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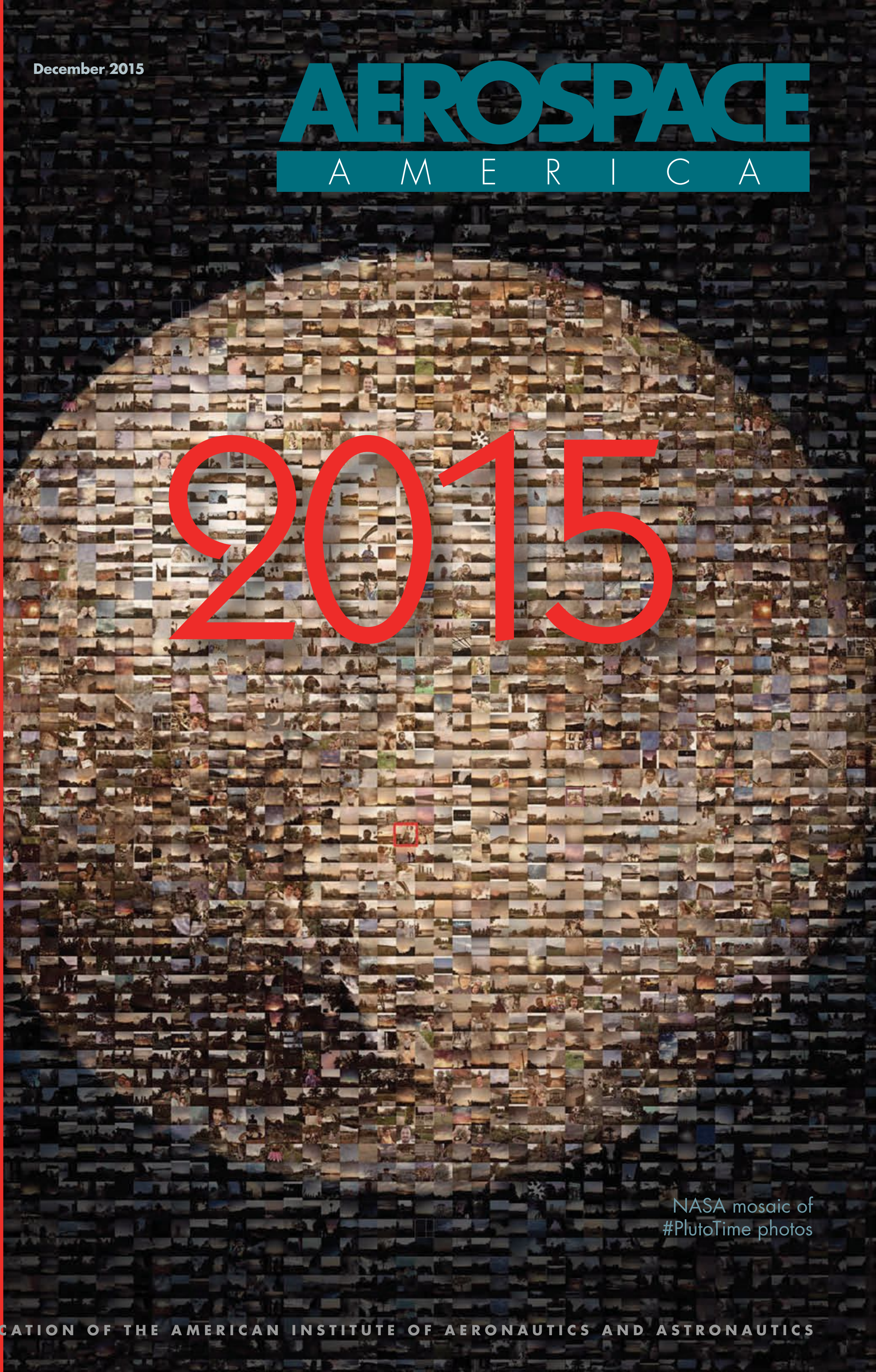
AEROSPACE AMERICA

