

Summer Internship Report-out



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About Me – Nicolas Daniel Oneto Santana



- Personal
 - ❖ From Dorado, Puerto Rico
 - ❖ Hobbies: Sports, Reading, Cooking, Going to the beach
- Education
 - ❖ Iowa State University, B.S. Aerospace Engineering
- Experience
 - ❖ CapStone Senior Design, design and manufacture small unmanned aerial vehicle.
 - ❖ Research Projects:
 - Particle Image Velocimetry of Supersonic Flow
 - Aircraft Icing Physics & Anti-/De-icing Technology Laboratory

Project: Helmholtz Resonator Feasibility

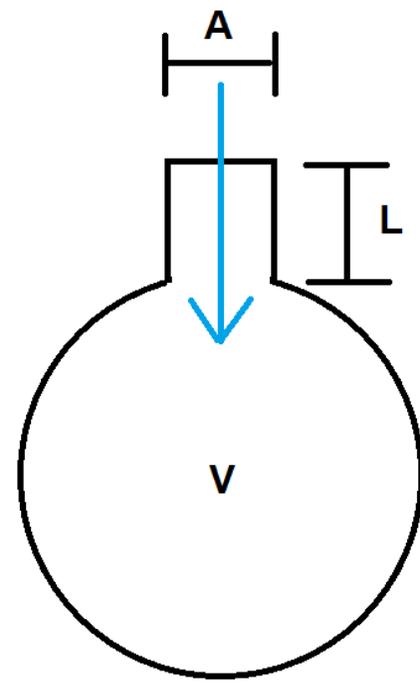


Context:

- What is a Helmholtz Resonator? A frequency-dampening technology, it is meant to dampen frequencies created by the combustion chamber. Frequency-dampers are used to keep dynamics within limits. If these frequencies are not dampened, they create flame instability and hotspots inside combustion chamber leading to damaged parts.

Goals and Requirements

- Be able to fit in current frequency-dampening system location
- Have integrated cooling to withstand F-Class combustor operating temperatures
- Be manufacturable with current technology provided by GE Vernova
- Reduce likelihood of ingestion

