

# 2006 UTSR Gas Turbine Industrial Fellowship Program

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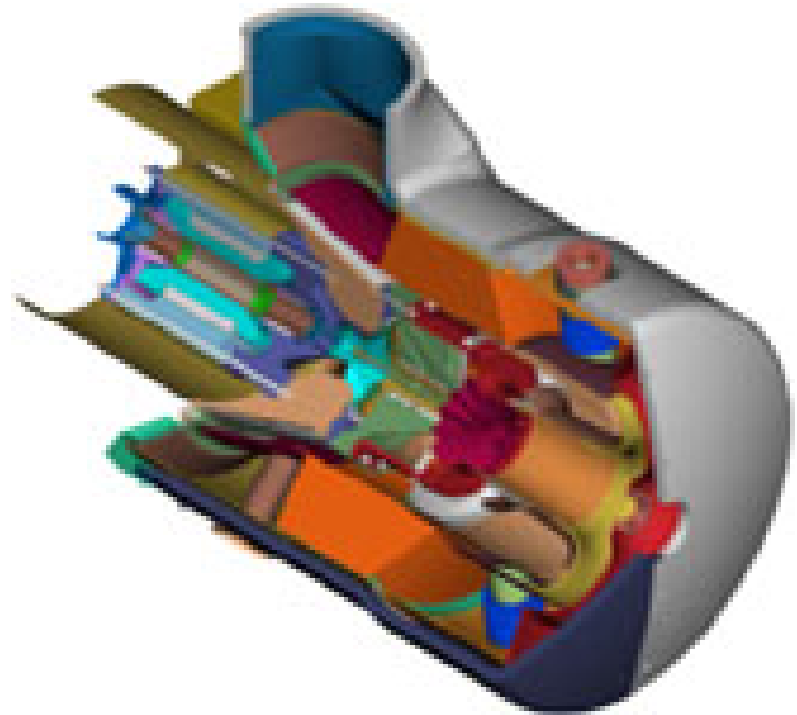
# Heat Transfer Model

## Project Description:

- Develop a heat transfer Model in ANSYS with an integrated secondary flow network

## Project Objectives:

- Couple the thermal and stress analysis in a single model, thus giving Capstone new modeling capabilities