In Review 2015



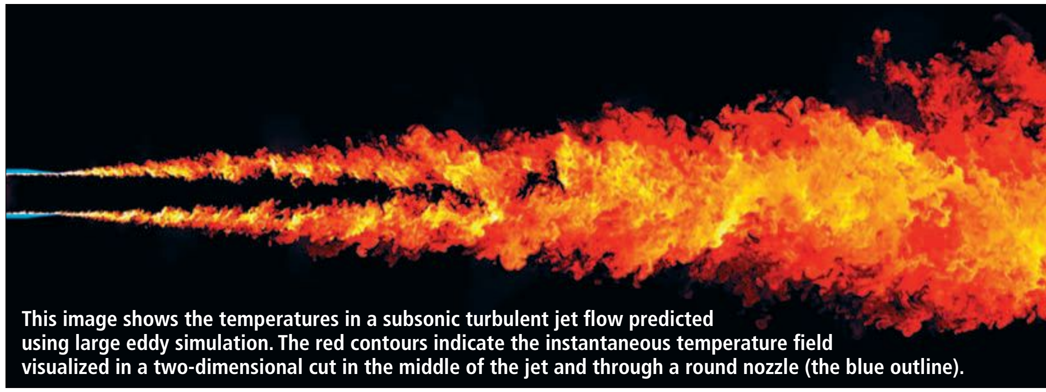
NASA mosaic of #PlutoTime photos

A PUBLICATION OF THE AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS

Flying quiet

by Dennis McLaughlin and Anthony Pilon

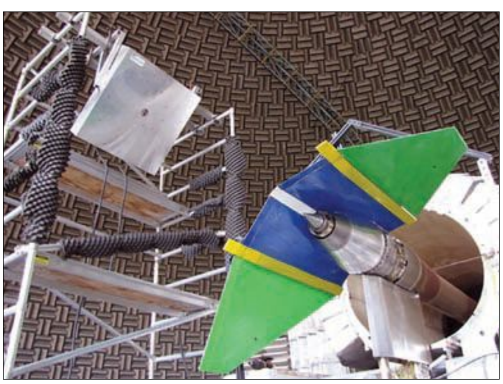
*The **Aeroacoustics Technical Committee** addresses the noise produced by the motion of fluids and bodies in the atmosphere and the responses of humans and structures to this noise.*



This image shows the temperatures in a subsonic turbulent jet flow predicted using large eddy simulation. The red contours indicate the instantaneous temperature field visualized in a two-dimensional cut in the middle of the jet and through a round nozzle (the blue outline).

Cascade Technologies

Noise generated by fluid flow is an important factor in the development of aerospace systems and ground vehicles. Development and operation costs are often directly correlated with **radiated noise**, so the demand for noise reduction will continue to be important for both military and commercial systems. In 2015, the aeroacoustics research and development community made advances to address these demands.



NASA Glenn Research Center

A scale model of an aft deck and tail of future supersonic airliner undergoes acoustic tests for exhaust noise at NASA's Glenn Research Center.

A scale-model of a low-noise conceptual N+2 (two generations from today's aircraft) supersonic airliner was tested in the **Aero-Acoustic Propulsion Laboratory** at NASA's Glenn Research Center in Cleveland. The model incorporated an inverted velocity profile jet flow with modeled airframe surfaces that simulate the aft end of a low-boom vehicle. Far-field and noise source distribution measurements were acquired to validate empirical models and physics-based simulations of exhaust flow-airframe interaction noise sources, shielding and reflection. These recently developed tools will be used in system studies to demonstrate the feasibility of a supersonic airliner that would be quiet enough to meet noise regulations.

Engine nacelle acoustic liners provide significant aircraft fan noise reduction, but further improvements in noise reduction capacity and bandwidth are needed. NASA and Honeywell Aerospace tested a fan model with an advanced multiple-degree of freedom, or MDOF, liner designed at NASA's Langley Research Center in Virginia. Preliminary results show that the MDOF liner provides additional broadband noise reduction relative to a current single-degree of freedom liner. These data will be used to refine the liner models and design codes to optimize future MDOF liners.

Together with academic partners at PPRIME Institute in Poitiers, France, and the California Institute of Technology, researchers at Cascade Technologies in Palo Alto, California, are leveraging high-performance computing and state-of-the-art hybrid modeling to perform **high-fidelity large-eddy simulations** of turbulent jets. Far-field noise predictions for an isothermal, Mach 0.9 jet matched the companion experimental measurements to within 0.5 decibel for relevant frequencies. An extensive LES database collected during the simulation is being mined to inform reduced-order models for wide application.

Researchers at Penn State are continuing to develop of the fluidic insert concept for on-demand noise reduction of tactical aircraft exhaust noise. Experiments are underway with a ¼ scale engine model at GE Aviation with ASE FluiDyne support. An alternate **on-demand noise reduction** concept is being explored at Lockheed Martin. This concept reduces jet noise via reconfiguration of variable geometry nozzle hardware to replicate a forced mixer nozzle.

The increased presence of advanced noise-test facilities in the automotive industry demonstrates how aerospace technology in aeroacoustics is benefiting broader and larger industries. There has been significant progress in developing test facilities for full scale **automotive wind noise testing** since the early 1990s. The test technology is critical to the development of modern vehicles, and numerous aeroacoustic wind tunnels have been recently commissioned for automotive wind noise testing.

Many new climatic wind tunnels also feature acoustic test capabilities for engine and drivetrain component testing. These test capabilities will continue to enable the development of vehicles with better wind noise attributes, fewer problems with sunroof "booming," and lower noise levels for auxiliary systems.