UNIVERSITY OF Southampton
School of Engineering Sciences

Additively Manufactured Engine Lowering Inefficiency at Altitude (AMELIA)

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AMELIA

Project Aims

- Primary aim: To design a workable ramjet combustion chamber and nozzle
- To additively manufacture the ramjet
- To install and test the ramjet
- To set up the ramjet as a teaching aid for laboratory classes

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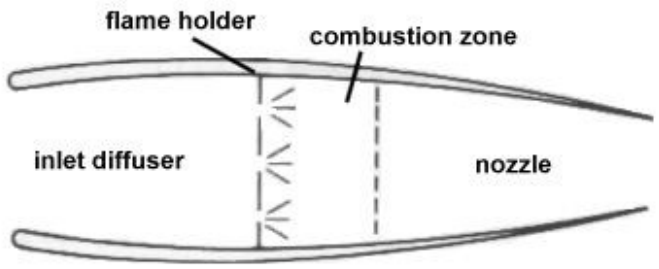
What is a Ramjet?



Ramjet

- Air enters the intake and is slowed
- Fuel is mixed into the air flow and set alight
- These heated gases are accelerated out from the nozzle, producing thrust
- Must have airflow already present to produce thrust
- Performance improves with speed

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Image source: aerospaceweb.org

Why is AMELIA special?

- Spiked plug nozzles' plumes change with altitude, compensating for pressure differences and thus providing an overall efficiency gain over a bell nozzle.
- It is envisaged the flameholding mechanism will minimise energy loss through the combustor. Thus bluff bodies will be avoided if possible.

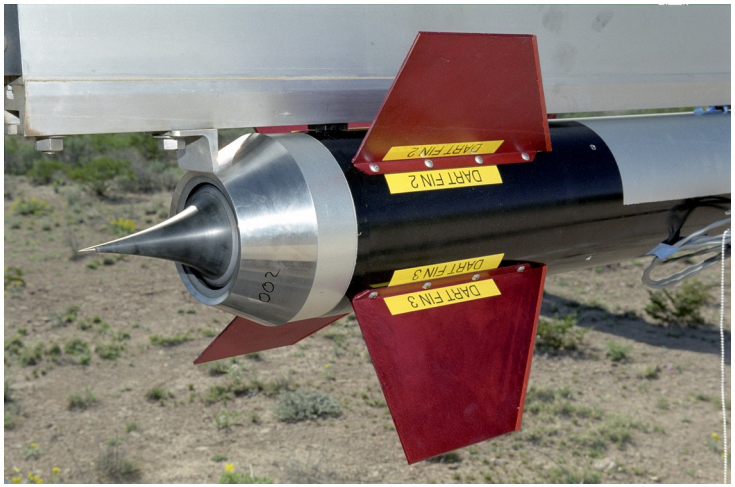

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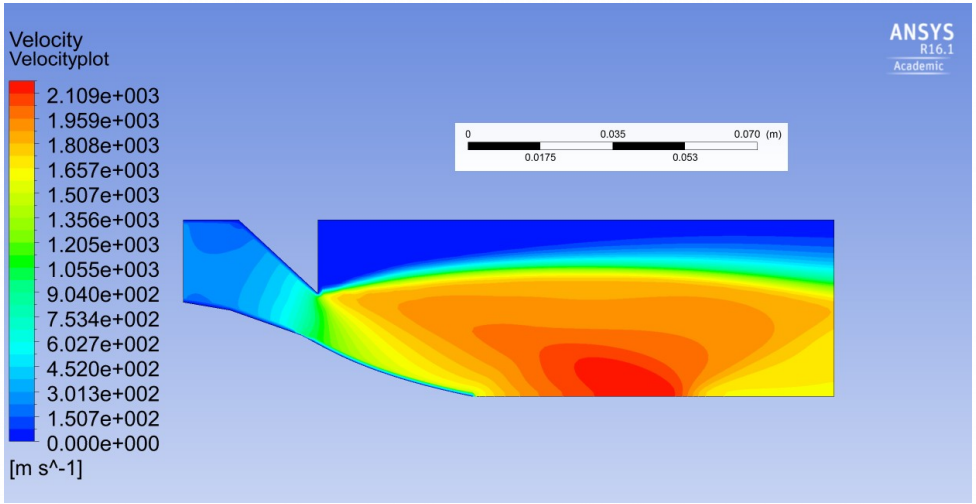
Image source: L, NASA; R, CALVEIN

Current Progress

- Basic concept established
- Initial CFD simulations completed
  - Next up: optimisation of nozzle geometry, down-selection of flameholder geometry
- Literature review begun



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Forseen issues

- Integration with the engine test cells
- Sound levels are envisaged to be dangerously high without mitigation measures
- Accurately predicting flameholding behaviour
- Ensuring sufficient progress is made in light of other commitments
- Managing heat

The Project Management Structure

- The CADMID cycle is broken down into six stages:
- Concept (Up until the 6th October)
  - In the Concept phase the need for a project is identified.
  - Options for possible solutions to the problem are identified.
  - In this project's context, the literature review is contained here, primarily.
- Assessment (6th October to 16th October)
  - In the Assessment phase the requirements are defined.
  - A single solution to the problem is identified and a logical system architecture is created.
  - In this project, a broad description of the control system's architecture will be created here.

- Demonstration (16th October to the 30th November)
  - In the Demonstration phase the solution to the requirements is defined more fully, and is used to demonstrate the compliance of the final solution with the requirements. The physical architecture of the project is created here.
  - In this project full CFD simulation will be used here to demonstrate efficiency, and the miscellaneous components of the control system will be defined and included.
- Manufacture (30th November to the 29th of April)
  - In the Manufacturing phase the final solution is built and validated.
- In-service (Depends on factors outside my control)
  - This phase begins when the project's output is accepted into use, and the project is monitored for obsolescence issues.
- Disposal
  - In this phase the obsolete solution is removed from use in such a way as to minimise the impact on the user and the environment.

Next Steps

- Contact staff members with specialisms in areas forseen to be problems. (Next few weeks)
- Assess the setup in the engine test cells. (This week – Done)
  - Next, need to get training with working in the test cells
- Further coarse CFD to try out different methods and designs. (Ongoing, aim to be done by November)
- Finer CFD to begin predicting performance and to highlight areas requiring additional investigation (Ongoing, aim to be done before mid-November)