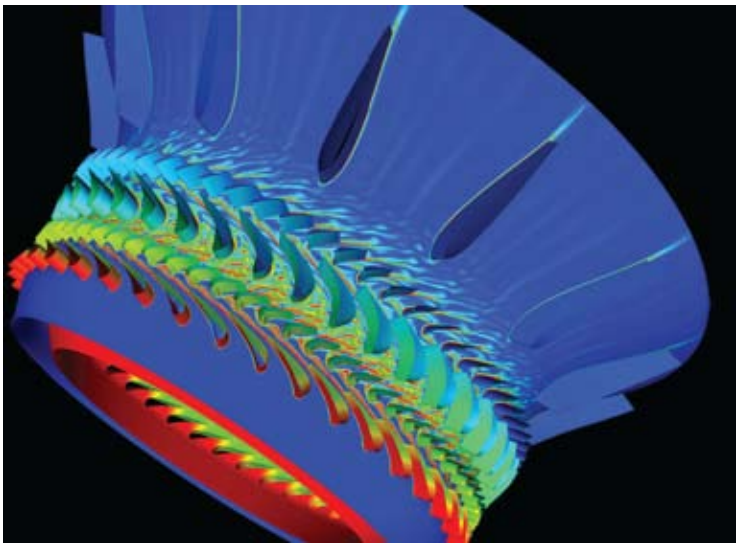
Aircraft

Large-Scale Simulations for Turbine Engine Core Noise

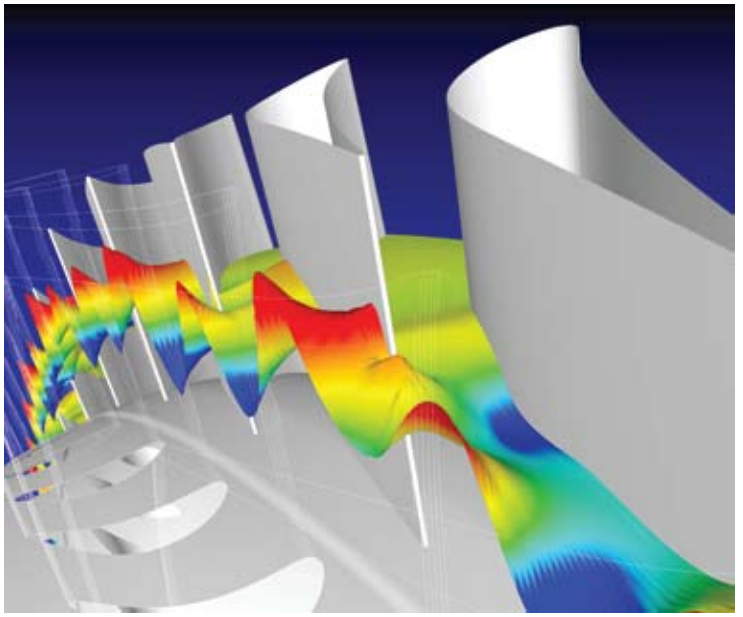
Turbines have been getting louder in both their absolute level and relative contribution to the total engine noise signature. The consensus of a recent turbine noise workshop was that development of simple multistage design rules for noise suppression is needed. Workshop attendees suggested that such rules could be distilled from computational data in particular—higher-fidelity data is expected to be available in the near future. The goal of this work, sponsored by the Subsonic Fixed Wing Project of NASA's Fundamental Aeronautics Program, is to provide this type of data for noise source identification and modeling. Such data will in turn, help NASA meet its goal of reducing the impact of aircraft noise on communities surrounding airports.

Time histories of static pressure are extracted from simulation data at multiple locations throughout the simulation domain. These data undergo spectral and modal processing to determine the propagating pressure modes in the turbine. This information, in combination with the turbine aerodynamic parameters, forms the basis of the noise modeling effort.

This scale of simulation would be impractical without the computing resources, data storage capacity, and high-speed networking available at NASA. These resources exceed that which is available at universities and companies, giving NASA a unique capability.



Velocity non-uniformities are a main tone noise generation mechanism. Blades are colored by static pressure and the flowfield shows vorticity. (Dale Van Zante, Jay Horowitz, NASA)



Pressure waves are created as the rotor cuts through the wake of the vane. (Dale Van Zante, Jay Horowitz, NASA)

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