



Thermal and Pressure Analysis on Remotely Operated Vehicle Electronics Housing

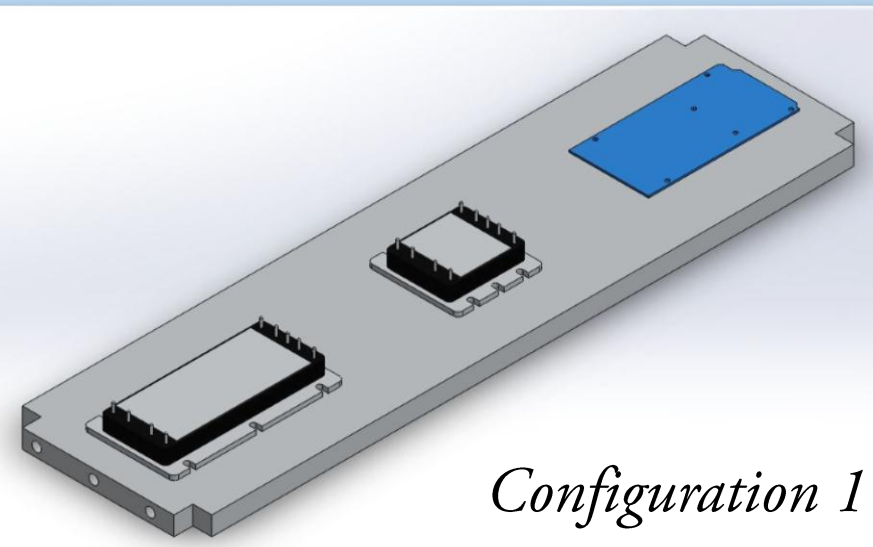
ME 786: Introduction to Finite Element Analysis

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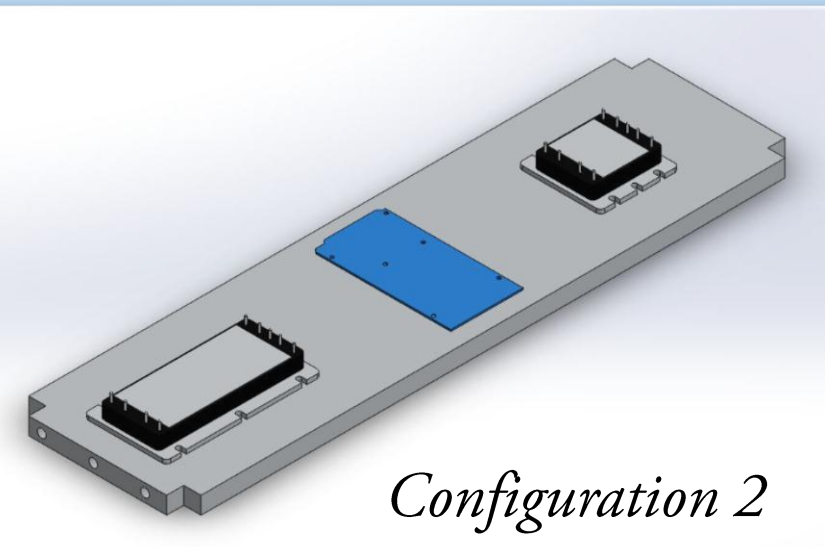
Thermal Analysis

Convergence Study (used for SolidWorks thermal analysis)