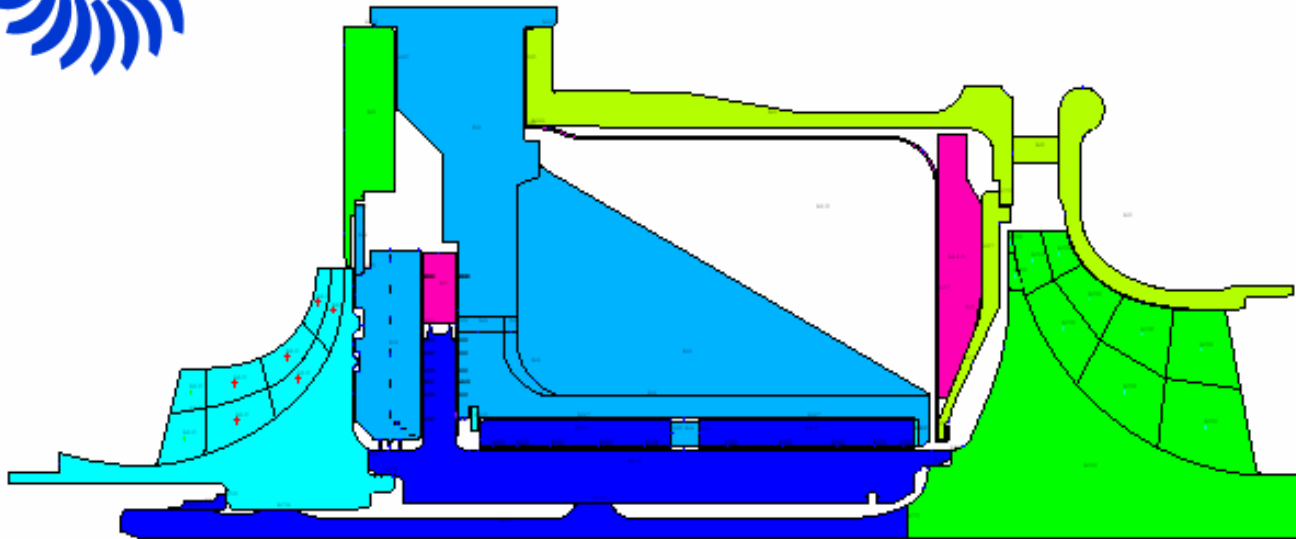




# Heat Transfer Model Documentation

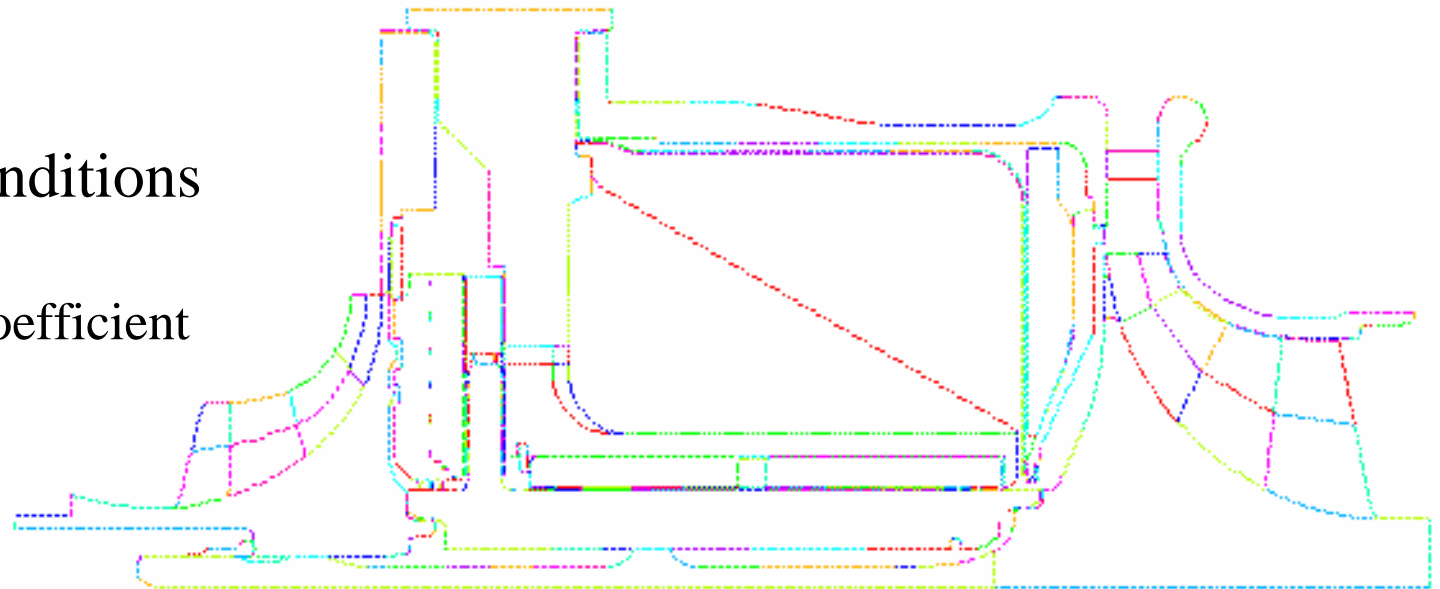
## Material Properties

- density
- thermal conductivity
- specific heat



