2020 MSE Expo

Rajat Mittal

Director of Graduate Studies

Mechanical Engineering

November 10, 2020

Agenda

- 5:00 Rajat - Welcome and Overview
- 5:20 Mark Savage - Life Design Lab
- 5:30 Luke Thorstenson – Co-Op Essay Option for ME Students
- 5:40 Nathan Scott - Master's Design options and Essay options offered by Industry
- 6:00 MSE Essay Presentations
- 6:25 Closing

MSE Degree Requirements

Section A - 8 advisor-approved courses

- 2 must be applied math, numerical analysis, or computational
- 4 (or 3 for Essay students) must be 530.xxx or 535.xxx Mechanical Engineering
- No more than 2 from Engineering for Professionals
- No more than 4 from upper-undergrad level (xxx.4xx only)
- No independent research, graduate research, or special studies.

Section B – choose one

- 2 more courses (530.820 MSE All-Course - Graduate Research can be one)
- Master's Essay (530.821 MSE Essay - Research and Writing)
- Co-Op Essay

Master's Essay
(530.602 / 530.821 MSE Essay - Research and Writing)

- **Identify a research advisor**
- **Conduct research**
  - 6 total credits of 530.602/821 (equivalent of 2 courses);
  - Prepare and submit an MS essay that summarizes your research (signed off by advisor + one other faculty "reader")
  - There is no essay defense!
- **Advantages of MSE Research Essay!**
  - Become part of a research team .
  - Learn from a topic-area expert.
  - Conduct research that might lead to papers and/or conference presentations.
  - Improve your writing/presentation skills.
  - Impress potential employers with your expertise.
  - Improve chances of entering a PhD program (JHU or others).
- **Disadvantages?**
  - 2 fewer courses?

Frequently Asked Questions about MSE Essay

- **How do I find an advisor?**
  - Contact professors in your area of interest (see list on slide 5) and inquire about MS research opportunities -or-
  - Contact the Director of Graduate Studies (Rajat Mittal) and he will connect you with potential advisors
- **What kinds of research projects do MSE student do?**
  - There is significant flexibility on what constitutes an MSE project and something that is decided by you and your advisor
  - For example, MSE research may be a fundamental scientific investigation involving theory an/or experiments and/or computational modeling or it might involve experimental design and/or testing of a device.
- **How long is the MS Essay?**
  - There is no recommended length. The essay is a summary of your project and is approved by your advisor and one other reader. Your advisor will usually guide you in the writing of your essay.
- **Research can sometimes be open-ended. What if I cannot achieve my research objectives even after 6 credits of research? Will that delay my graduation?**
  - No! The MS essay is written, submitted and approved at the end of 6 credits of MSE research. As long as your advisor is satisfied that your research effort was appropriate and you prepare an essay that is approved, you are done.
- **I am thinking of joining the 5-Yr MSE program. Can I include an essay and still finish in 1 year?**
  - Yes! Talk to potential advisors early (in your Senior year) so that you can start planning your essay right away.
- **Is there funding available for MSE students who conduct research?**
  - Most MS research is unfunded, but some advisors might have funding available.

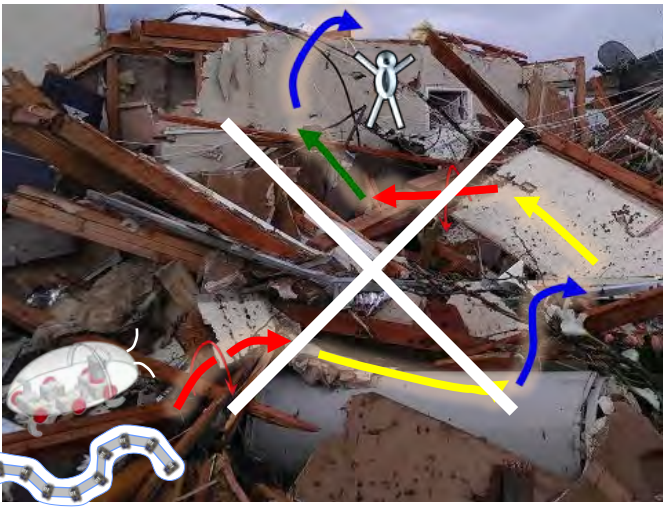
MSE Essay Research Opportunities in 2020-2021

