Development of an alternate approach for determining propeller blade stresses

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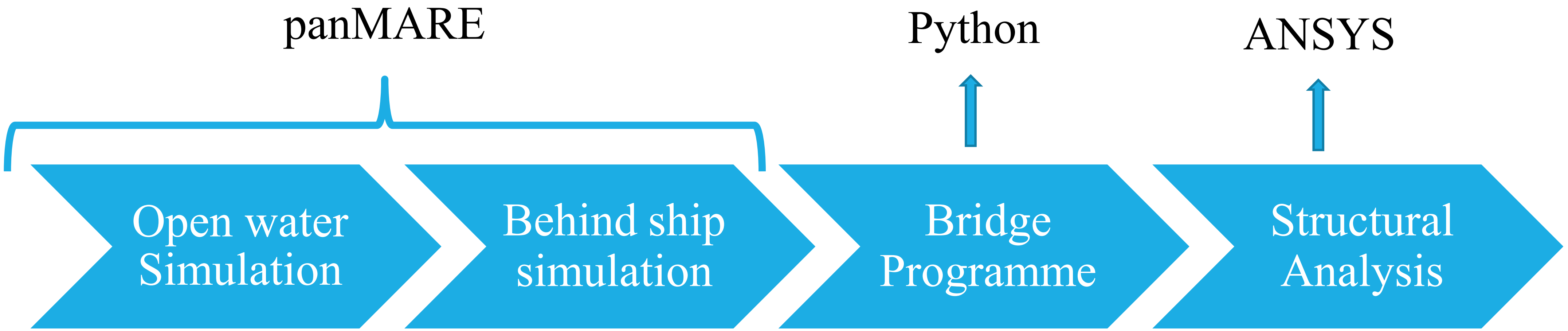
EMSHIP 8TH COHORT

MOTIVATION

- Prepare alternate approach - propeller blade stresses
- Reduce analysis time and steps involved
- Automate steps involved –CFD and FEM

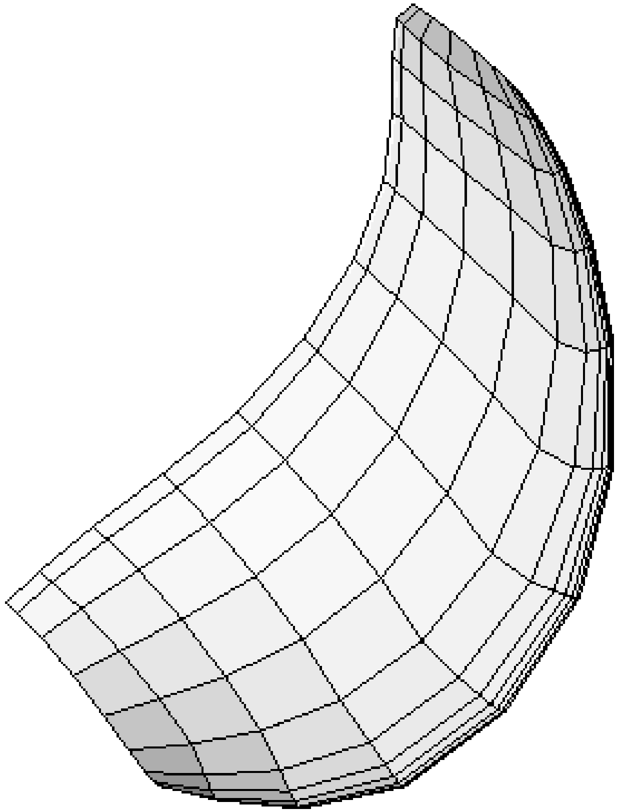
METHODOLOGY



OPEN WATER SIMULATION

➢ INPUT

- Propeller Geometry, Reference data for comparision
- Panel specifications (in CFG file)
  - ✓ Resolution, Tip Cut, Wake Rotation, Span Distribution



➢ OPEN WATER TEST OUTPUT

- Mesh convergence
- kT and kQ values

➢ Python program - Automate the Open water result data

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SELF PROPULSION/BEHIND SHIP SIMULATION

