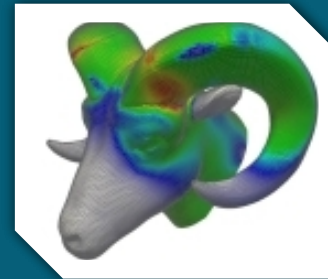
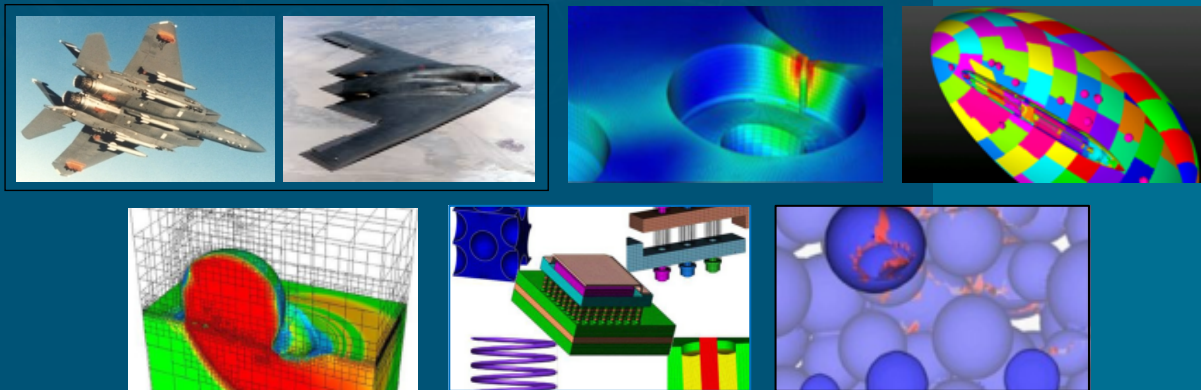




# Research and Applications of Mechanics of Structures (RAMS) End of Summer Presentation



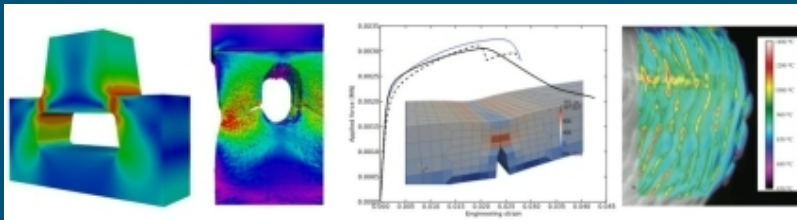
## 2021



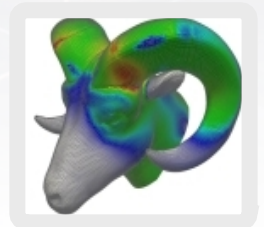
Harshita Narang



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Dept. 1558  
Mentor: John Emery  
Manager: Eliot Fang



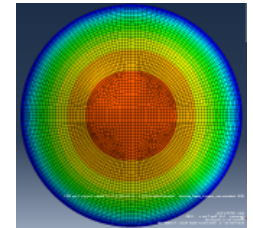
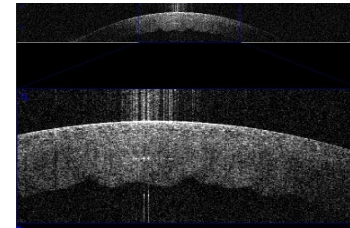
# Background



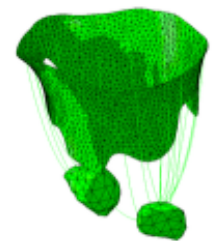
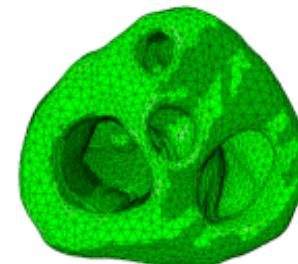
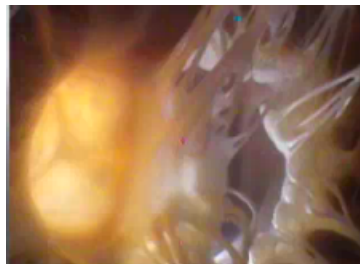
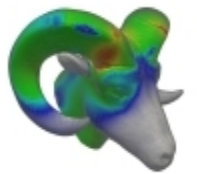
- BS in Biomedical Engineering - University of Rochester
- MS in BME - UT Austin (just completed 3<sup>rd</sup> year of PhD)
- Interest in mechanical modeling - through BME
- Wanted to expand my understanding of constitutive modeling for plasticity and failure this summer
- Why Sandia?
  - Top tier work + culture of growth and learning



Hiking - CA hills



Corneal model developed from optical and microstructural data



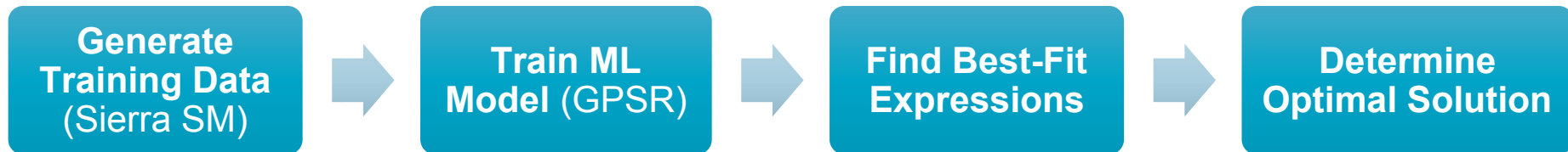
Heart valve model developed from imaging and microstructural data