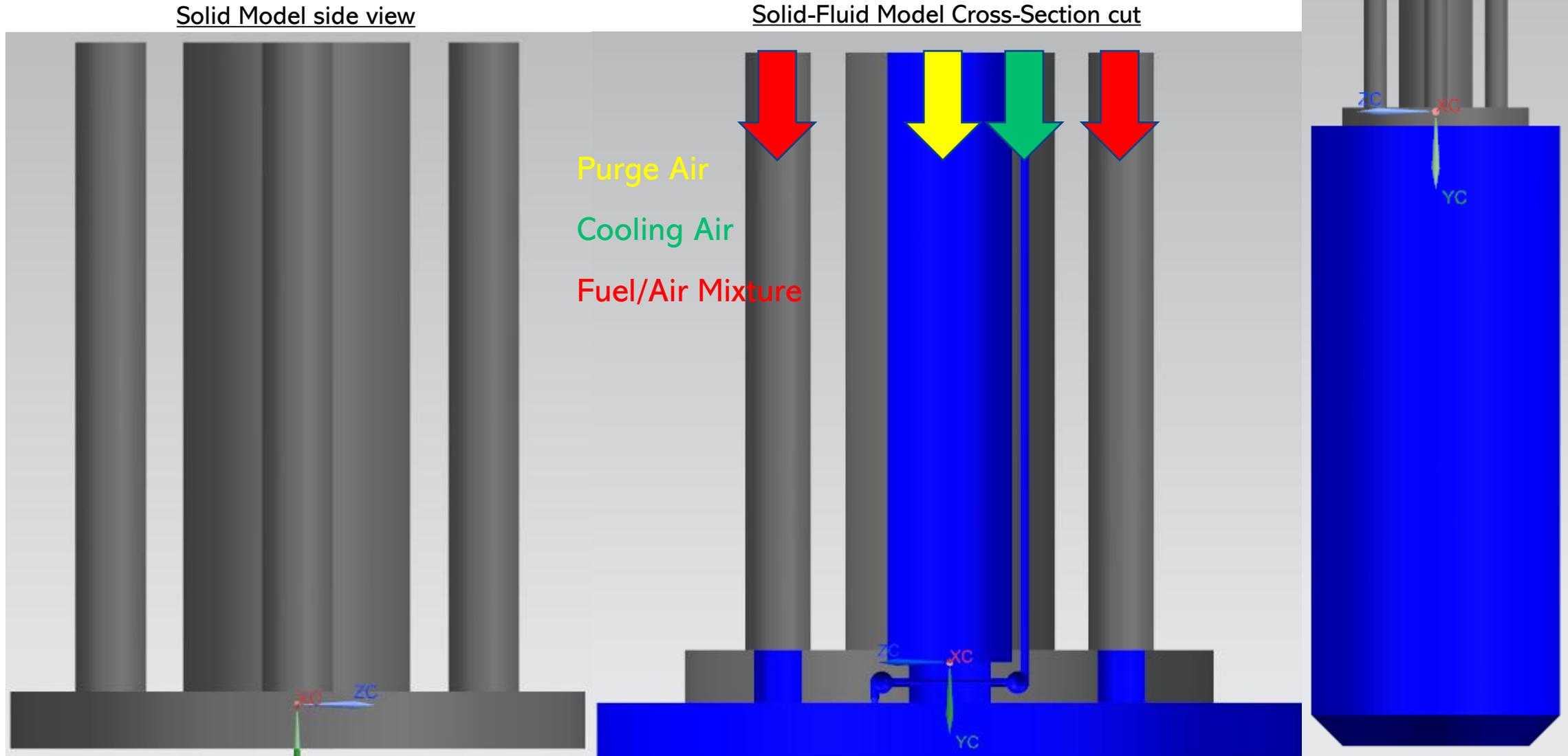


$$f = \sqrt{\gamma RT} \sqrt{\frac{A}{L * V}}$$

- f : frequency
- gamma : heat capacity ratio
- R : universal gas constant
- T : static temperature
- A : area
- L : length
- V : volume

Project: Helmholtz Resonator Feasibility

Solid and Fluid Models



Solid-Fluid full Model

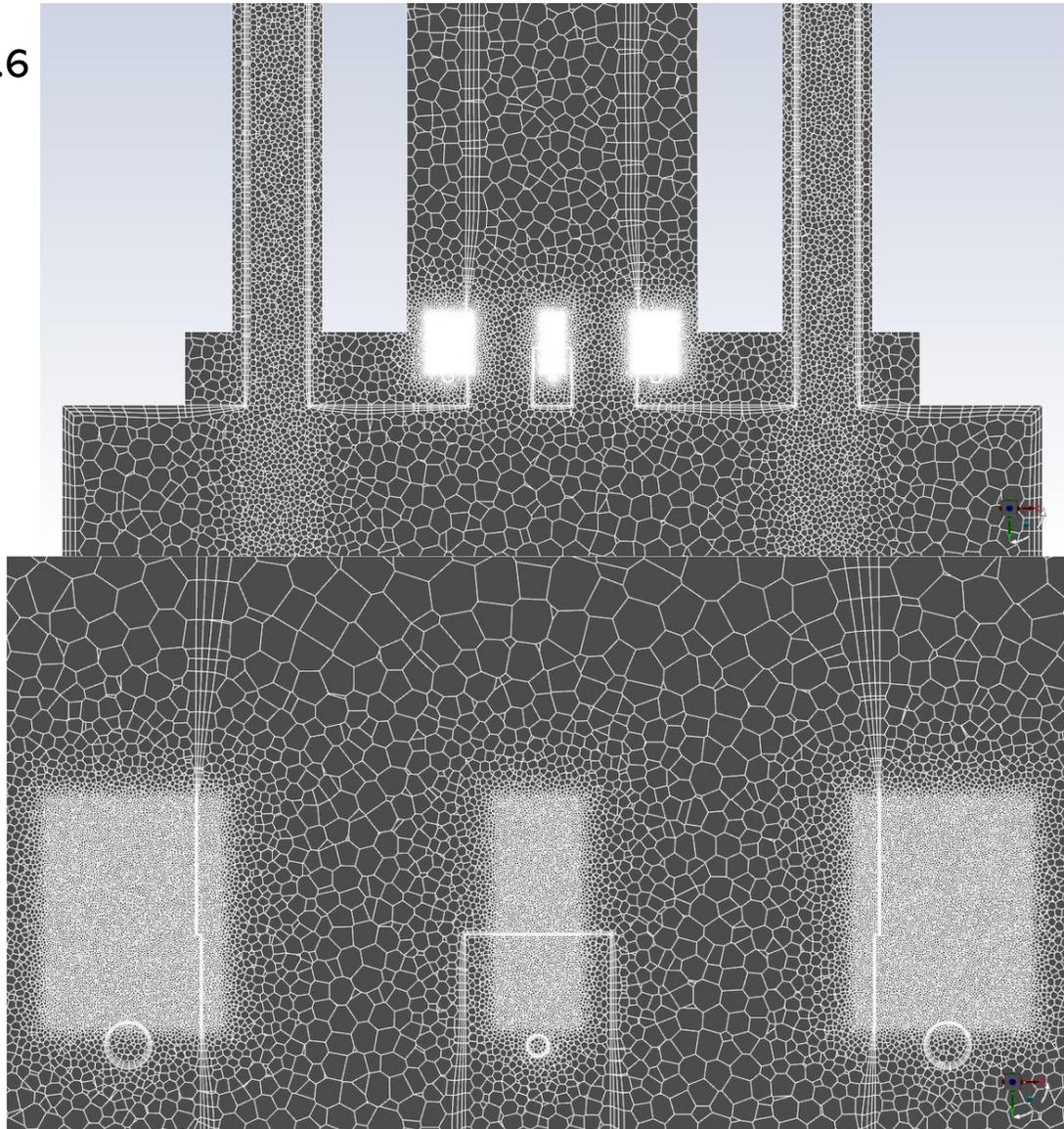
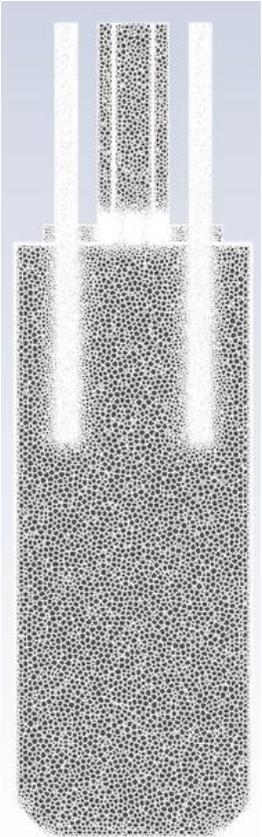