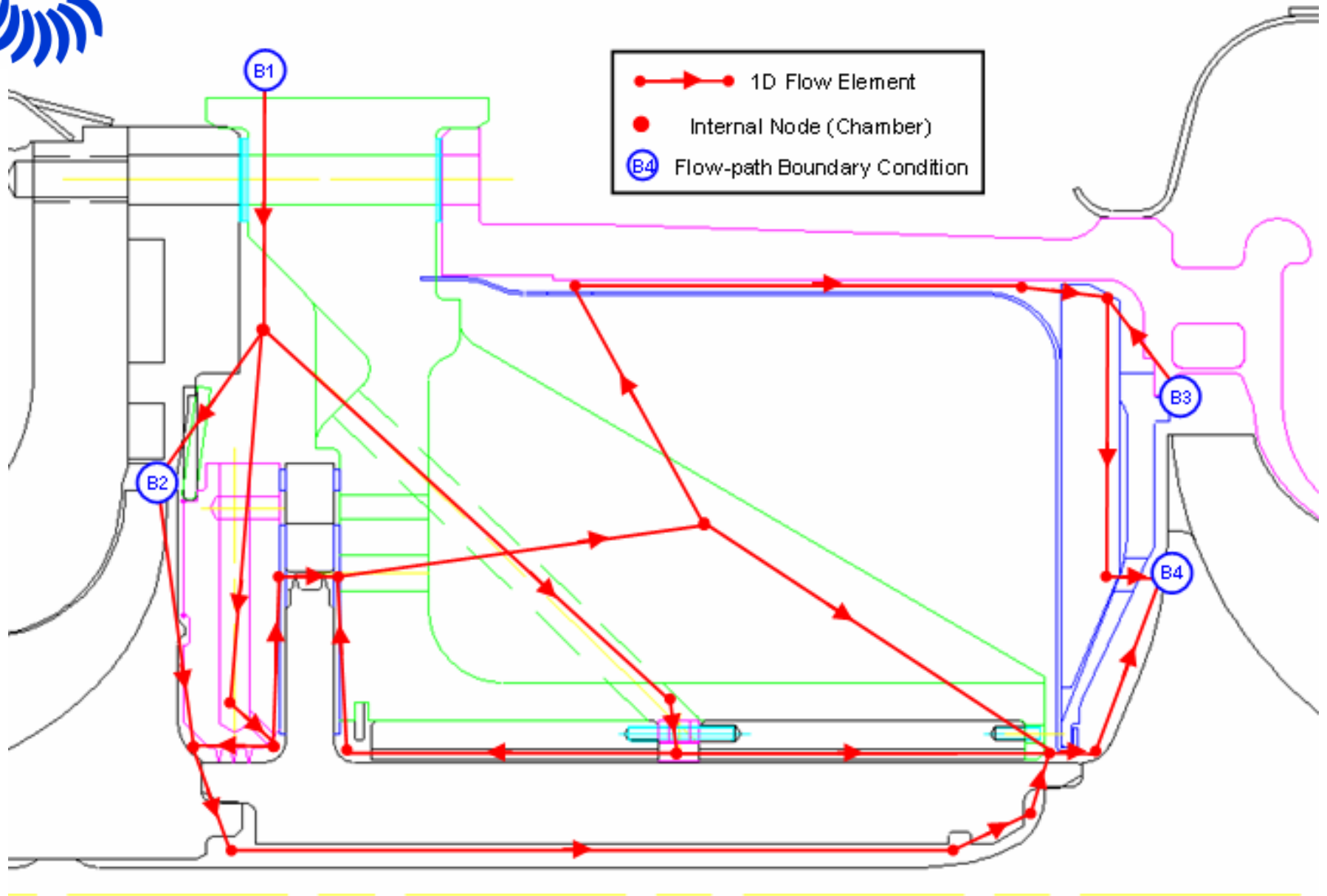
## Boundary Conditions

- temperature
- heat transfer coefficient



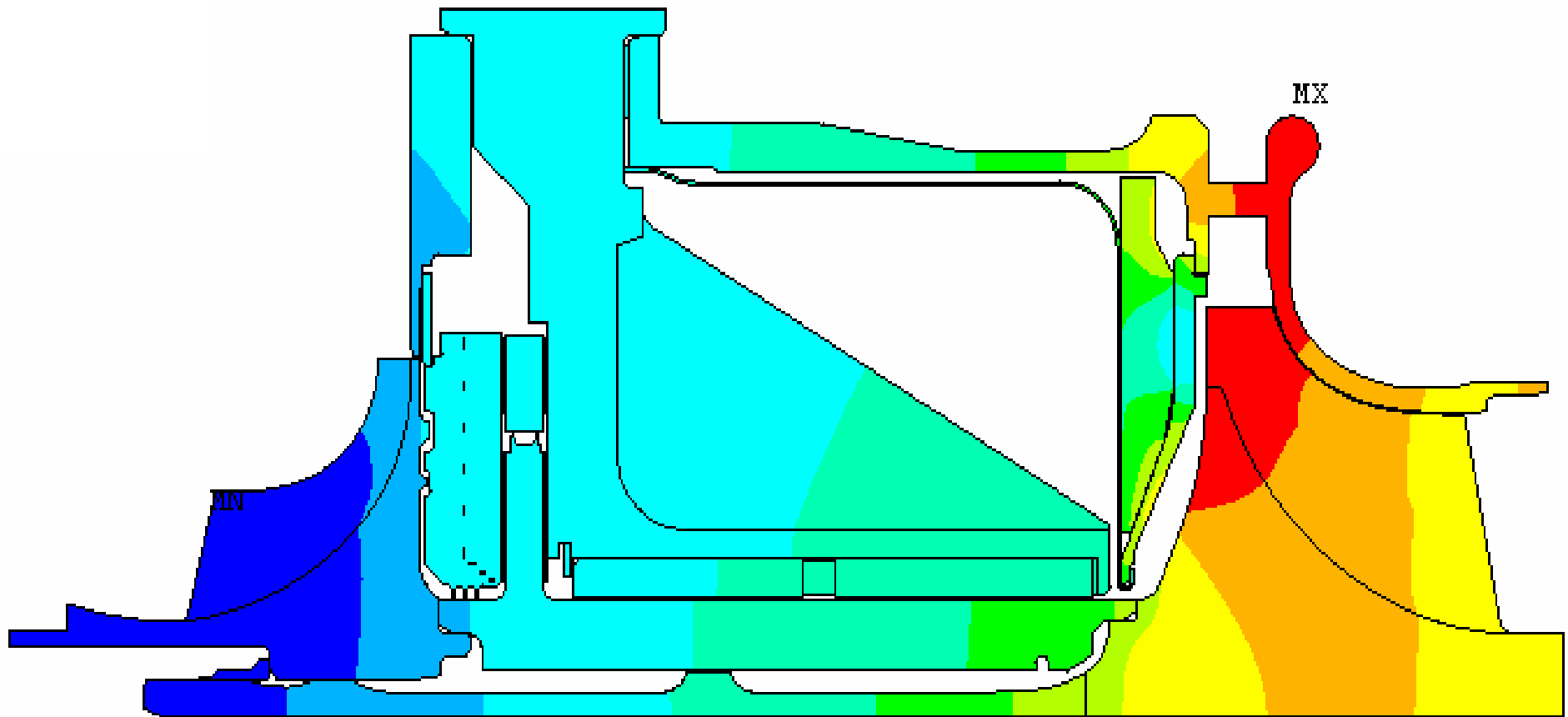


# Secondary Flow Networking





# Steady State Solution



Example of