ASCENT Project 59A

Jet Noise Modeling To Support Low Noise Supersonic Aircraft Technology Development.

Georgia Institute of Technology

PI: Jimmy Tai & Dimitri Mavris

GT PM: Joshua Brooks

FAA PM: Sandy Liu

Cost Share Partner: Georgia Institute of Technology

Objective:

- To identify off-design configurations for fixed inlets to minimize performance impacts from implementation of noise reduction technologies.
- To identify performance impact to on-design behavior if off-design changes are insufficient.
- To identify potential on-design geometries which would allow for sufficient on and off-design recovery if initial inlet performance is limited.

Project Benefits:

The developed tool will enable airframe and engine manufacturers to analyze and explore the design space of supersonic inlets, and ultimately to quantify the improvement competitive inlet designs offer toward recovering nozzle-related thrust losses while maintaining mission performance.

Research Approach:

- Assemble zeroth-order methods for predicting supersonic inlet performance.
- Extend performance prediction code into an environment for performing design functions.
- Determine installed thrust loss by jet noise reducing nozzles and find inlet designs that overcome this.
- Integrate low-fidelity structural analysis and weight-prediction capability to improve design space exploration tool.

Major Accomplishments (to date):

- Initial zeroth-order supersonic inlet performance and structural analysis for 2D inlets complete.
- Analysis capabilities extended to include most 2D inlet geometries.
- Zeroth-order performance analysis tool validated against public literature.

Future Work / Schedule:

- Complete conversion of inlet analysis into design environment, including axisymmetric configurations.
- Incorporate inlet sizing and installation performance.
- Extend validation against additional known inlets.

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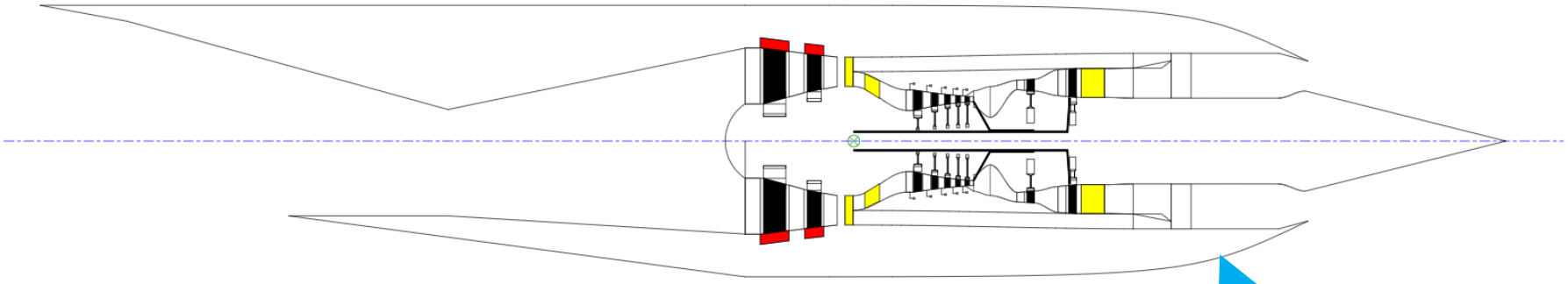
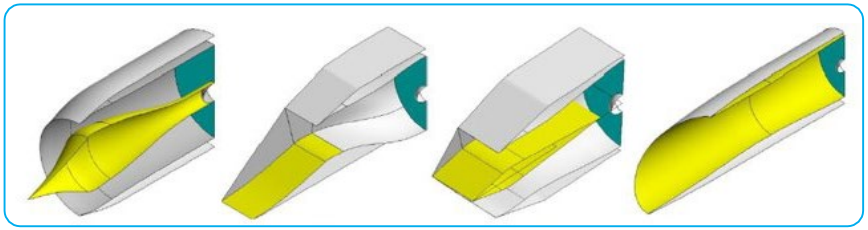
Zeroth-order Inlet Analysis

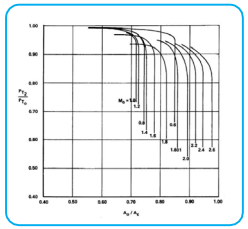


Noise Reducing Nozzle Technology
Has traditionally negatively impacted thrust production.

Inlet Designs
May be improved to recover these thrust losses.

Engine System Level Integration
Enables the determination of installed performance and the potential for offsetting nozzle-related thrust loss.





Zeroth-order Inlet Design Tool
Allows us to rapidly explore the design space of alternatives regarding on-design and off-design performance.

Current Status & Next Steps

- Current Status
  - Formulated a supersonic inlet analysis tool
    - Currently allows for parametric modeling of supersonic 2D inlet
  - Validated to ensure accurate geometric definition and performance predictions
    - Good agreement with external compression $M_d = 2.3$ inlet in Fundamentals of Aircraft and Airship Design [2]
    - Good agreement with mixed compression $M_d = 5.0$ inlet provided in IPAC paper [1]
    - Currently performing performance analysis and validation of PIPSI "R2DSST" $M_d = 2.3$ mixed compression inlet [3]

- Next Steps
  - Transitioning from being an "analytical" tool to a "design" tool
  - Extend existing 2D tool to include axisymmetric configurations
  - Incorporate structural and weight estimation analysis capability