Name	Energy & Environment	Fluid Mechanics & Thermal Sci.	ME in Biology and Medicine	Mechanics and Materials	Micro/Nano Scale Science	Robotics, Systems, Control
Mehran Armand			X			X
Jeremy Brown			X			X
Noah Cowan			X			X
Jaafar El-Awady				X		
Dennice Gayme	X	X				X
Ryan Hurley				X		
Claire Hur		X	X		X	
Iulian Iordachita			X			X
Sung Hoon Kang	X		X	X	X	
Chen Li			X			X
Leszlo Kecskes		X		X		
Rajat Mittal	X	X	X			
Vicky Nguyen			X	X		
Rui Ni	X	X	X			
KT Ramesh			X	X		
Nathan Scott	Design					
Jung Hee Seo		X	X			
Sean Sun			X			
Gretar Tryggvason	X	X				
Feng Zhu				X		

Terradynamics Lab

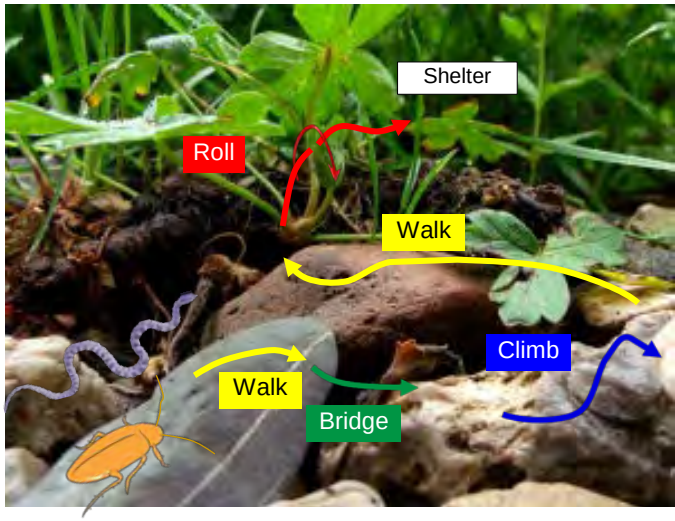
Movement Science at the Interface of Biology, Robotics, & Physics

- **Prof. Chen Li**
- https://li.me.jhu.edu chen.li@jhu.edu

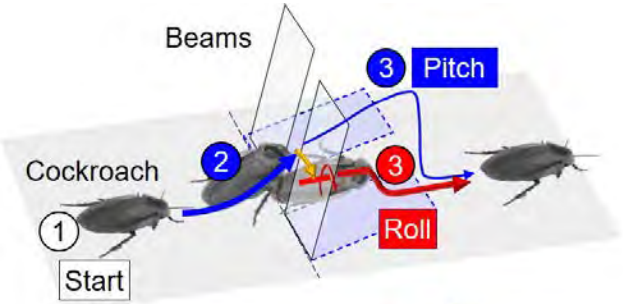


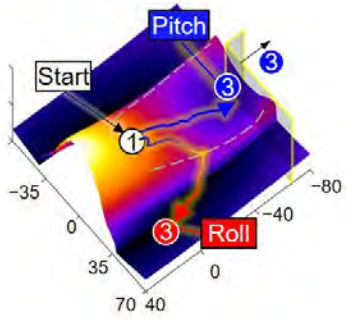
Most robots use geometric maps to avoid obstacles but are poor at traversing them.

Animals use physical interaction to traverse obstacles robustly.