INPUT

- Propeller geometry, Wake field, Propeller RPM

OUTPUT REQUIRED

- Blade pressure, Blade angles for different thrust points

panMARE MODIFICATION

- Removed ship influence from the simulation
- Code added to export blade pressure and panel center
- Code to export additional panel centers

BRIDGE PROGRAM BETWEEN CFD AND FEM

- Find convergence of thrust w.r.t each rotation
- Find angle of minimum, mean and maximum thrust
- Input pressure and panel centre details
- Filter pressure
- Carry out interpolation

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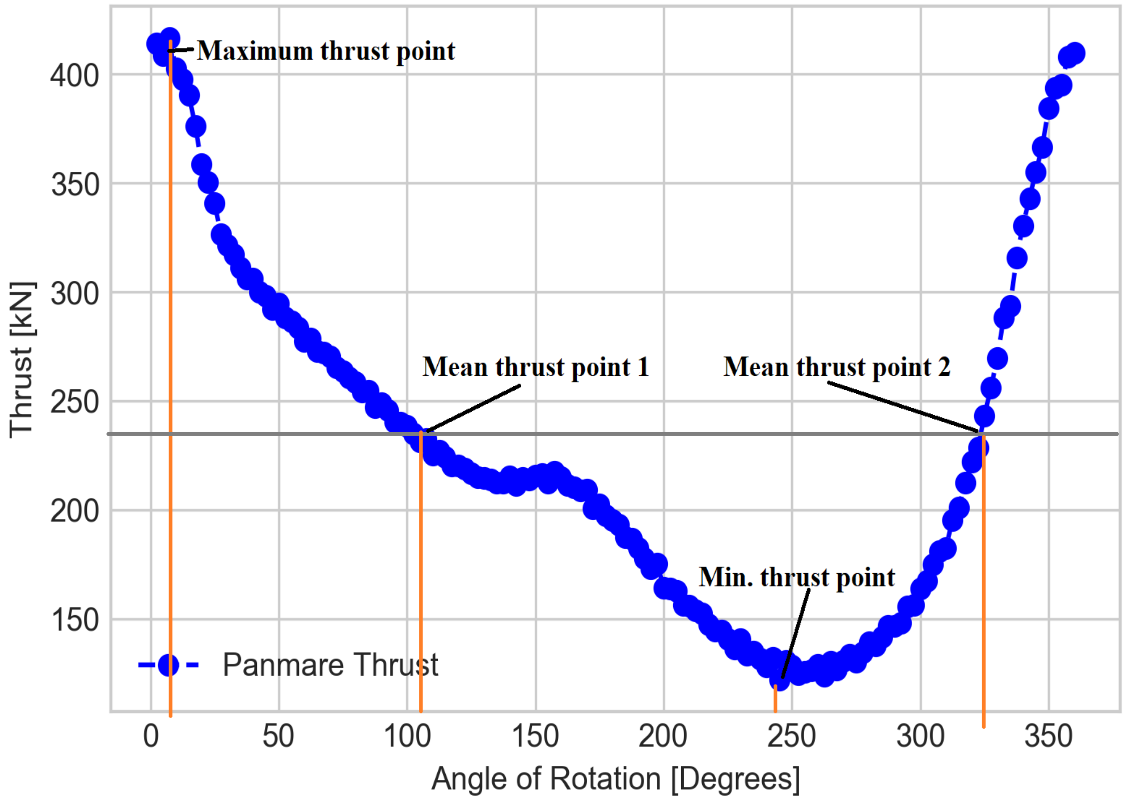

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Open water Simulation | Behind ship simulation | Bridge Programme | Structural Analysis

