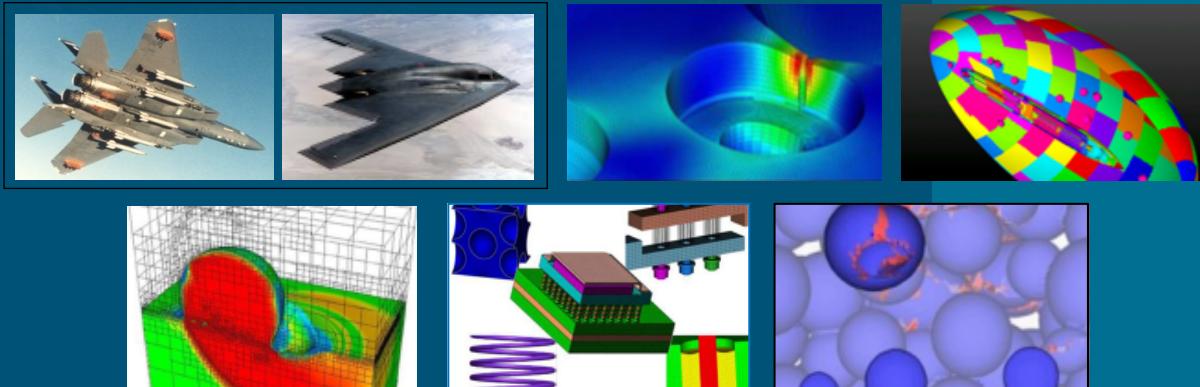
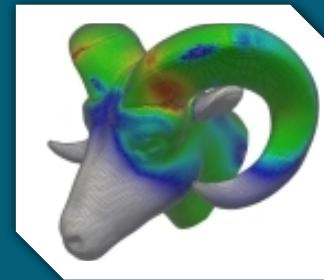




Research and Applications of Mechanics of Structures (RAMS)

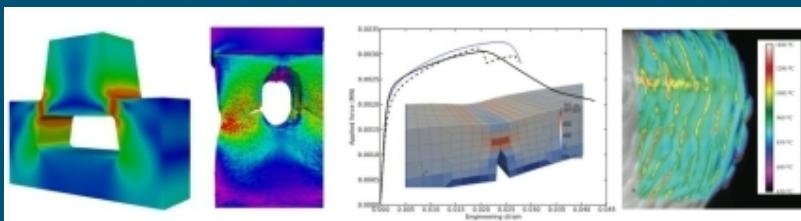
End of Summer Presentation

2021

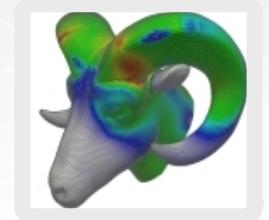


Harshita Narang





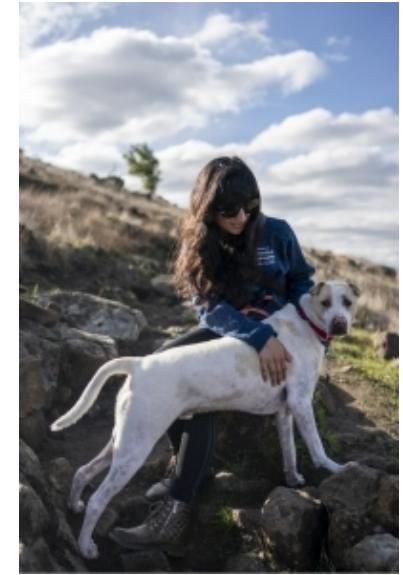
Harshita Narang
Dept. 1558
Mentor: John Emery
Manager: Eliot Fang



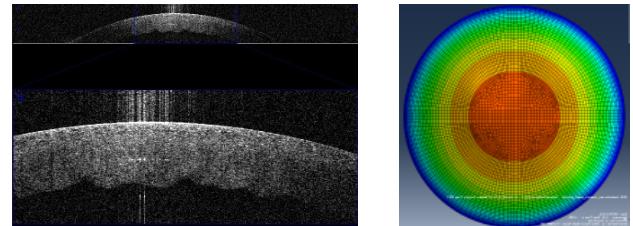
Background



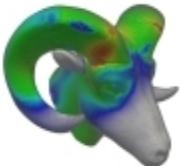
- BS in Biomedical Engineering - University of Rochester
- MS in BME - UT Austin (just completed 3rd year of PhD)
- Interest in mechanical modeling - through BME
- Wanted to expand my understanding of constitutive modeling for plasticity and failure this summer
- Why Sandia?
 - Top tier work + culture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



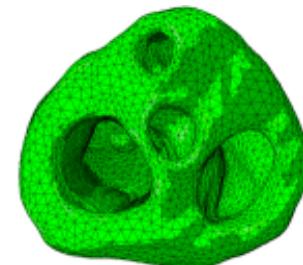
Hiking - CA hills



Corneal model developed from optical and microstructural data



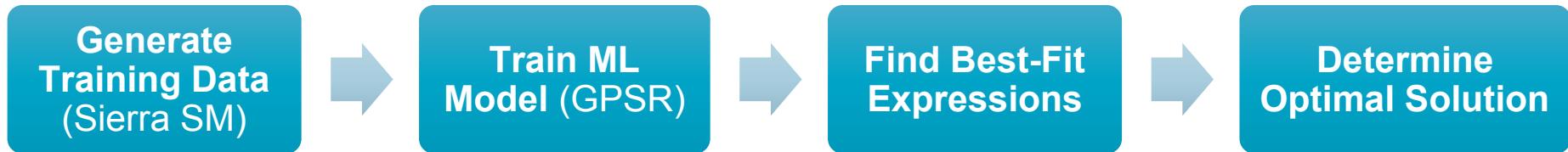
Heart valve model developed from imaging and microstructural data



What did I do?