Othayoth, Thoms, Li (2020) *PNAS*

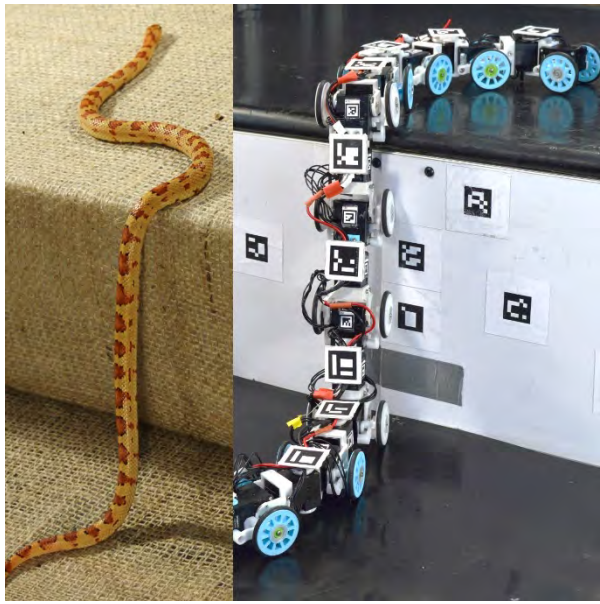




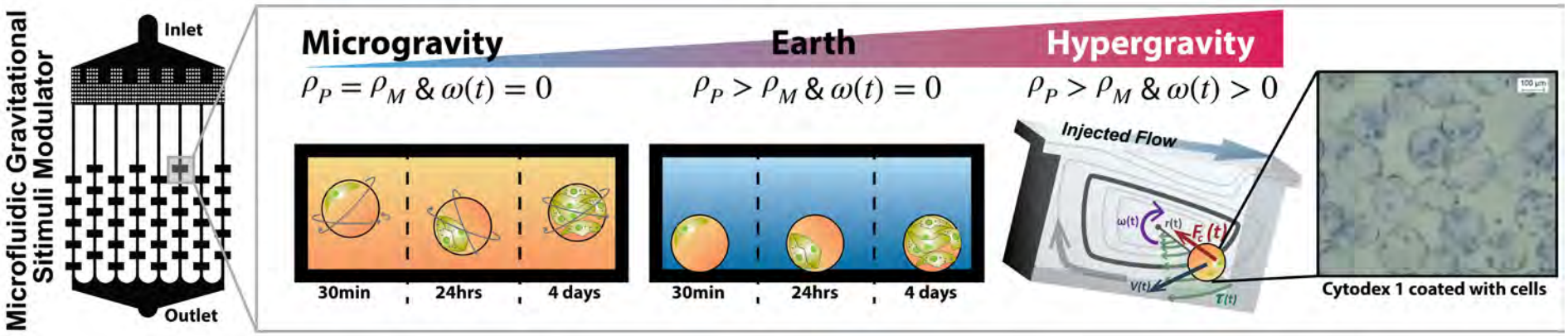
Fu & Li (2020) *Roy. Soc. Open Sci.*

We study how robust locomotor transitions emerge from interaction with complex terrain, by integrating:

- **animal experiments**
- **robotic experiments**
- **physics modeling**



Hur lab: Space gravitational impact on cells



Space@Hopkins

hur
µFluidic Biophysics

Defect Engineering of Structural Materials

Laszlo Kecskes' Group

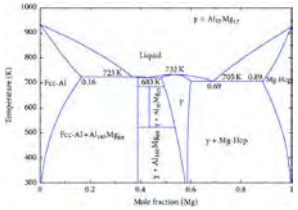
Focus: improving materials for engineering applications

Approach: study underlying physical mechanisms and understand processing-structure-property relationships

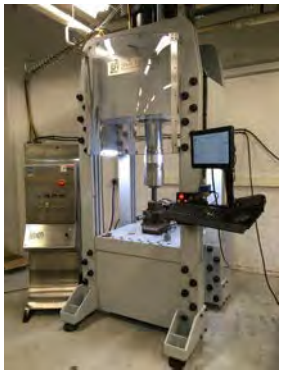
Projects: thermomechanical processing and characterization of Mg alloys, additive manufacturing of refractory alloys, and process modeling

