Project 59E

Moderate Fidelity Simulations for Efficient Modeling of Supersonic Aircraft Noise

Penn State University

PI: Philip J. Morris

Co-PI: Daning Huang

GRA: Dana Mikkelsen

PM: Sandy Liu and Muni Majjigi

Cost Share Partner: Penn State University

Objective:

To develop and assess computational tools to simulate the flow and noise of Civil Supersonic Aircraft engines.

To seek innovative approaches to reduce the computational cost of noise predictions for realistic engine geometries

Project Benefits:

The developed tools will enable airframe and engine manufacturers to assess the noise impacts of engine design changes and to determine if particular designs will meet current or anticipated noise certification requirements

Research Approach:

Perform steady and unsteady numerical simulations of the internal and external flow from dual-stream, subsonic and supersonic jet nozzles using a commercial CFD application

Predict the radiated noise using an acoustic analogy and compare with experimental measurements

Couple steady and unsteady methods to reduce computational cost

Use an acoustic analogy based on RANS simulations to predict noise from high Strouhal numbers

Major Accomplishments (to date):

Performed preliminary LES simulations using STARCCM+ for the inner nozzle

Optimized the LES inner nozzle grid for improved correlation with the Georgia Tech experimental results & additional validation cases

Future Work / Schedule:

Use Ffowcs Williams & Hawkings acoustic analogy to predict radiated noise for the inner nozzle

Generate RANS and LES grids for dual-stream nozzle, perform the CFD simulations and noise prediction, and compare with experiments

Generate grid for internal mixer nozzle RANS simulations

This research was funded by the U.S. Federal Aviation Administration Office of Environment and Energy through ASCENT, the FAA Center of Excellence for Alternative Jet Fuels and the Environment, project 59E through FAA Award 13-C-AJFE-PSU-058 under the supervision of Sandy Liu. Any opinions, findings, conclusions or recommendations expressed in this this material are those of the authors and do not necessarily reflect the views of the FAA.