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

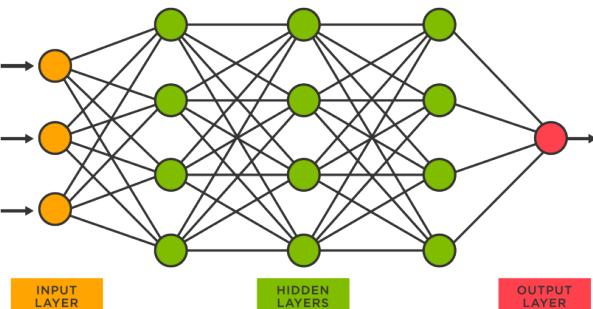


- Genetic programming with symbolic regression (GPSR) in 

Neural network: “black box”



Genetic programming with symbolic regression:
interpretable algebraic expressions



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

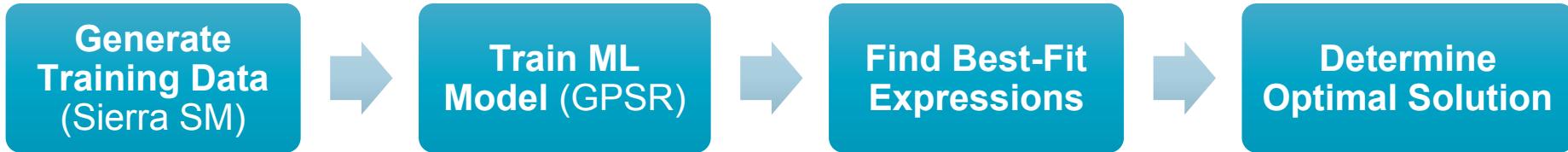
X_0 -Hydrostatic stress
 X_1 -Von mises stress
 X_2 -Lode angle
 X_3 -Void volume fraction

Want to improve physical accuracy and maintain interpretability!

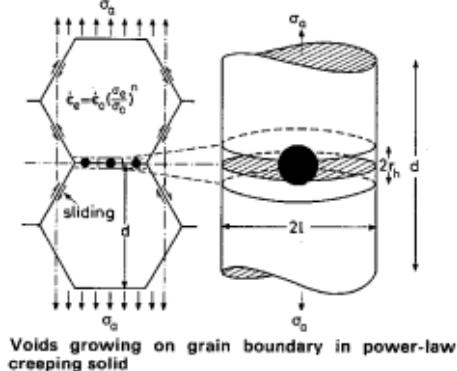
What did I do?



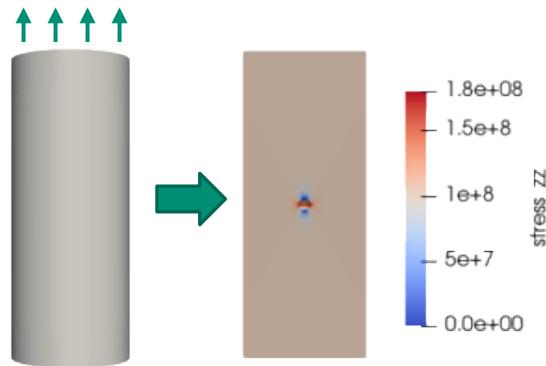
- Objective: develop an improved model of damage in porous materials



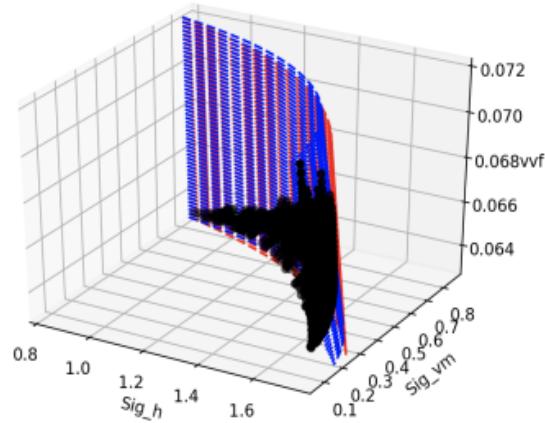
- Set up pipeline to generate training data using Cocks-Ashby model of void growth
- Working toward running Bingo using training data
- Found that:
 - Likely not all of the original Cocks-Ashby model assumptions are valid
 - GPSR technique is highly tunable, able to generate accurate mathematical models



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