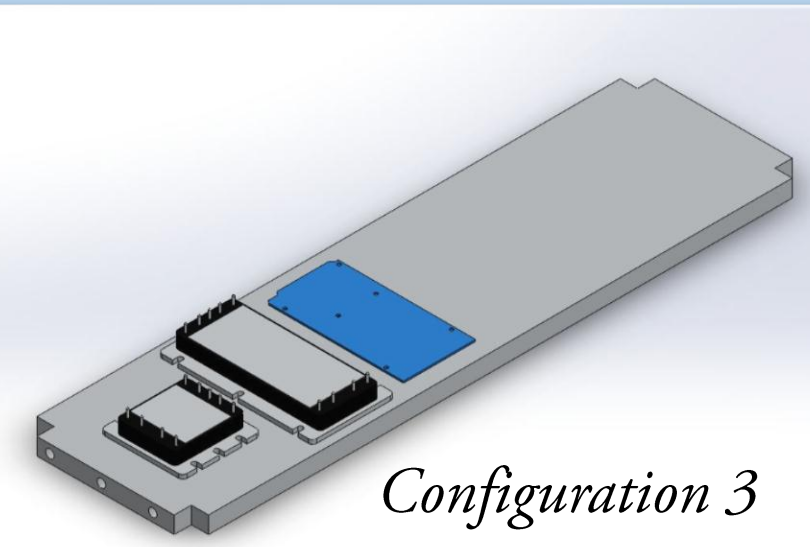
Pressure Analysis



Configuration 1

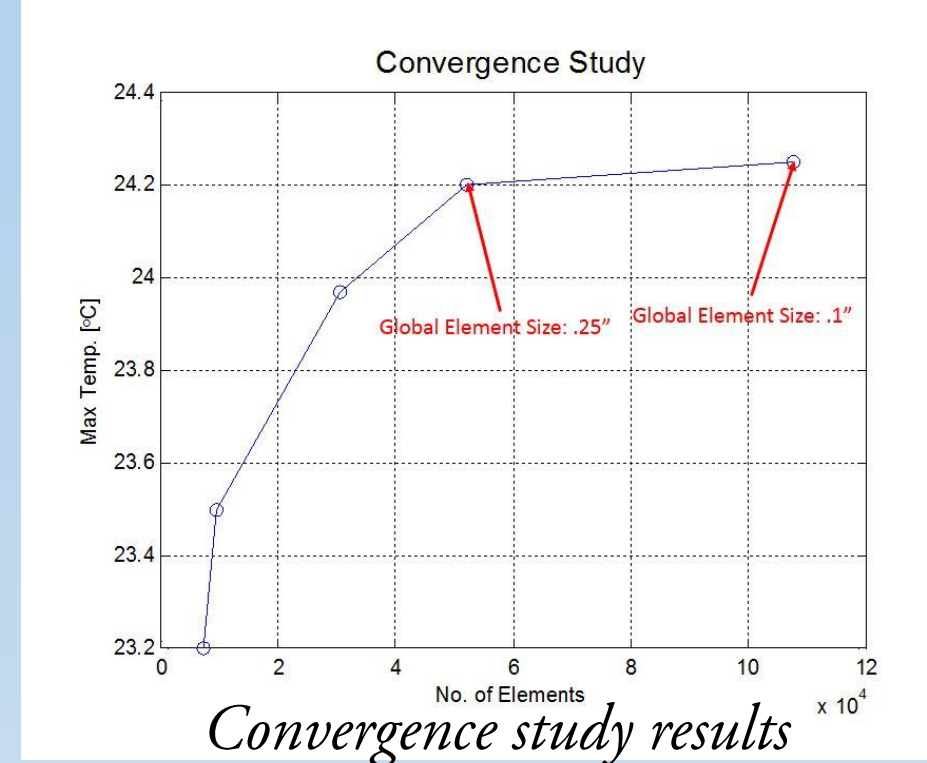


Configuration 2



Configuration 3

Analytical Analysis



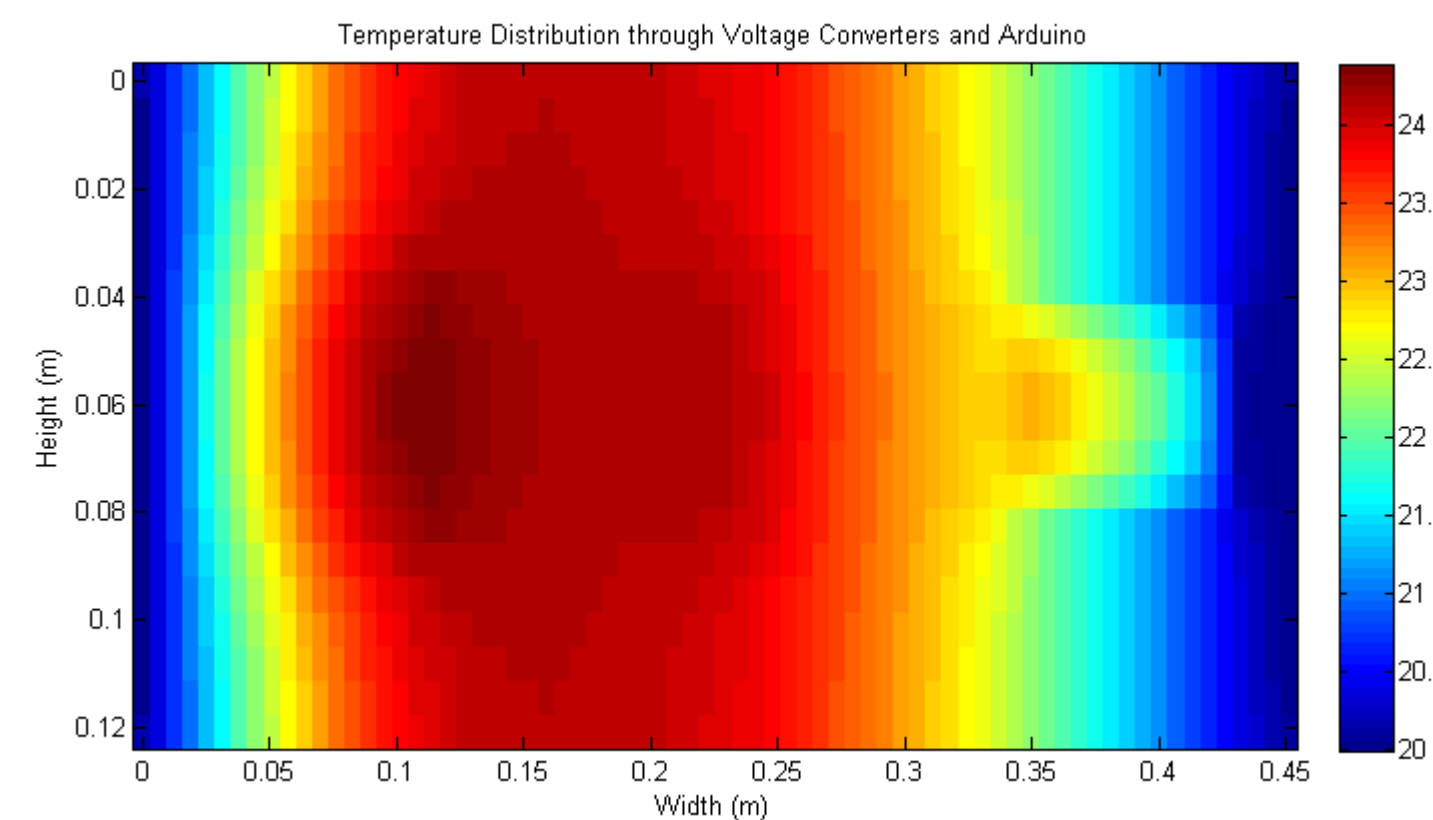
Analytical Analysis

MATLAB:

- MATLAB finite element analysis
- Excel spreadsheet laying out plate
- Analysis completed for only configuration 1
- Square elements .25"x.25"

Results:

- High temperature areas match SolidWorks
- Maximum Temperature = 24 °C

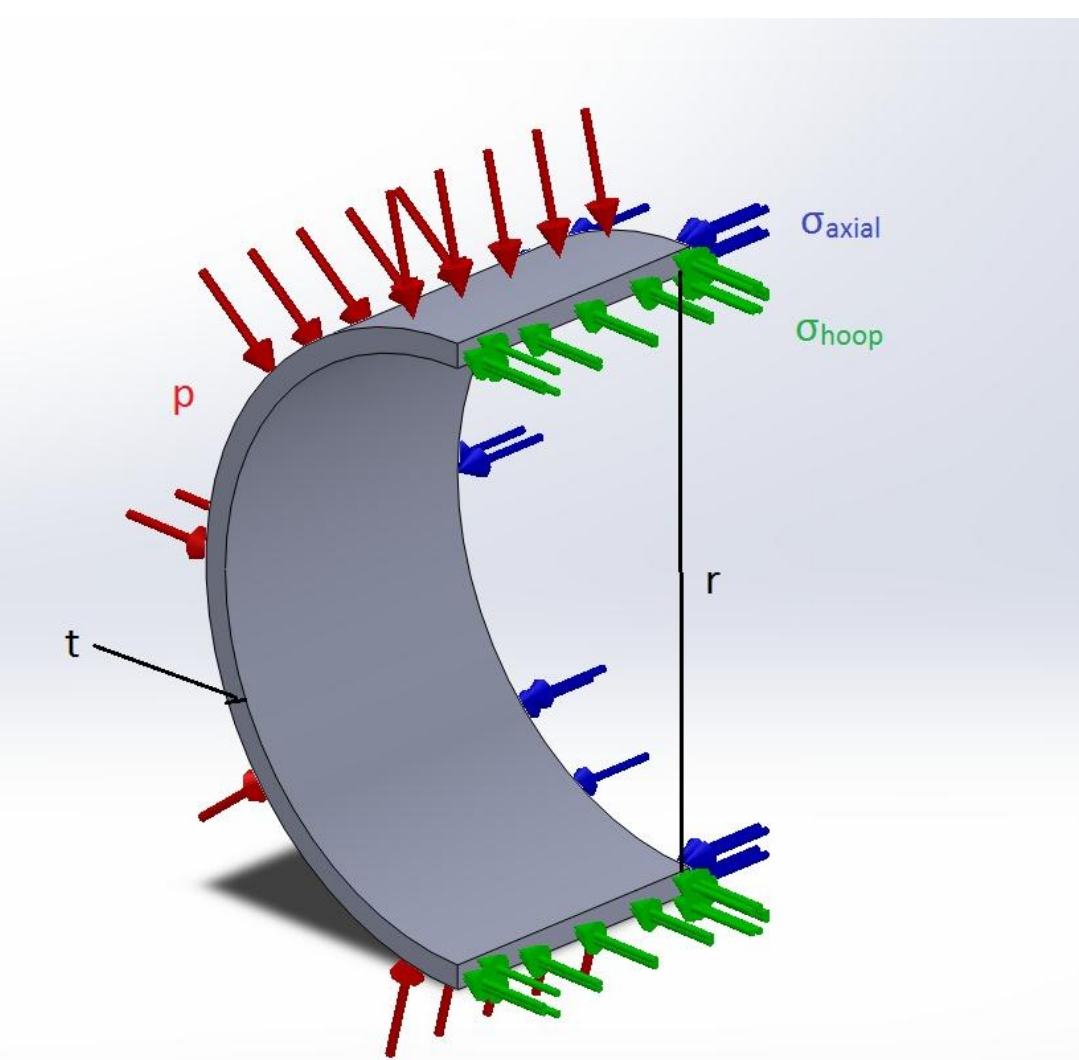


MATLAB contour plot of theoretical temperature distribution across plate for config. 1

Theory:

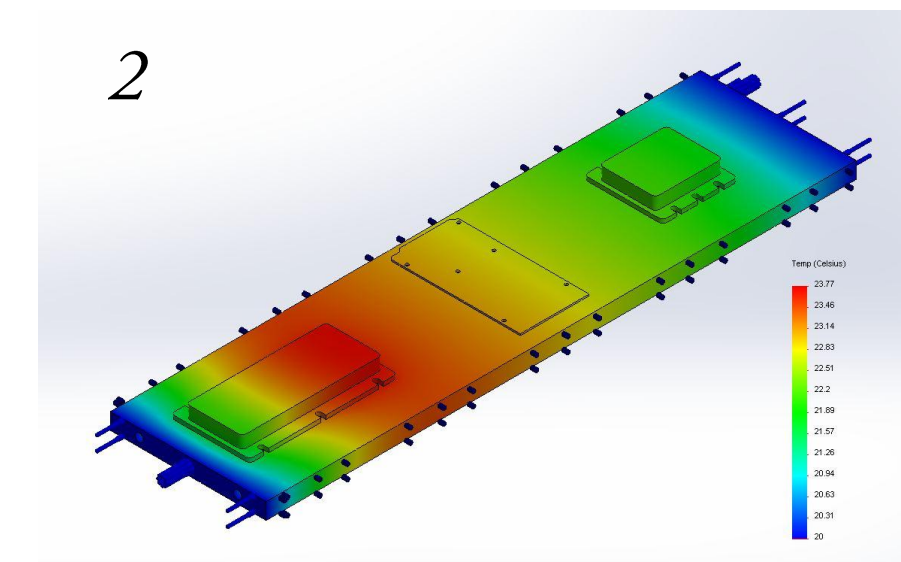
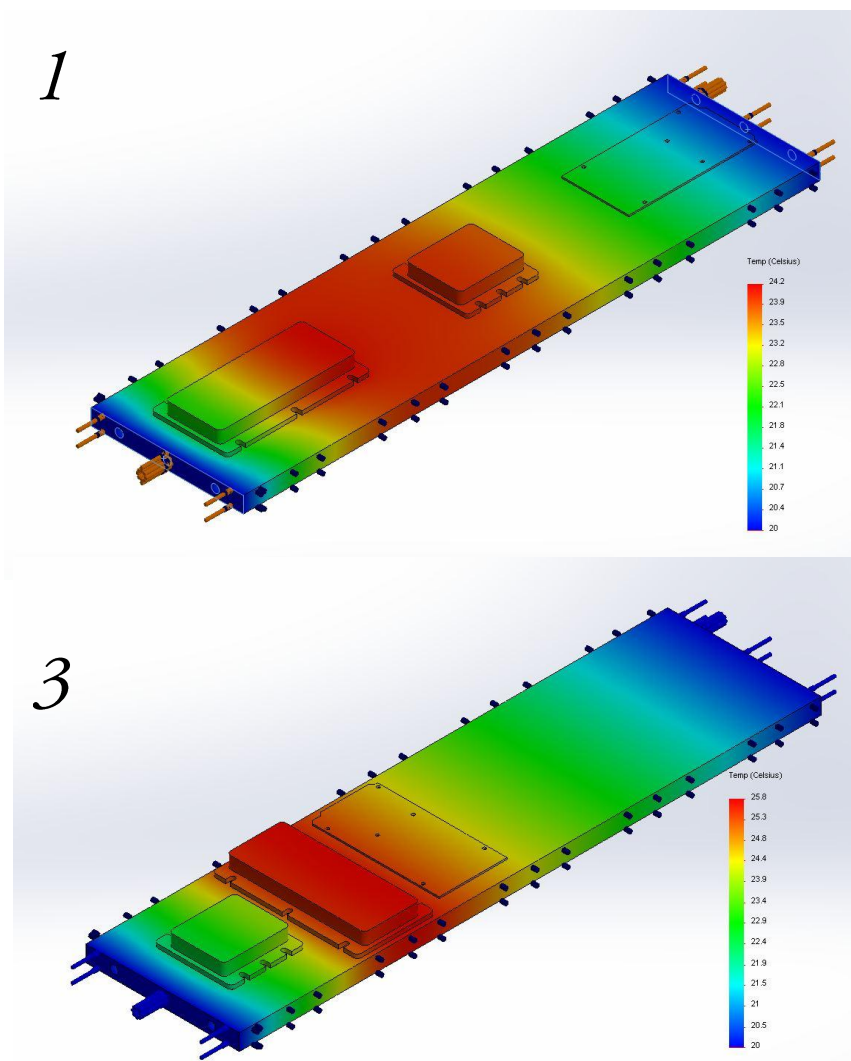
- Hydrostatic pressure acting on a cylindrical vessel

- Hoop stress: $\sigma_{hoop} = \frac{pr}{t}$
- Axial stress: $\sigma_{axial} = \frac{pr}{2t}$
- Von Mises Stress: $\sigma_{Von Mises} = \sqrt{\sigma_1^2 - \sigma_1\sigma_2 + \sigma_2^2}$
- $\sigma_{Von Mises} = 1243000 \frac{N}{m^2}$



SolidWorks FEA

- Mesh: 30,175 CST elements (determined by convergence)
- Heat power applied to all electronic components
- Temperature at each end held at 20 °C (293.15K)
- All layouts deemed to have negligible temp. changes
- Layout 1 chosen based on wire management applications.



Max. Temperatures:
 Configuration 1 – 24.2 °C
 Configuration 2 – 23.77 °C
 Configuration 3 – 25.8 °C
 Configuration 1 was chosen based on wire management

SolidWorks FEA

Mesh:

- 4 point curvature based mesh
- Total nodes: 30869
- Total elements: 16169

Results:

- $\sigma_{Von Mises} = 1173166 \frac{N}{m^2}$
- Ignore stress concentration at end cap-tube interface
- Minimum FS_{yield} = 24.41 (at stress concentration)