Project: Helmholtz Resonator Feasibility



CFD Mesh & Case Set-up

- Skewness >0.6



Case Set-up

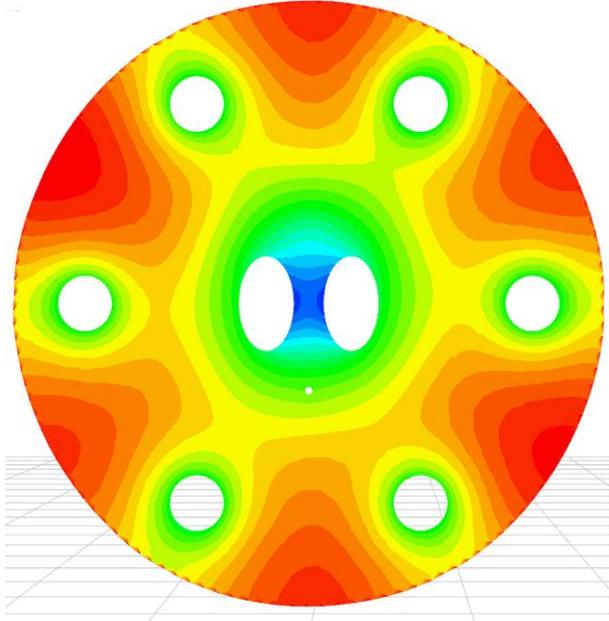
- Conjugate Heat-Transfer used to simulate convection and conduction of heat between combustion chamber and solid
- Head-End Reacting to simulate combustion reaction

Takeaways: Mesh is fine enough to provide accurate results, 2 bodies of influences were used to provide finer mesh in zones of relevance. CFD models used will simulate environment that CAD model will experience.

