with flow seeding concepts, and in the current operational mode. Unlike other particle generation methods, this concept has control over the particle size range ejected, breaks up agglomerates, and is gravity-independent. This makes this device useful for testing in microgravity environments.

Before any particles can be generated in the flow, the cartridge chamber is filled with the solid particles of choice. A programmable mechanical motor providing a range of rotational motion is used to drive a helical brush (or wiper) inside the chamber. Due to the action of the brush, the particles are dragged across the length of the internal chamber, particularly along the surface of the fine mesh screen, causing the particles to pass through the screen. The flow around the cylindrical body of the cartridge then entrains the ejected particles into the flow stream. System components consist of: a motor, flange supports for mounting and sealing the internal chamber volume, a drive shaft and tube conduit, a particle sample cartridge, a helical wire brush or wiper, a fine mesh screen, and screws (see figure). An optional aerodynamic leading edge can be used to streamline or stabilize the flow around the cartridge body, and to decrease flow effects as the particles are entrained in the flow. Alternately, a turbulence gener-

https://ntrs.nasa.gov/search.jsp?R=20130009432 2019-06-20T04:59:15+00:00Z
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.

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 Xilinx. Due to the high-speed designs and partnerships...