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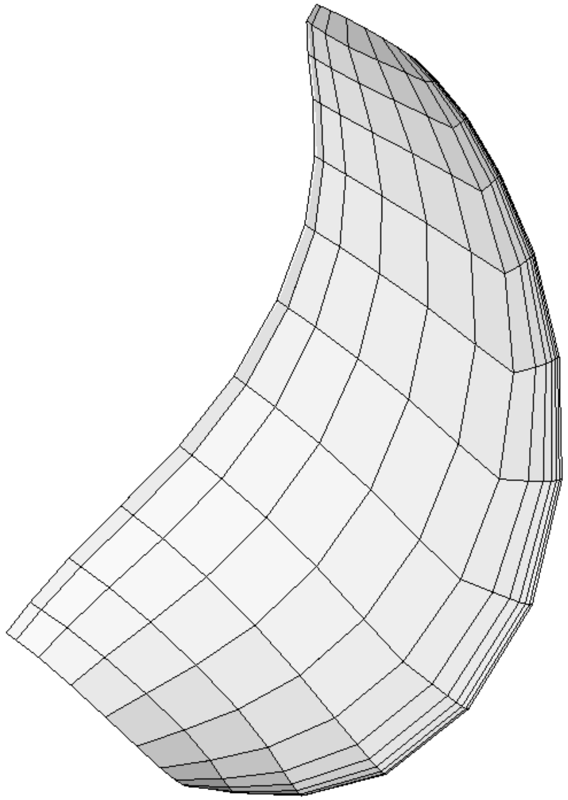

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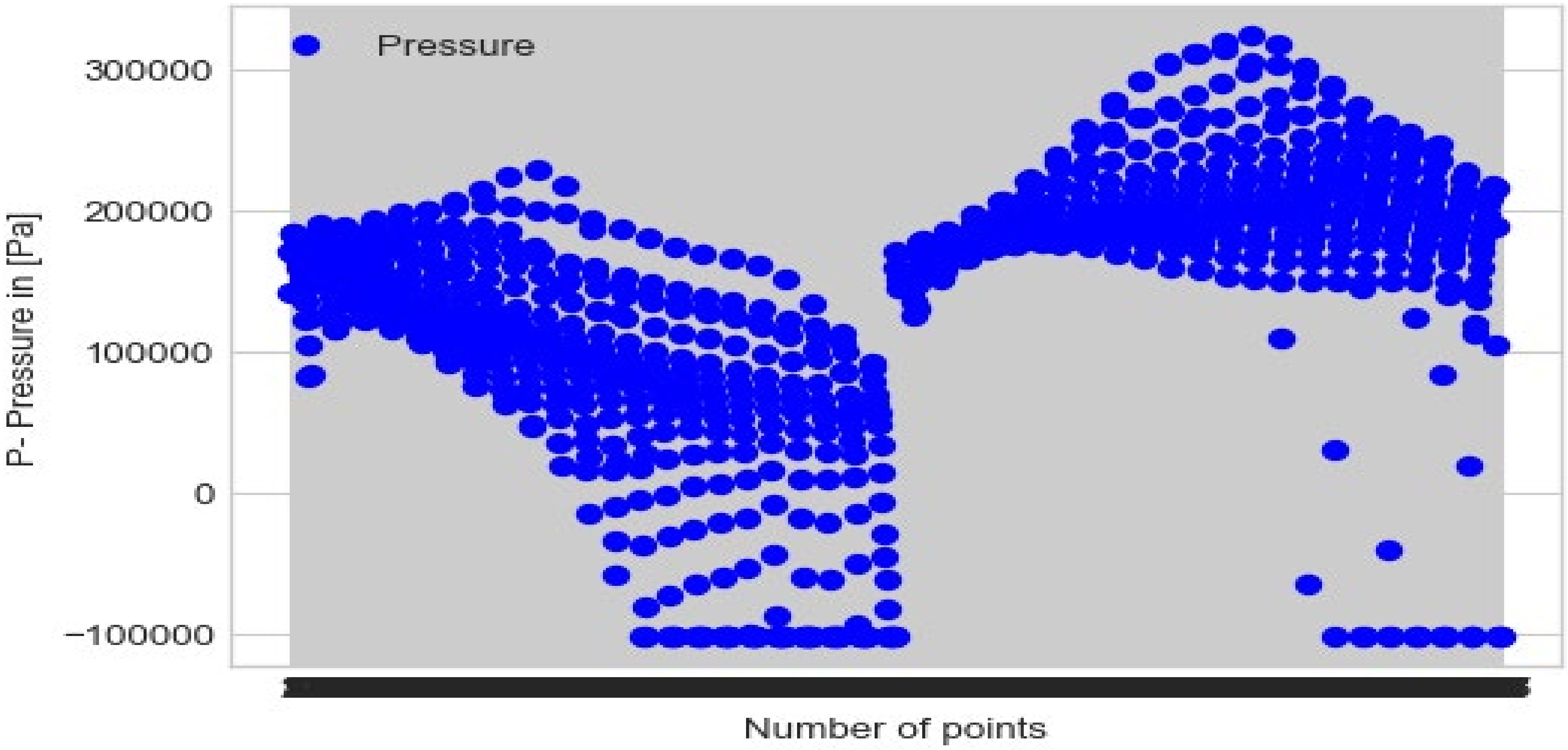

