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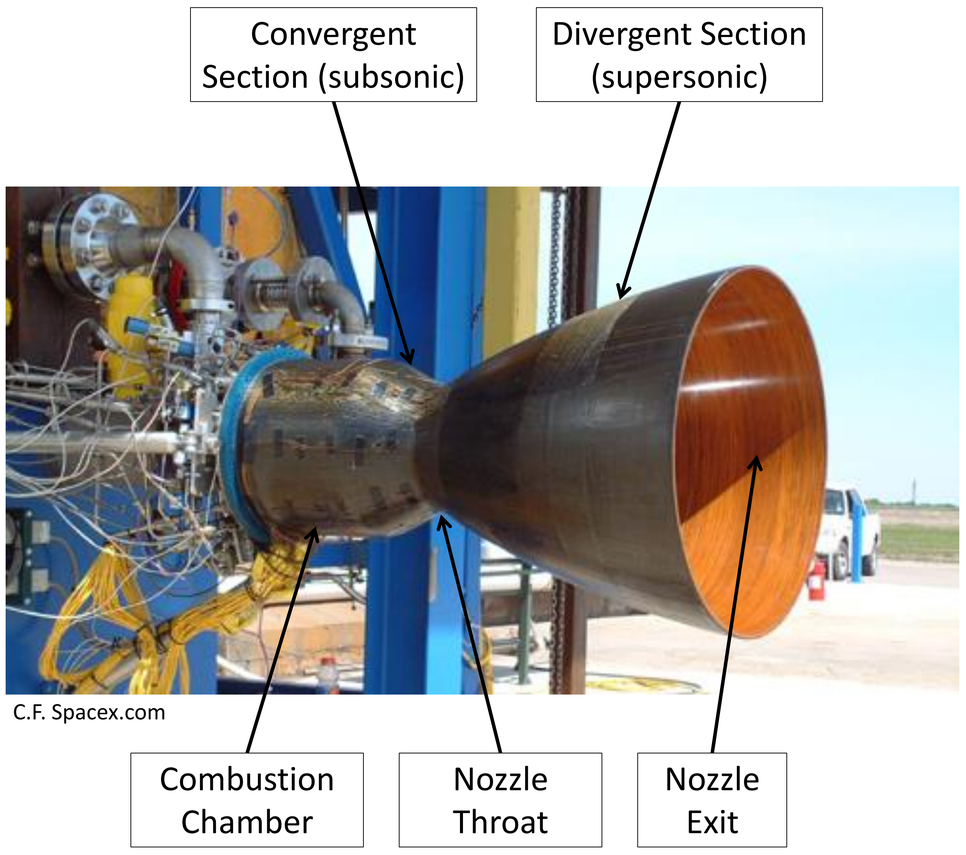
Development of a Converging-Diverging Nozzle for Lab Use

Background:

Converging-Diverging Nozzles are primarily used to accelerate a combusting gas mixture to supersonic velocities. They are currently the only method of getting objects into space. However the equations governing nozzles may be successfully applied in wind tunnels, diffusers, and nozzles for measuring the velocity of a gas.



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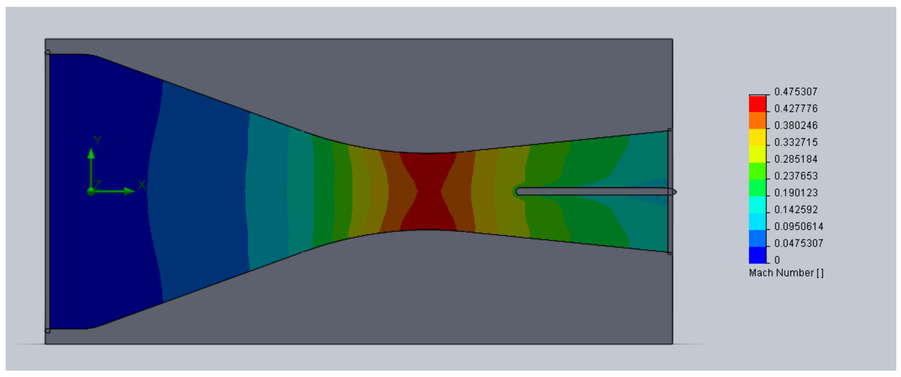
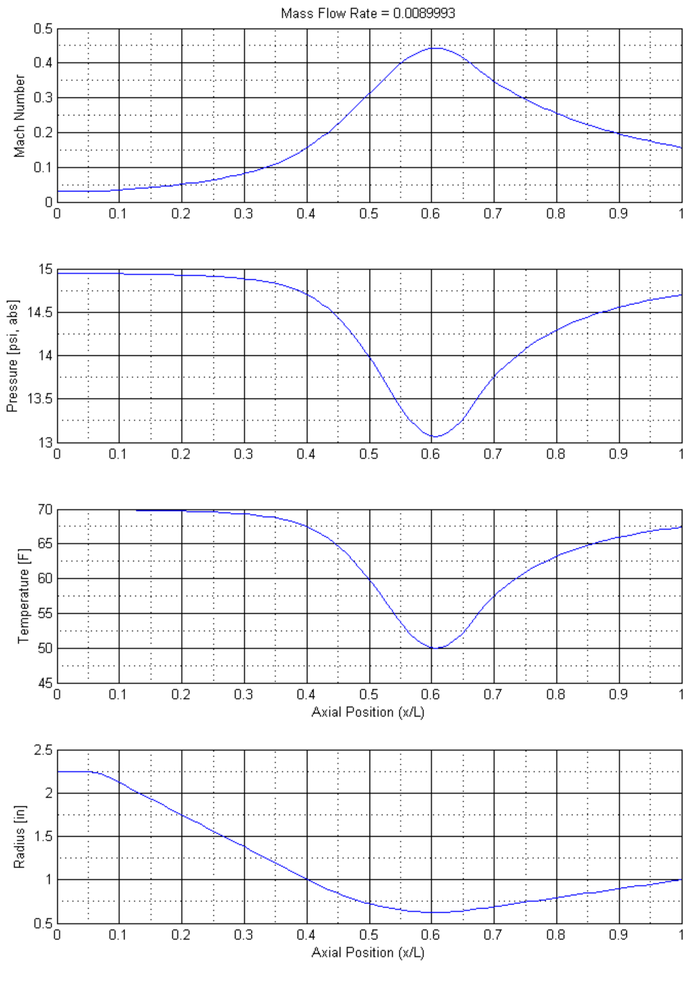
Design:

