

Case Study

Image Credit: Rick Goodfriend

Image Credit: ATA Engineering
(see technical publication
referenced below)

Supporting Engine Test Cell Development by Modeling High-Speed Jet Exhaust Noise and Its Impact on Facility Structural Integrity

OVERVIEW

Merrick-RS&H Joint Venture was redesigning an engine test cell facility to accommodate a higher-thrust engine. ATA Engineering (ATA) supported this effort by developing a multidisciplinary modeling workflow for trade studies of various noise-control treatments (NCTs) in high-value facilities. ATA used its Navy partner's high-fidelity computational fluid dynamics (CFD) predictions to create low- and high-frequency engine source models and developed a novel method for deriving acoustic models of the jet noise source for use in the vibroacoustic analysis software Wave6.

These acoustic models were used to predict noise levels throughout the test cell facility and perform NCT trade studies with computational vibroacoustic analysis tools such as the boundary element method (BEM) and generalized statistical energy analysis (SEA). Also, frequency response function (FRF) analysis of test cell wall-modeled large-eddy simulation (WMLES) data was used to identify potential acoustic feedback and lock-in mechanisms associated with the engine installation to identify facility acoustic modes that may be excited by jet exhaust.

TASKS PERFORMED & KEY OUTCOMES

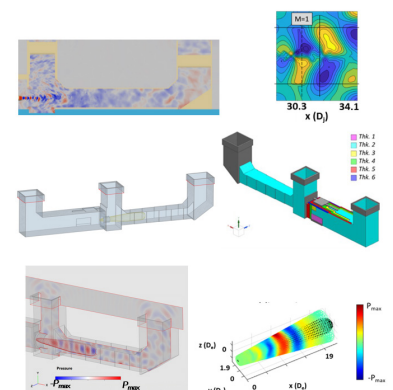
- Processed CFD data in the jet near-field to decompose fluctuating pressure into a plurality of partial acoustic fields at each frequency of interest.
- Used an inverse method to develop an equivalent jet acoustic source model informed by both CFD and outdoor engine test data.
- Developed engine test cell BEM and SEA models with and without NCTs based on acoustic impedance and absorptivity.
- Automated solving for hard-wall and treated test cell acoustic levels under jet source loadings.

TECHNICAL PUBLICATION REFERENCE

- Shah, P.N., M. Yang, D. Berg, S. Hambric, D. Douglas, D. Mayo Jr., J. Spyropoulos, and R. Denton. "Methods for High-Speed Jet Exhaust Aero-Vibro-Acoustic Modeling in Engine Test Cells." GT2025-154047. *Proceedings of ASME Turbo Expo 2025 Turbomachinery Technical Conference and Exposition*, Memphis, TN, June 2025.
- Request the full technical publication at <https://www.ata-e.com/insights/technical-papers/>.

"ATA's support allowed the P620 team to model acoustics and vibration to demonstrate estimated compliance with clients' requirements. ATA's expertise, flexibility, and timely performance were key to completing the work and maintaining project viability."

Steve Perrot, PE, LEED AP
Senior Project Manager, Merrick-RS&H
Joint Venture



Multidisciplinary demonstration of an enhanced modeling workflow that used high-fidelity CFD, jet source partial field decomposition, BEM, SEA, and FRF tools to perform NCT trade studies and identify flow-acoustic feedback mechanisms