

# Modeling Liquid Propellant Rocket Nozzle using MATLAB and SolidWorks

## Purpose

Quickly determine the design of a rocket nozzle based on engine parameters such as:

- Combustion Chamber Pressure and Temperature
- Thrust
- Optimized Altitude
- Propellant Properties (Coefficient of Heats and Gas Constant)

## Algorithm<sup>[1]</sup>

Import engine performance parameters from Excel to MATLAB



Calculate flow conditions at the throat and nozzle exit



Use Prandtl-Meyer Expansion Function to calculate left and right running characteristic lines



Create 2D plot of calculated nozzle shape

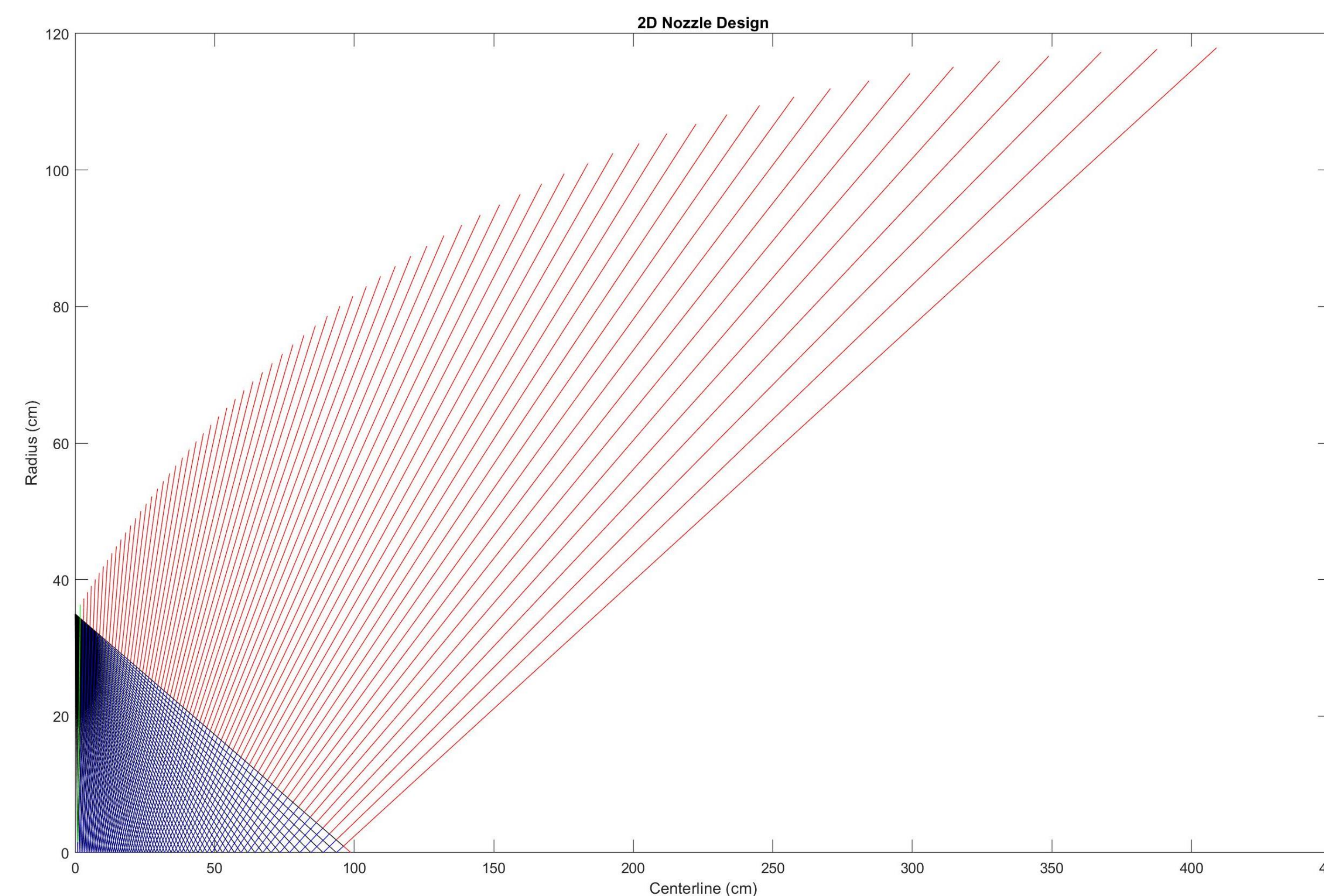


Export nozzle wall points into an Excel file

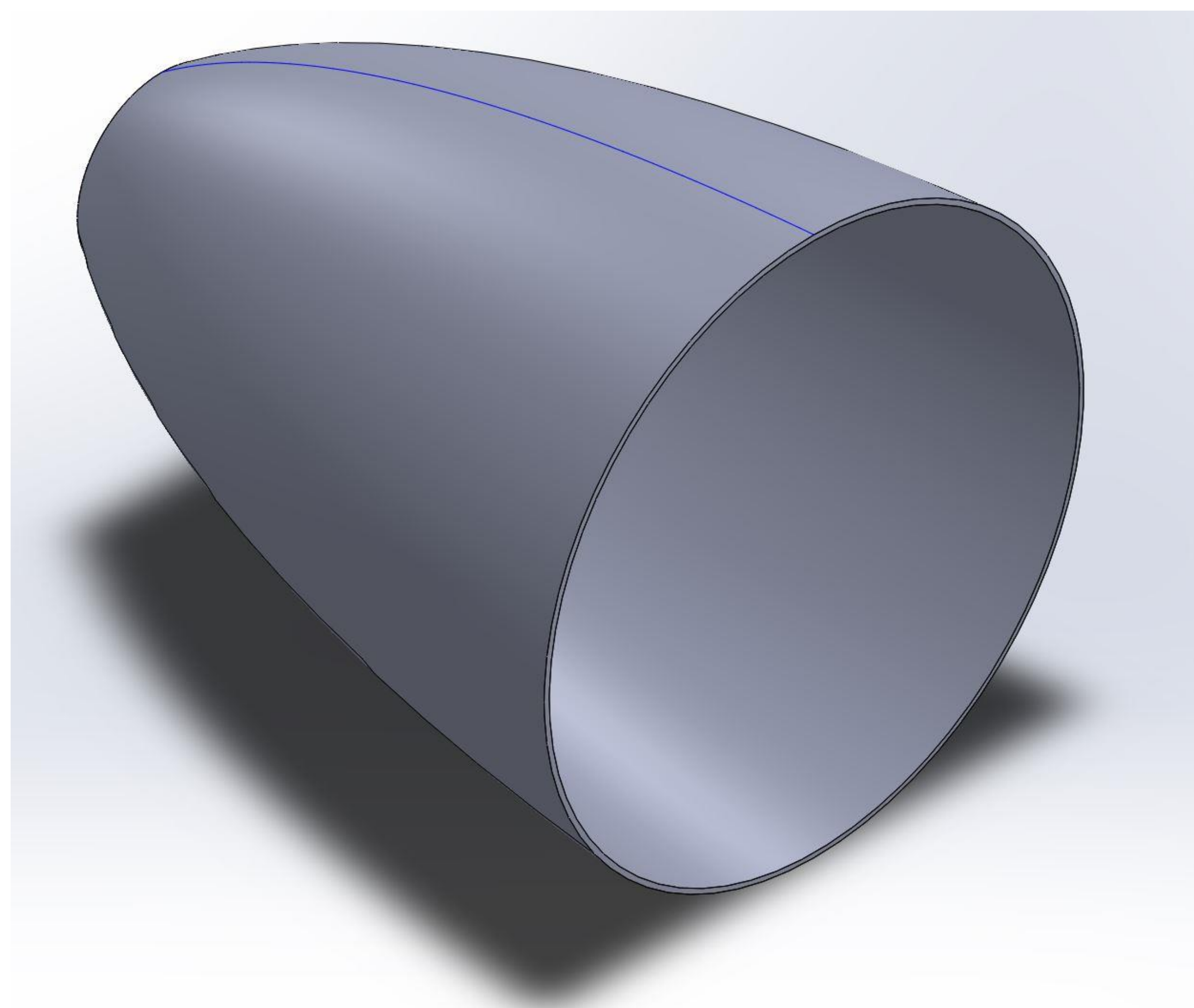


Import wall coordinates into Solidworks and generate 3D model

## 2D Nozzle Plot



## 3D Nozzle Model



\*Nozzle Dimensions:  
Throat Radius: 35cm      Exit Radius: 118cm      Nozzle Length: 410cm

## Benefits

- Quickly determine basic nozzle design for desired engine performance
- Rapid design early in a project allows for more time troubleshooting and testing
- Easy to modify engine parameters and observe changes in design
- Possibilities to modify MATLAB program to include additional design parameters

## For the Future

- Perform CFD analysis on designed nozzles to verify performance
- Fabricate models for analysis
- Test nozzles in wind tunnels
- Test nozzles on test stand/vehicle

## References

- [1] VDEngineering, Rocket Engine Design with MATLAB and Solidworks – Method of Characteristics Nozzle Tutorial!, 2018 [Streaming Video]. Available: [https://www.youtube.com/watch?v=iRuG\\_Zbz2Ig](https://www.youtube.com/watch?v=iRuG_Zbz2Ig)