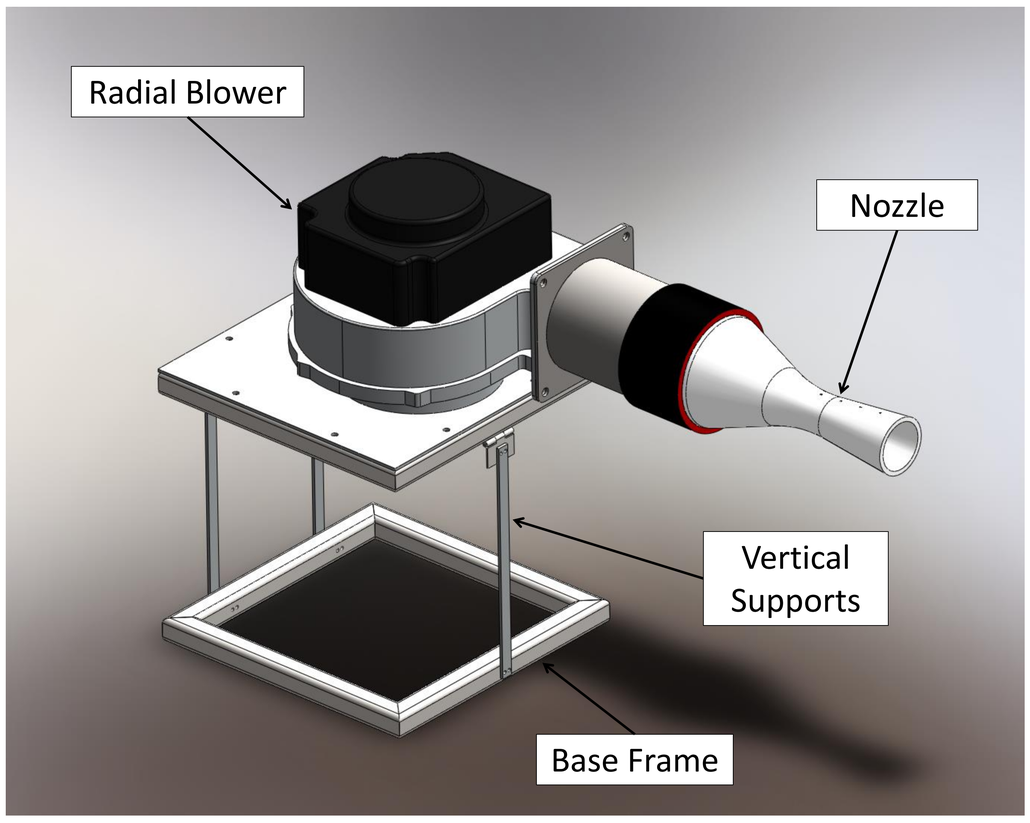
- A simple model of the nozzle was created in SolidWorks in order to take advantage of the Flow Simulation software.
- A macro was created to take slices of the 3D model and save each slice's area to a text file.
- A Matlab script was written to take the section areas from SolidWorks and compute the pressure, temperature, and Mach number distribution in the model.
- The solutions determined from the Matlab script were verified using a computational fluid dynamics model in the Flow Simulation software.





Objectives:

- The primary goal of this project was do develop a greater understanding of the process of designing a converging-diverging nozzle.
- The secondary goal was to develop a lab for the Mechanical Engineering Dept. Advanced Measurements Lab.



Instrumentation:

- The following are the properties of interest in the analysis of a gas nozzle:
  - Static Pressure
  - Stagnation Pressure
  - Static Temperature
  - Stagnation Temperature
  - Thrust
- The above properties are easily determined through the use of Pitot-Static probes, and Temperature Probes.
- Thrust may be measured by strain gages mounted on the vertical supports

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