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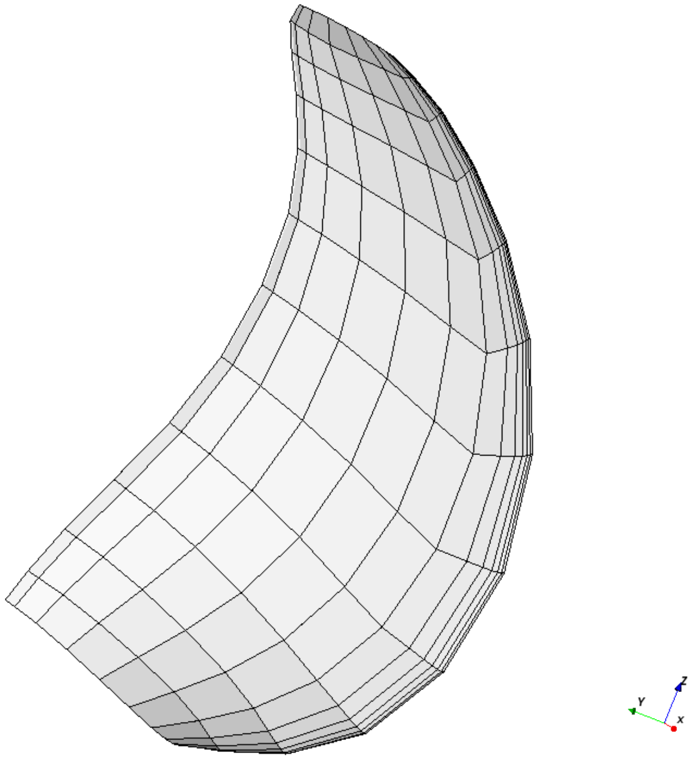
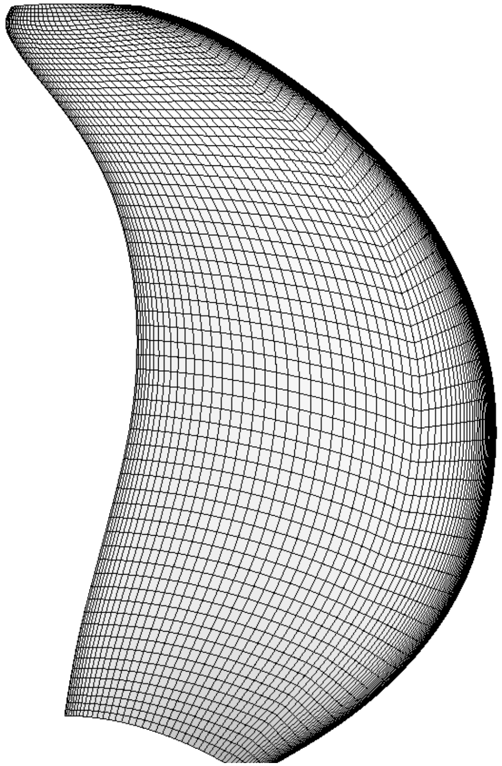
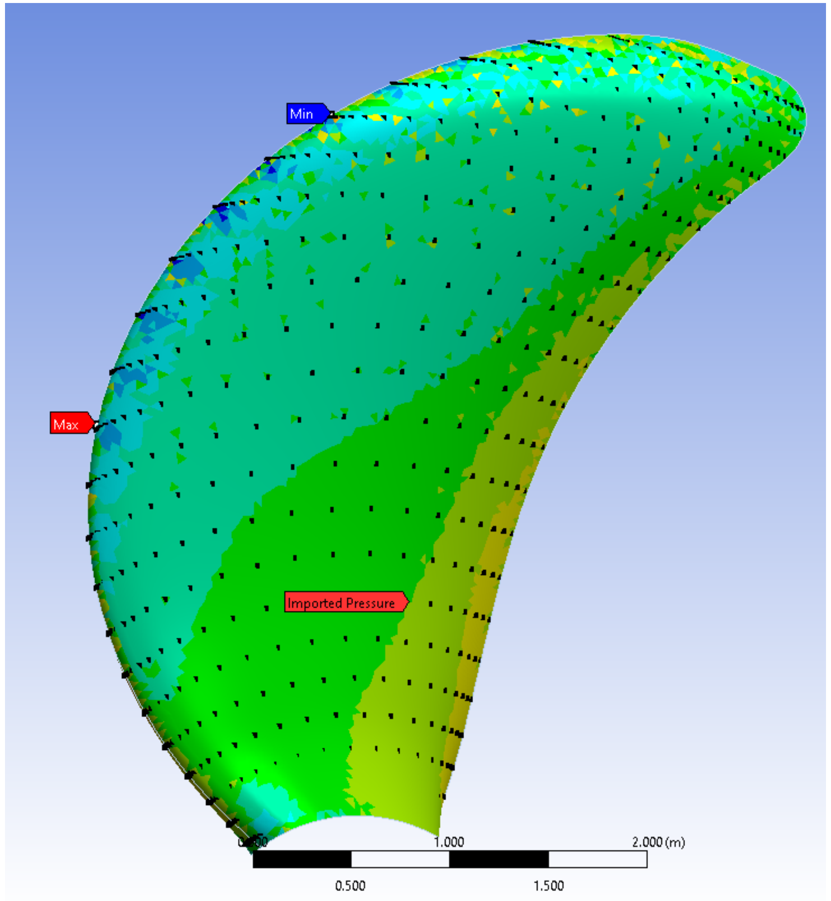