pre-validated steady-state temperature distribution



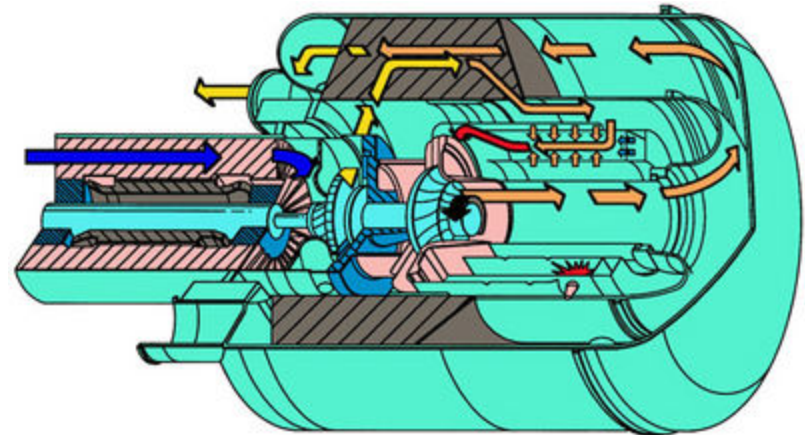
# Compressor Rig Testing

## Project Description:

- Experimentally obtain compressor performance measurements

