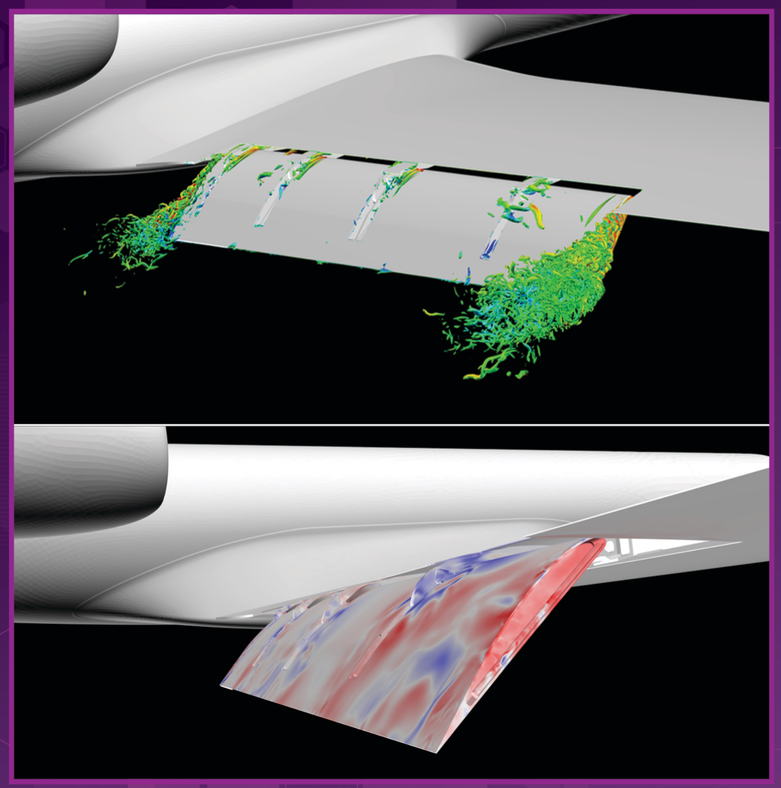
From a Roar to a Whisper: Making Modern Aircraft Quieter



Two visualizations of the simulated flowfield for a Gulfstream aircraft high-lift configuration depict the complex, unsteady flow features at both flap tips. The upper image shows the formation of vortex filaments and their roll-up into a single, prominent vortex at each tip. The lower image shows the corresponding surface pressure fluctuation field (noise sources), corroborating wind tunnel measurements that were obtained at NASA Langley Research Center. *Raymond Mineck, NASA/Langley; Patrick Moran, NASA/Ames*

Aircraft noise during landing and takeoff adversely affects communities near major airports. Our effort focuses on the prediction and mitigation of the noise generated by wing flaps. We use NASA's Pleiades supercomputer to accurately simulate the noise-producing aerodynamic processes that occur near the flap tips. Our simulations clearly demonstrate that:

- Significant flow unsteadiness at the flap tips is caused by the formation of strong, streamwise vortices
- Vortex merging and interaction with solid surfaces produce high-amplitude pressure fluctuations at the tips
- Portions of the pressure fluctuations are converted into sound waves that radiate towards the ground
- Effectiveness of noise abatement technologies can be accurately evaluated

We will extend the current simulations by including other major airframe components such as the main landing gear. Those simulations will allow us to perform, for the first time, system-level airframe noise prediction for a full aircraft. Such studies will help NASA develop and produce novel noise-reduction technologies that will confine aircraft noise footprints on the ground within airport boundaries.

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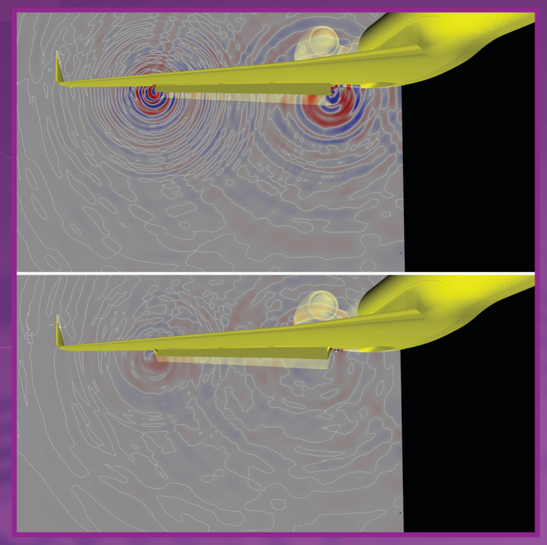

A comparison of the simulated flap noise sources for a Gulfstream aircraft, using a two-dimensional planar cut of the acoustic field, shows the radiated sound waves (noise) emanating from the tips of the deployed flap. The upper image shows the baseline configuration (without noise treatment). The lower image shows the effect of the noise reduction concept applied to the flap tips. *Raymond Mineck, NASA/Langley; Patrick Moran, NASA/Ames*