High-Fidelity Simulation of Jet Noise From Rectangular Nozzles

Large eddy simulation (LES) model for noise reduction in advanced jet engines and automobiles

This Phase II project validated a state-of-the-art LES model, coupled with a Ffowcs Williams–Hawkings (FW-H) far-field acoustic solver, to support the development of advanced engine concepts. These concepts include innovative flow control strategies to attenuate jet noise emissions. The end-to-end LES/FW-H noise prediction model was demonstrated and validated by applying it to rectangular nozzle designs with a high aspect ratio. The model also was validated against acoustic and flow-field data from a realistic jet-pylon experiment, thereby significantly advancing the state of the art for LES.


NASA photo

Applications

NASA

▸ Supersonic aircraft:
  • High-fidelity LES modeling for noise control
  • Testing of scale-model single or dual rectangular nozzles
  • Testing of nozzles with chevrons and bevels
▸ Subsonic fixed-wing aircraft:
  • Testing of high aspect ratio rectangular nozzles

Commercial

▸ U.S. Navy:
  • Noise suppression technology for the F/A-18E/F and Joint Strike Fighter F-35B programs
  • Retrofits for F414-400 engine, F404-400 engine, and F/A-18C/D aircraft
  • High-fidelity modeling for next-generation propulsion systems
▸ Automotive:
  • High-fidelity predictive tools for noise reduction caused by vortex shedding of side-view mirrors
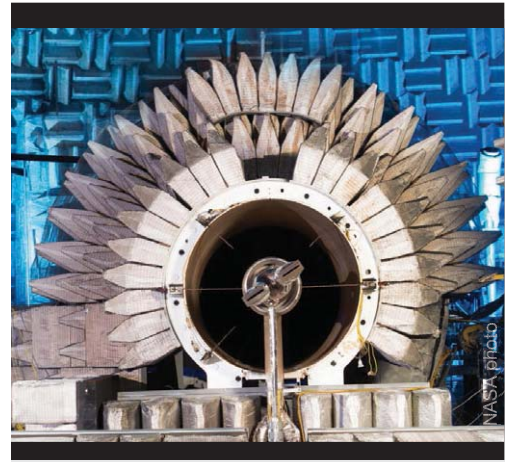
Phase II Objectives

▸ Upgrade the LES for accurate interfacing with the nozzle internal flow field, including the effects of the nozzle boundary layer turbulence on initial shear layer growth
▸ Rectify overprediction of initial turbulent velocity statistics at the nozzle lipline
▸ Validate the LES/FW-H for performing flow-field predictions of high aspect ratio rectangular and bevel nozzle free jets using detailed flow-field and acoustic measurements
▸ Provide validation of the LES/FW-H model for predicting noise emissions for a real-world engine installation with effects of pylon on far-field noise

Benefits

▸ Provides highly predictive modeling
▸ Reduces noise in jet engines and automobiles

Firm Contact

Combustion Research and
  Flow Technology, Inc.
Neeraj Sinha
sinha@craft-tech.com
6210 Keller's Church Rd.
Pipersville, PA 18947–1020
Phone: 215–766–1520 ext.16

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