ASCENT Project 075

Improved engine fan broadband noise prediction capabilities

Boston University (BU) & Raytheon Technologies Research Center (RTRC)

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Cost Share Partners: BU, RTRC, Aeroacoustics Research Consortium (AARC)

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Objective:

Improve low-order (LO) models for the prediction of fan broadband interaction noise by addressing gaps in existing methods using both computation and experimentation. The main gaps being considered are a LO model for the inflow to an exit guide vane.

Project Benefits:

Elimination of time-consuming, high or mid-fidelity simulations or prototype development and testing in order to assess broadband noise levels created by high bypass turbofans.

Research Approach:

- Develop a surrogate model for a fan wake parameters using machine learning.
  - Start by learning wake at different operating points for one fan
  - Learn wake at OPs for similar but different fans
  - Learn wakes for very different fans
  - Test 2D and 3D CNN
  - Test learning passage values. Test learning averaged values.
  - Determine necessary inputs
- Continue to test the current LO exit guide vane response method's ability to predict the broadband noise.
  - Develop method for modeling effect of inflow nonuniformity
  - Validate on full scale fan
  - Use new rig scale experiment to validate some predictions

Major Accomplishments (to date):

- Development of database
  - SDT, new baseline, lean, swept, low blade count fan 584 cases
  - New agreement with ISAE to increase database
- ML methods for mean flow wake, TKE, length scale
  - Demonstration of feasibility of ML for learning these parameters
  - Developed 2D and 3D CNN decoder part – working well
- Acoustic prediction for all cases in database +
  - Rig and full scale; nonuniform inflow; - still to be verified
- Rig experiments ¾ designed

Future Work / Schedule: (fall/spring)

- ML
  - Add multiple cases to database (from ISAE, from new simulations)
  - Consider alternative architecture – based on ideas from ISAE
- Acoustics
  - Verify the full-scale calculation (LBM and Hanson's model)
  - Run rig tests at RTRC

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