## Project Objectives:

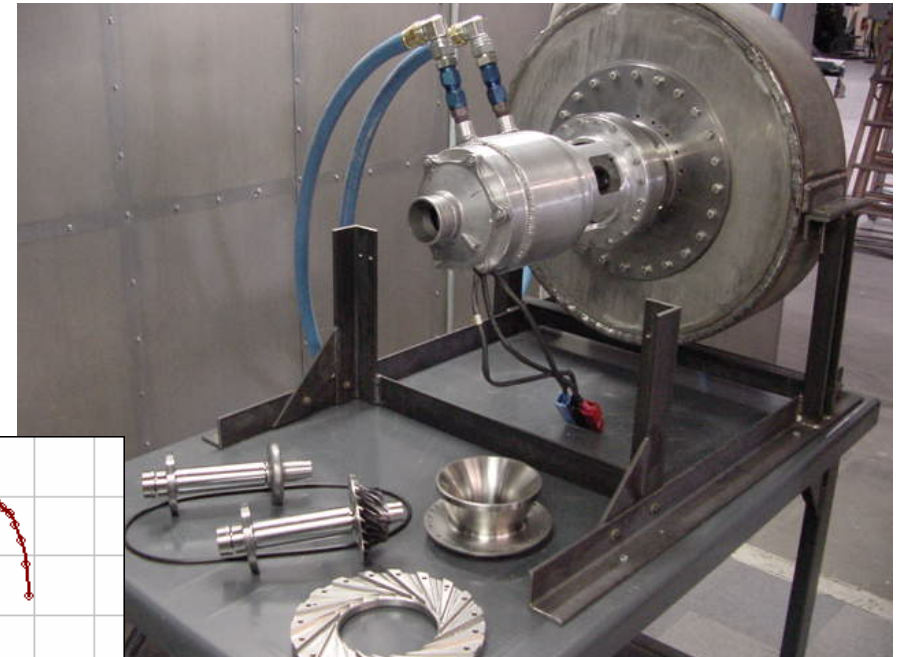
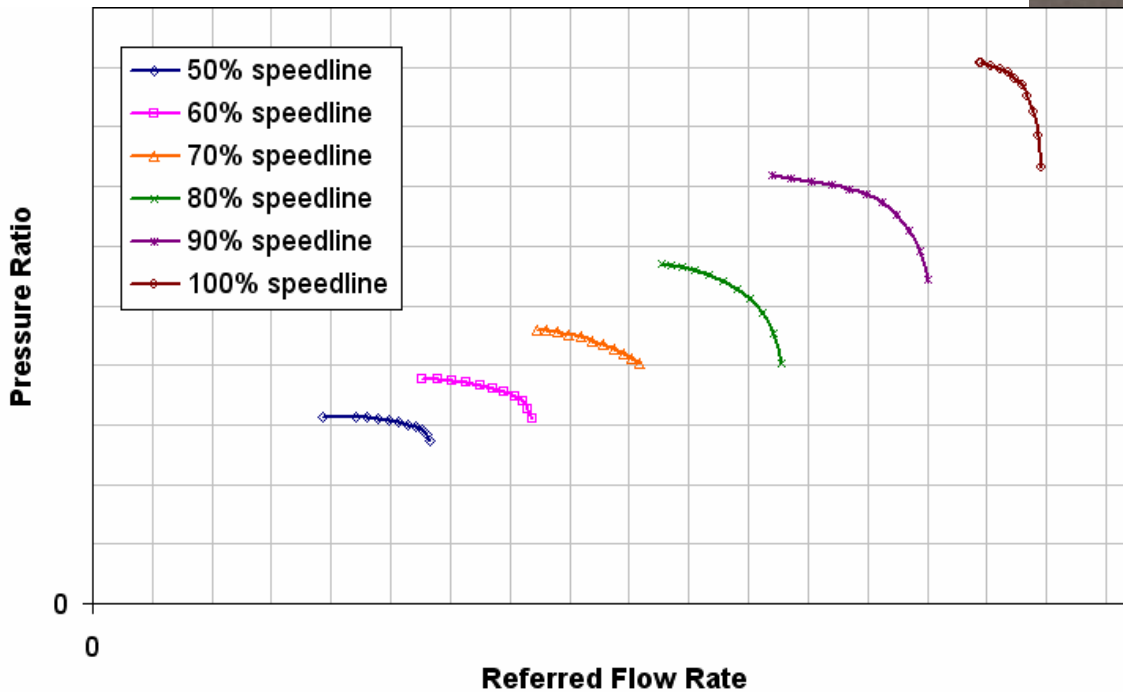
- Create a compressor map to obtain more precise efficiency values to validate and improve performance predictions