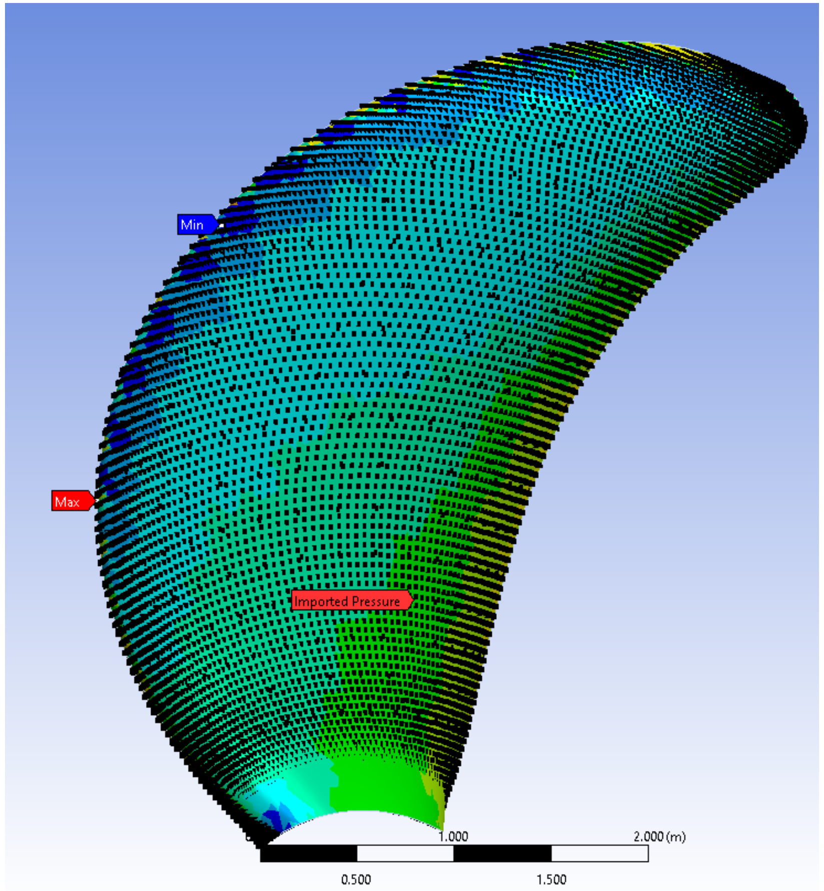


panMARE

Open water Simulation
Behind ship simulation
Bridge Programme
Structural Analysis

