Homework 1.2

Assignment 1.2 Date Assigned: **Wednesday September 8, 2021**
Date Due: **Mondy September 20, 2021**
Title: 2-D ***Method of Characteristics*** (M.O.C.) Grid Solver Development
Num. of Points: 10

- Code and Verify subroutines or scripts for
  - Initial Data Line along Expansion Section Wall
  - Internal Flow Unit Process
  - Centerline Intercept Unit Process (C- characteristic line)
  - Wall Intercept Unit Process (C+ characteristic line)
  - Minimum Length Nozzle Maximum Turning Angle
- Link and Sequence Unit Process Modules to Calculate M.O.C Grid

Homework 1.2 (2)

Solve Problem 11.1 in Anderson, page 429. (See Section 1.1 Notes for Example)

... Minimum Length Nozzle with Maximum Turning Angle -- infinitesimal expansion section

... $M_{exit} = 2.0$

... $D^* = 2.0$ cm

... Assume $\gamma = 1.4$

... Repeat with $\gamma = 1.2$

Solve Problem 11.2 in Anderson, Page 430 but with ...

... Finite expansion section radius of Curvature equal to 1.5 x throat radius

... $M_{exit} = 2.0$

... $D^* = 2.0$ cm

... Assume $\gamma = 1.4$

... Repeat with $\gamma = 1.2$

for all parts

Plot nozzle half-contours

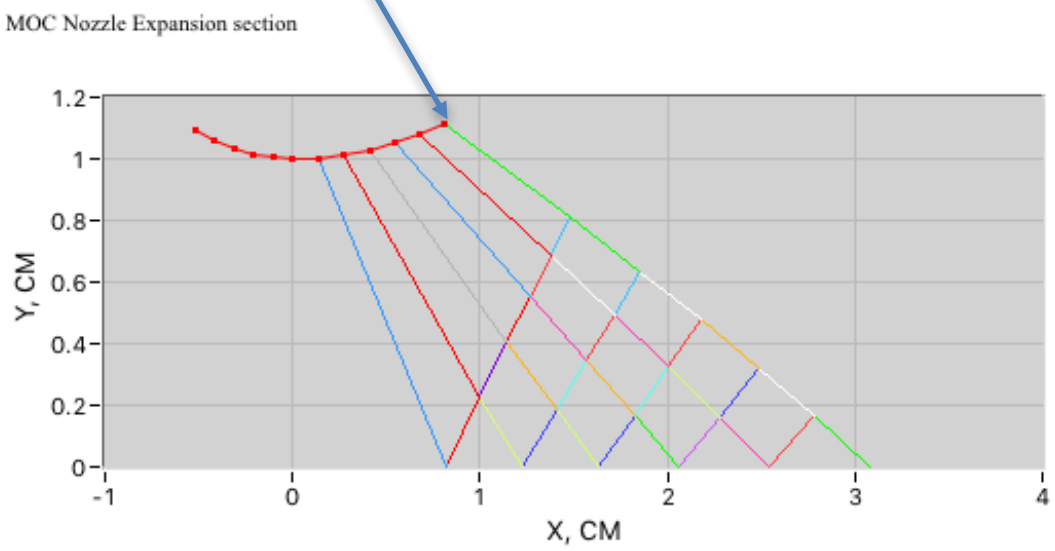
Plot nozzle Mach number profile along upper wall and along centerline

Compare to Mach number profile calculated using A/A* equation

Homework 1.2 (3)

For each of the 4 Nozzle Contours above →

- Use the approximate "bell-curve" mapping technique to solve for P, Q, S, and T of the Parabolic Contour
- Plot Contours against the derived M.O.C contours, compare shapes
- Use M.O.C. values for θ_{max}, Nozzle length L_N, and Radius of Curvature R_c of the expansion section for these calculations
- Be sure to show Calculations for X_n, Y_n, P, Q, S, T, etc.
- Assume Nozzle exit angle is zero for each case
- Use "X" data from turning section to create Bell curve
- Assume X_n, Y_n are from final point on wall for *Expansion Section*



- Assume X_e, Y_e are from final point on Turning Section wall