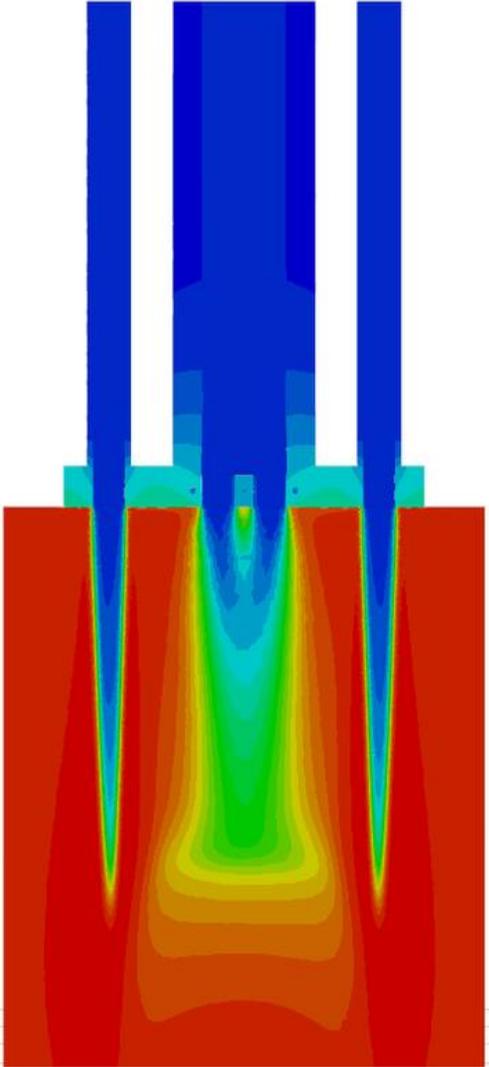
Project: Helmholtz Resonator Feasibility



Temperature Contour of Surface Facing Combustion



Temperature Contour of XY-Midplane



Takeaways/Results

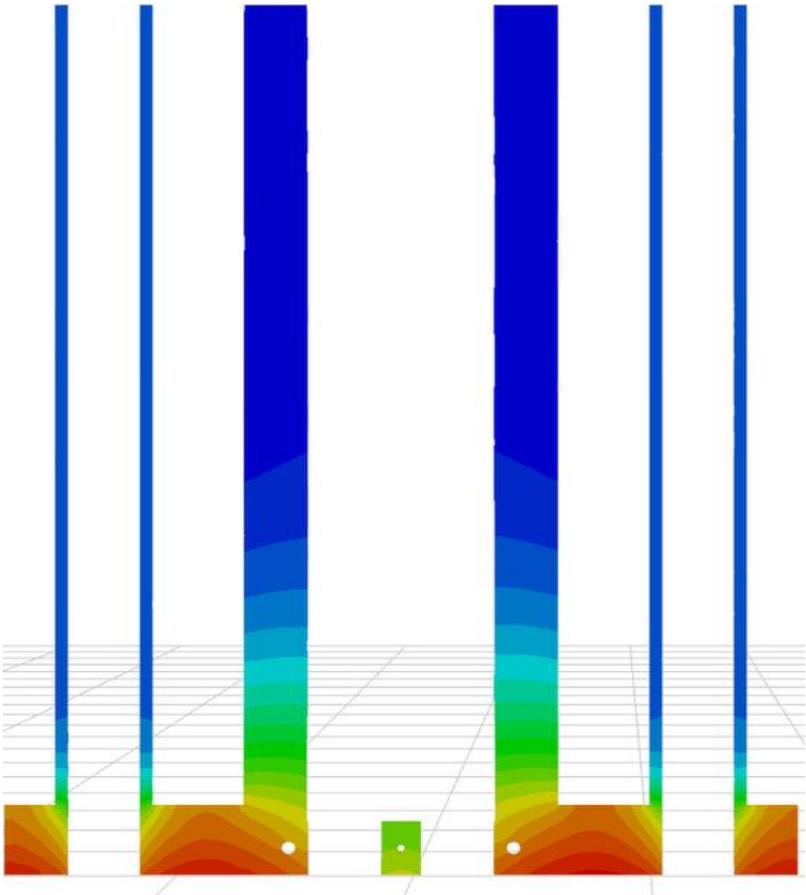
- Contours show symmetry
- Flame is well developed
- Convection is allowed to happen between the plate surface and dump freestream
- Conduction is happening through the length of the solid
- Temperature on plate facing hot side within material capability
- Hot gas ingestion prevented
- Showed possible feasibility

Project: Helmholtz Resonator Feasibility



Takeaways/Results (continued)

Temperature Contour of XY-Midplane Cut of Solid



Velocity Contour of XY-Midplane