BRIDGE PROGRAM BETWEEN CFD AND FEM





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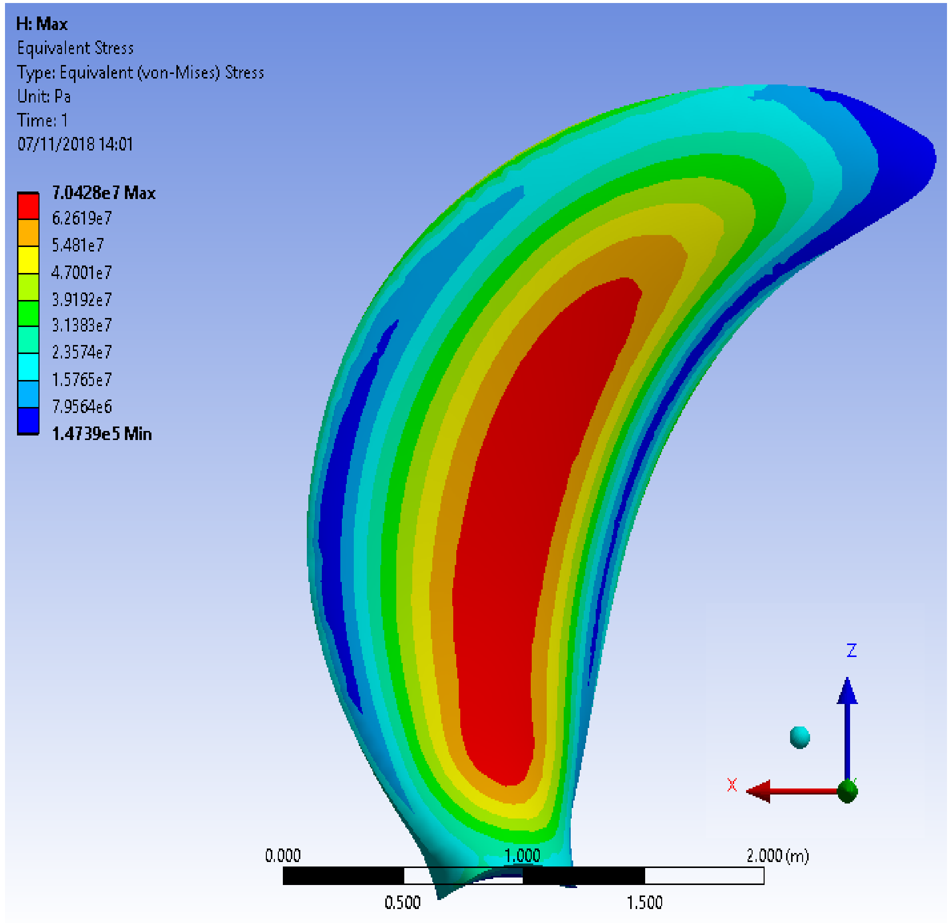
FEM RESULT SUMMARY

- panMARE: 22x22 panelisation (968 panels per blade)
- ANSYS Meshing: Tetrahedral Mesh
- Interpolation: 70x70 panelisation (9800 points)



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SUMMARY

- panMARE
  - panMARE panelisation: 22 x 22 (968 panels per blade)
  - Time Required: 6 Hours
- Structural analysis
  - Force reaction found in range (5-10%) panMARE thrust
  - Time Required: 10 min
- Future scope
  - Blade geometry optimsation
  - Fatigue - Wake addition

CONCLUSION

- One click solution!!! Removed manual intervention.
- Bridge program between CFD and FEM solvers
- Time efficient methodology.