# What did I do?



- Objective: develop an improved model of damage in porous materials

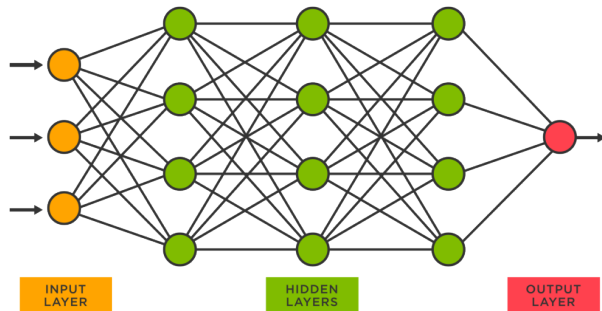


- Genetic programming with symbolic regression (GPSR) in 

Neural network: “black box”

vs.

Genetic programming with symbolic regression:  
interpretable algebraic expressions



$$-X_1 \left( X_1 + X_0^2 X_3 \left( 0.9534 (X_0 + X_2 - \cosh(X_0) + \frac{\cosh(X_0)}{X_1}) + X_0^2 \right) \right)$$

$X_0$ -Hydrostatic stress

$X_1$ -Von mises stress

$X_2$ -Lode angle

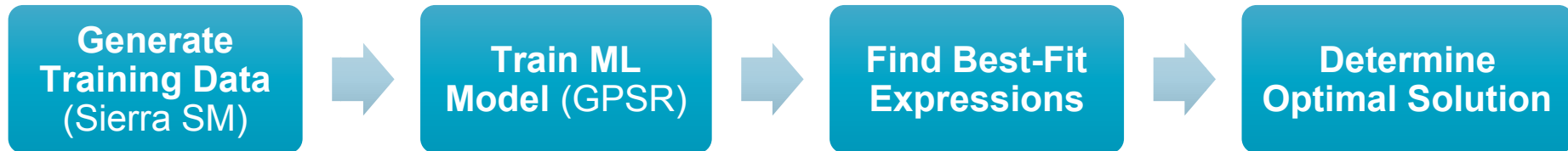
$X_3$ -Void volume fraction

Want to improve physical accuracy and maintain interpretability!

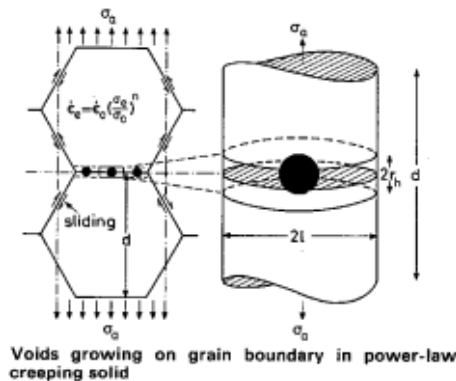
# What did I do?



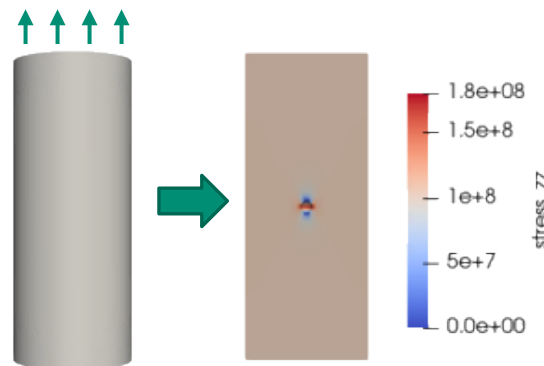
- Objective: develop an improved model of damage in porous materials



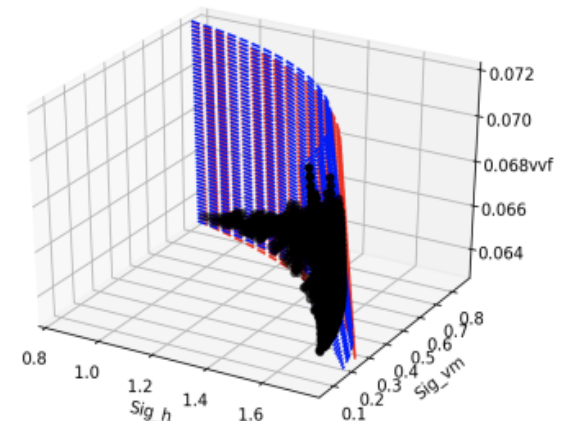
- Set up pipeline to generate training data using Cocks-Ashby model of void growth
- Working toward running Bingo using training data
- Found that:
  - Likely not all of the original Cocks-Ashby model assumptions are valid
  - GPSR technique is highly tunable, able to generate accurate mathematical models



Cocks and Ashby, 1980



Generation of training data



Comparison of data to GPSR output

# What was my experience like?



- Biggest takeaway: Sandia is a great place to work
- Best Activities
  - Group activities
  - Facility tours (though I wish this was in person!)
- Lessons Learned
  - “Expect everything to fail at least five times”
  - People are generally available and happy to help
- The one thing I will most remember about my Sandia experience is . . .
  - Daily discussions with my mentor, John