# Compressor Rig Measurements

- Compressor map with speed-lines between 50% and 100%



- Un-instrumented compressor rig with compressor components



# Turbine Nozzle Model

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## Project Description:

- Create a turbine nozzle model and perform a CFD study under variable inlet flow conditions.

## Project Objectives:

- Support a combustion redesign
- Understand how variable inlet swirl conditions affect the performance of the turbine nozzle.

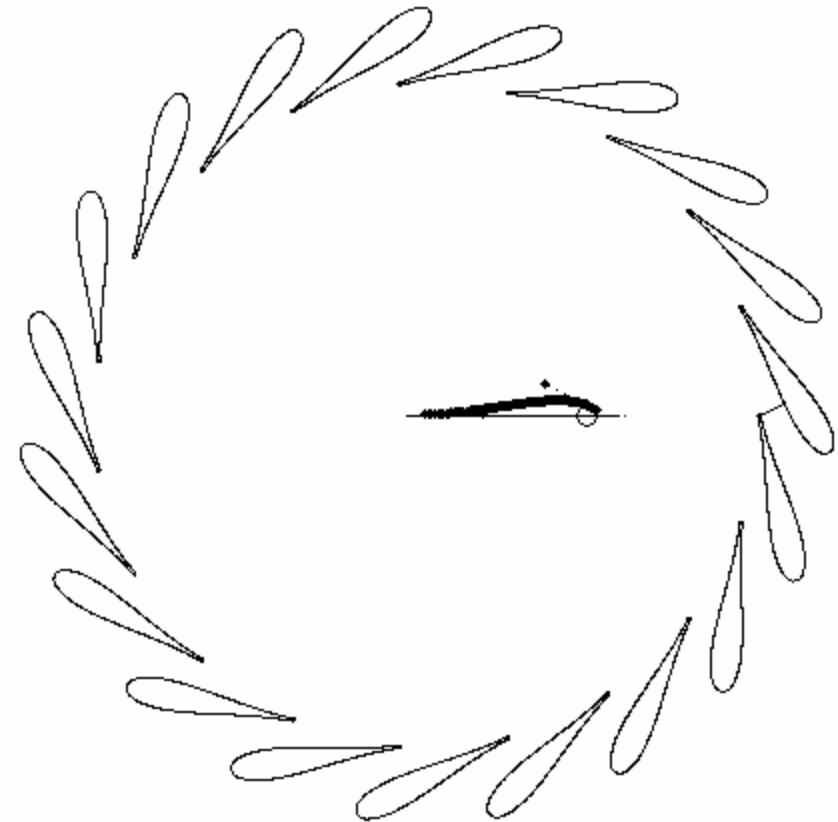
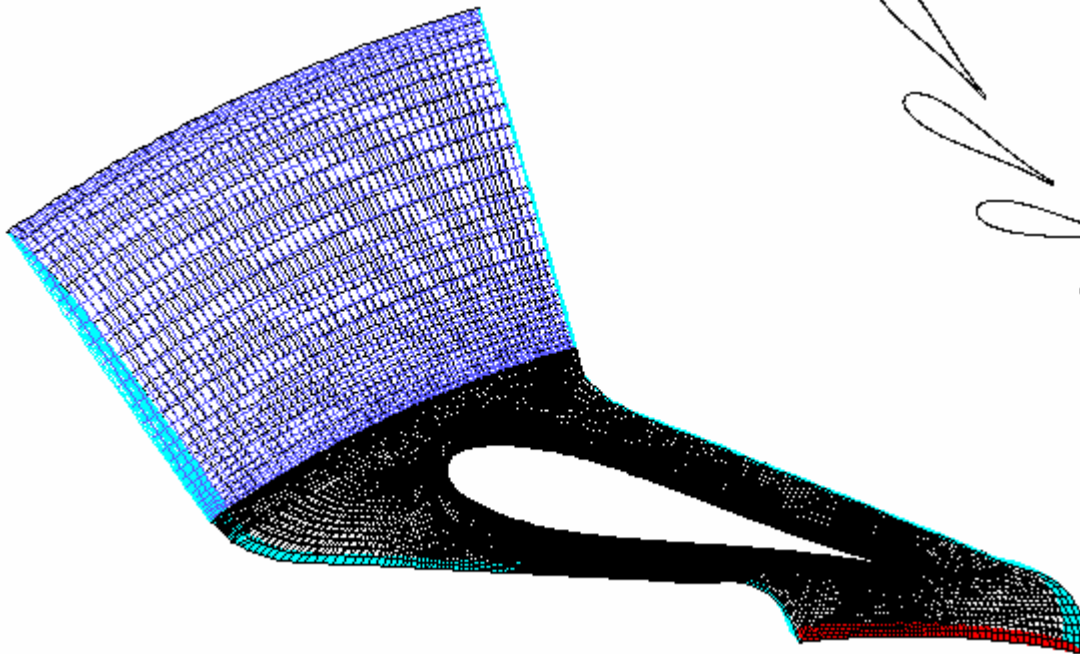




