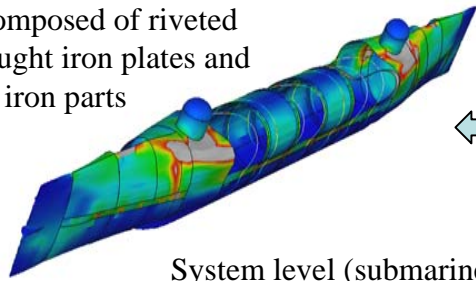
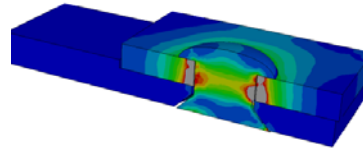


Material Characterization and Structural Analysis of Historic Artifacts (Warren Lasch Conservation Lab)

The H.L. Hunley submarine is composed of riveted wrought iron plates and cast iron parts



Static deformation of highly corroded rivet under shear loading



System level (submarine) and component level (rivet) analyses are coordinated to achieve an overall assessment of the structural integrity of the submarine

Technical issues:

- Degraded materials are highly heterogeneous,
- Traditional non-destructive evaluation techniques are usually not readily applicable because of adverse environmental conditions and large scale,
- Critical decisions and protocols concerning the handling of artifacts are made based on limited information.

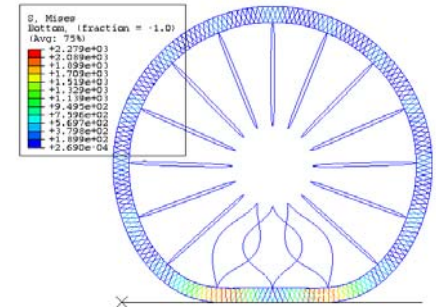
Design of Non-Pneumatic Tires (Tweels) for Space Applications (NASA, Michelin)

The research consists of

- studying various configurations of tweels and simulate their behavior under extreme conditions encountered on the Moon and Mars,
- developing meta-materials as a functional replacement of polymeric materials without sacrificing existing mechanical performance (i.e., optimum carrying load capacity, minimum strain, and maximum traction).

Technical issues:

Selected materials must resist wide temperature range, UV, abrasion, wear, and fatigue.



Overload (3000 N)

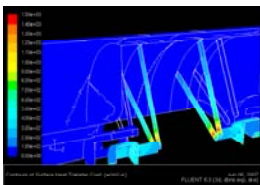
Modeling of the Molding Process of Precision Glass Lenses by FEA

(Collaborators: K. Richardson, P. Joseph. Sponsors: US Army, Edmund Optics)

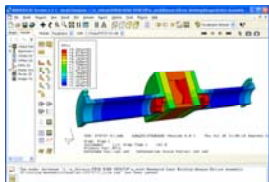
Goal: Predict final shape of lenses, which is significantly affected by the cooling history

Research: Simulate the transient heat transfer through the entire system during cooling stage

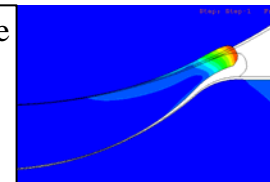
Use FLUENT to simulate the flow of Nitrogen through the system (force convection) and determine heat fluxes



Use FEA (Abaqus) to simulate the 3D transient heat transfer analysis of the entire assembly



Use FEA (Abaqus) to simulate the 2D fully-coupled thermo-mechanical behavior of glass lens and molds



Technical issues:

- Heat losses are due to forced convection and radiation (complex)
- Surface conductance between parts of the assembly depends partially on unknown pressure
- Limited experimental data prevents model validation