# Turbine Nozzle Model

## Creating Nozzle Geometry

- reconstructing nozzle profiles using Vellum
- creating 3-D model and mesh using G/Turbo and Gambit



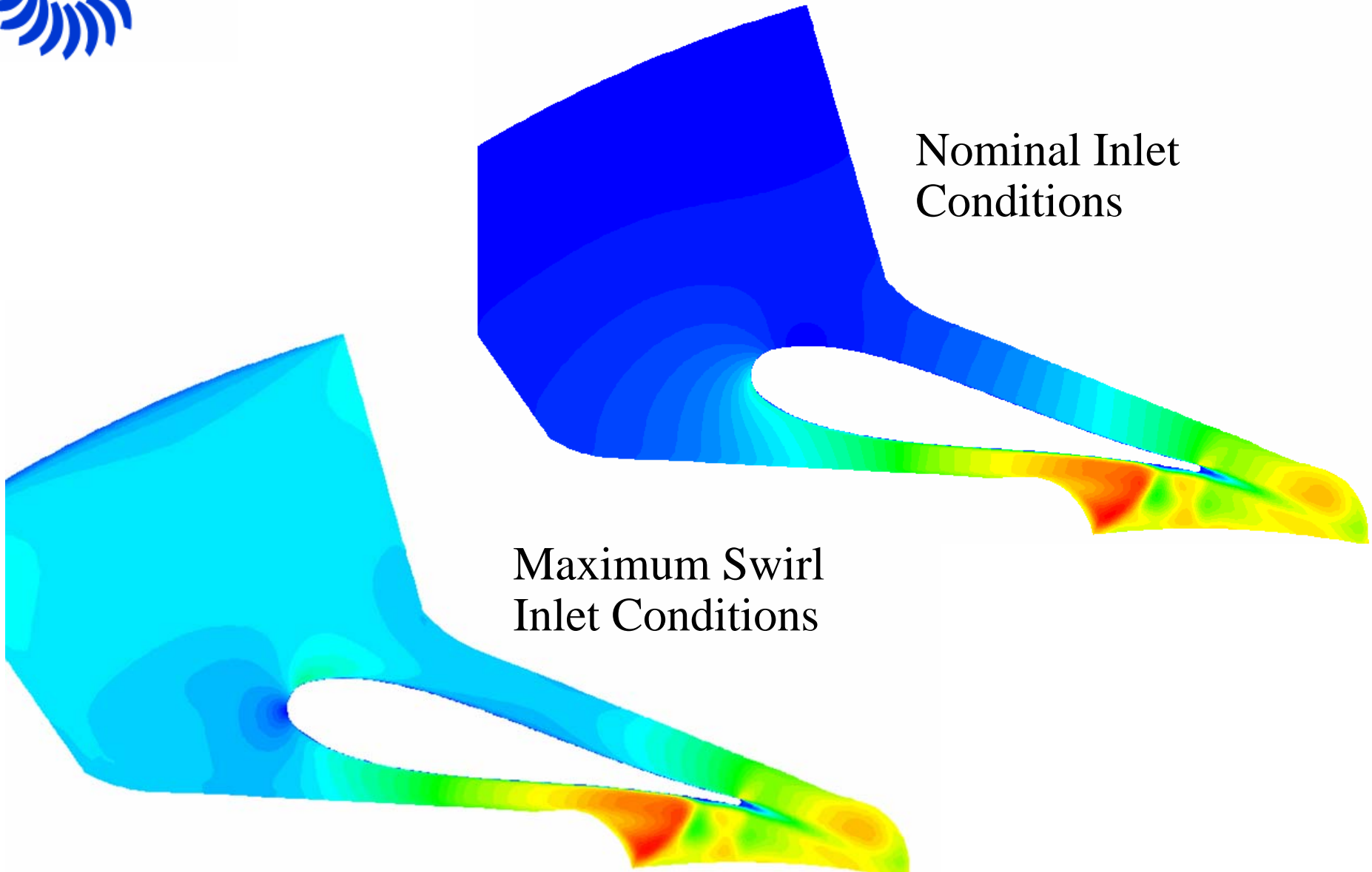


# Vane Mid-span Mach Numbers

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Nominal Inlet  
Conditions

Maximum Swirl  
Inlet Conditions



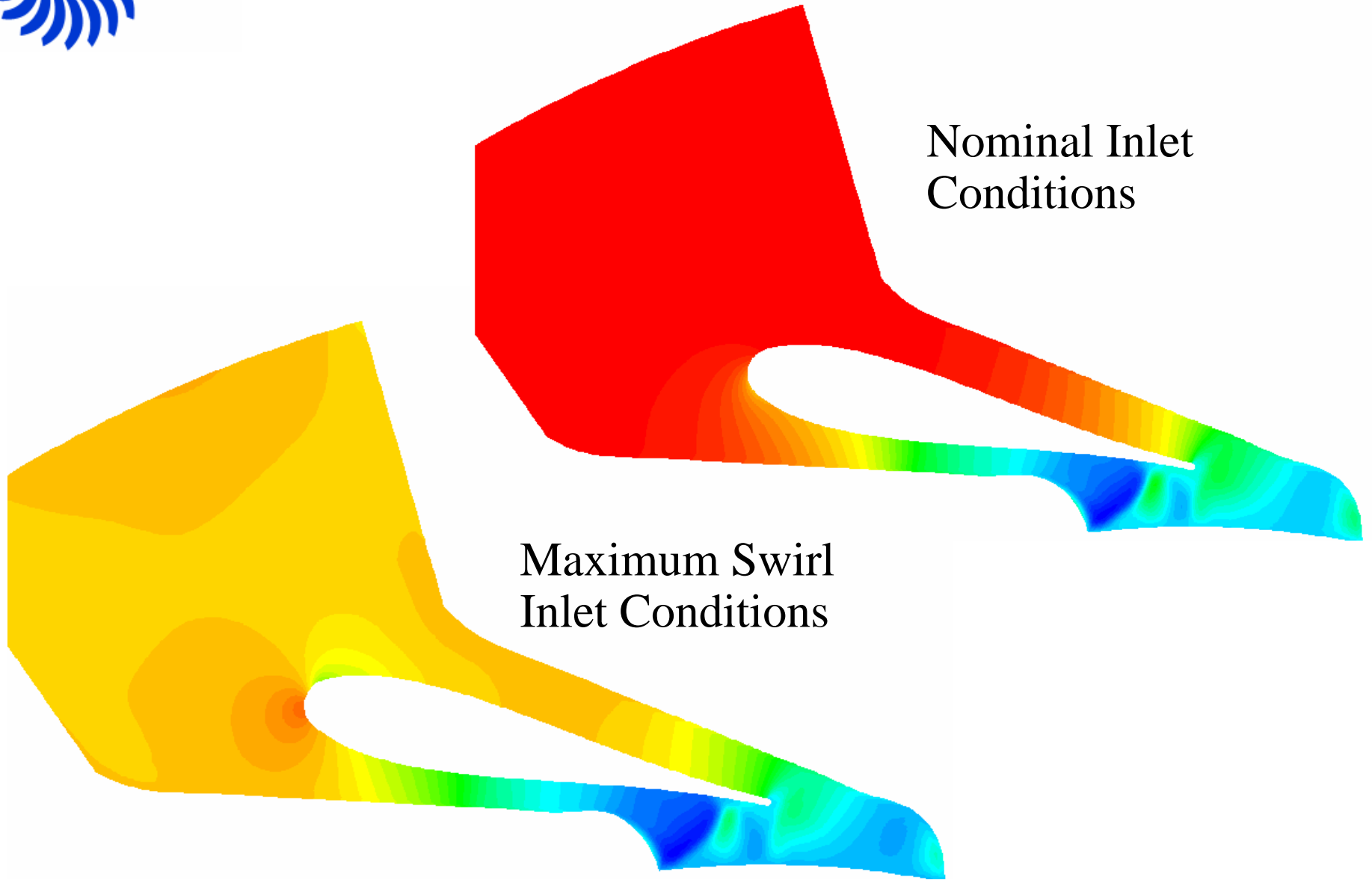


# Mid-span Pressure Distributions

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Nominal Inlet  
Conditions

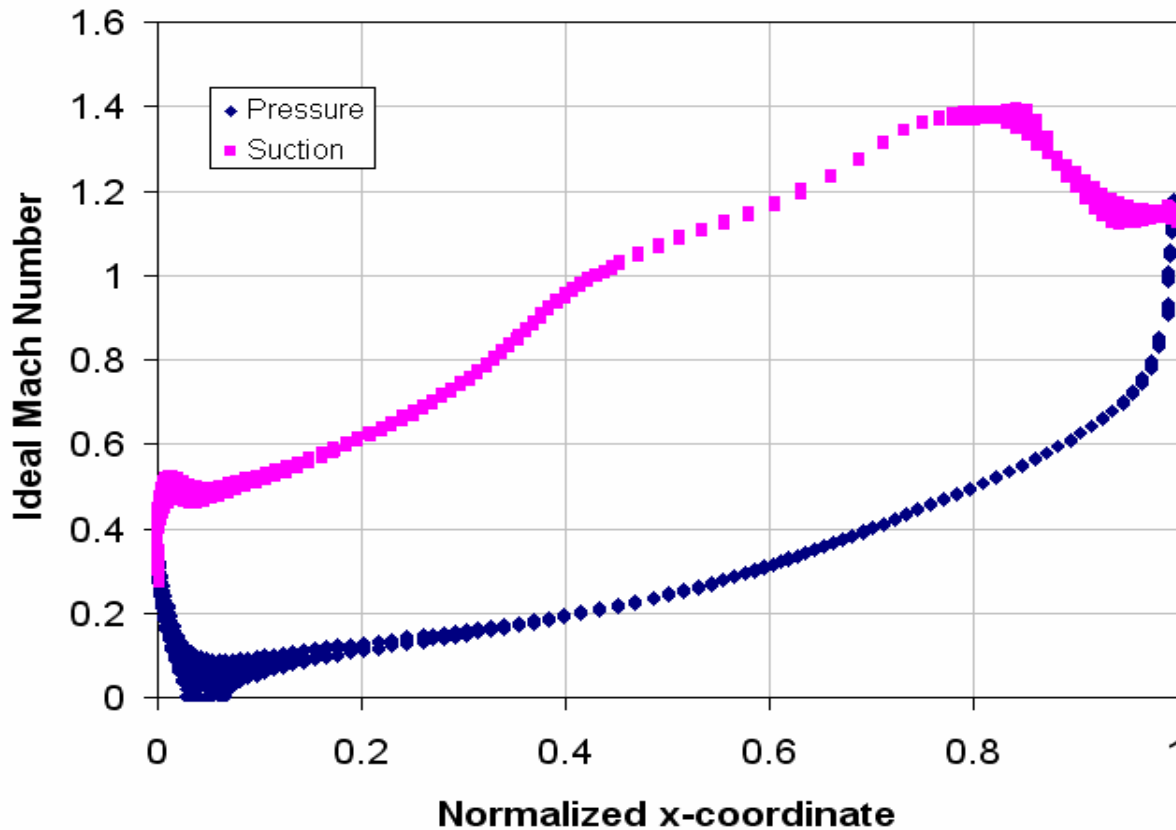
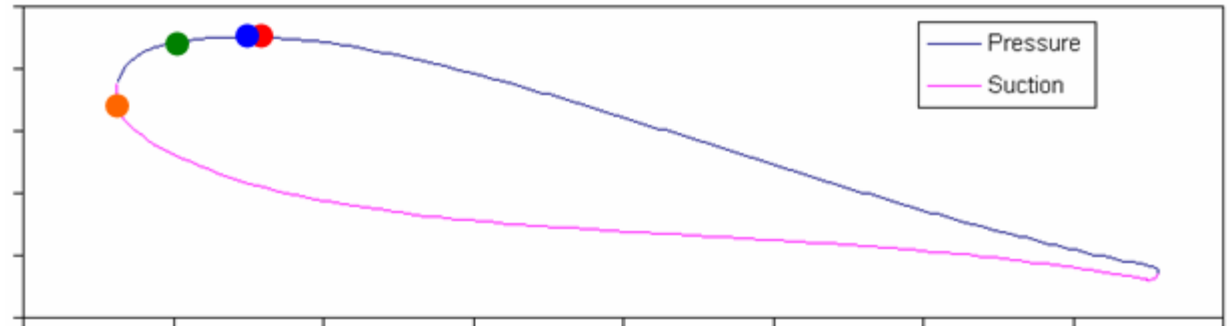
Maximum Swirl  
Inlet Conditions





# Further Nozzle Results

Stagnation locations  
under various inlet  
conditions



Nozzle Vane loading  
at an intermediate  
inlet condition



## Conclusion

UTSR Fellowship experience has allowed me to develop skills and experience with

- Heat Transfer and Stress Analysis techniques using commercial engineering software
- Experimental techniques and data acquisition
- Turbomachinery design and 3-D Computational Fluid Dynamics

Special Thanks to my mentor Dan DeMore and UTSR for the valuable experience