Thermomechanical Processing of Lightweight Alloys

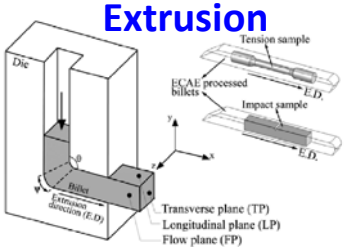
Mg-Al Model Alloy System

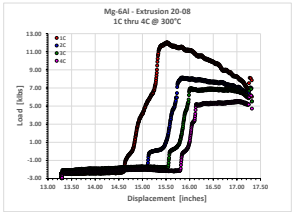


SPD* Processing



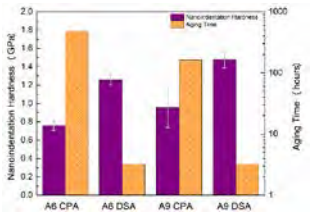
Equal Channel Angular Extrusion



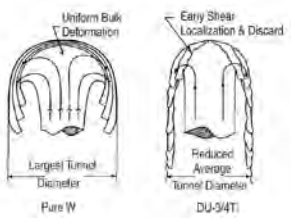


Mechanism-Based Deformation Behavior

Mechanical Properties

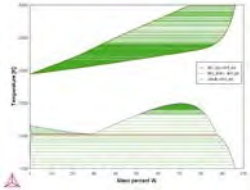


Additive Manufacturing of Refractory Alloys



Deformation Engineering

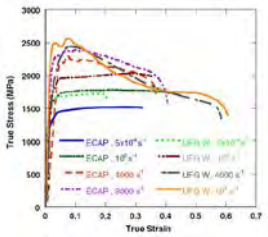
Alloy System Design



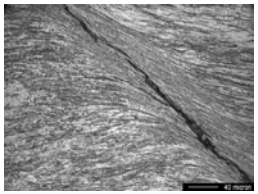
Laser Powder Bed Fusion

Property Characterization

Mechanical



Microstructural



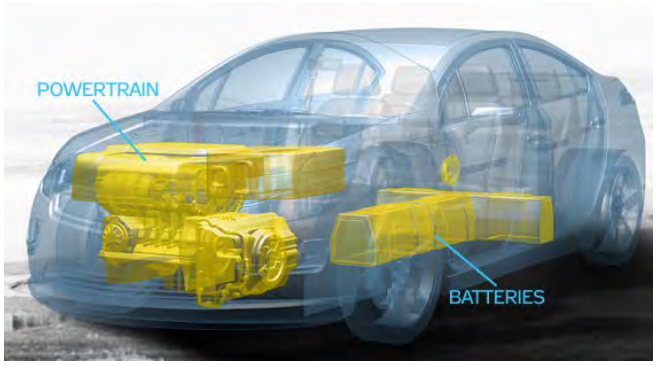
SPD – Severe Plastic Deformation

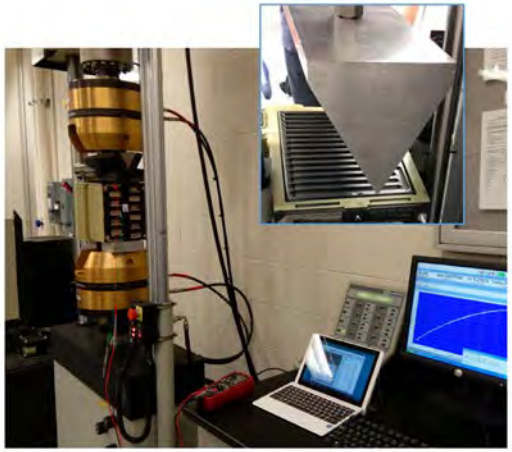
Contact Information: lkecske1@jhu.edu

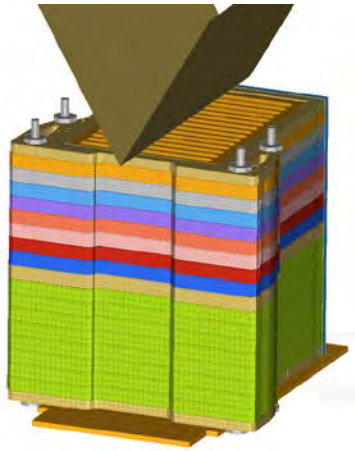
Impact Safety of Materials, Structures and Systems

Feng Zhu @ Hopkins Extreme Materials Institute (HEMI) & Mechanical Engineering Dept
Contact: fzhu8@jhu.edu

- **Damage behavior of Li-ion vehicle battery under abuse conditions**

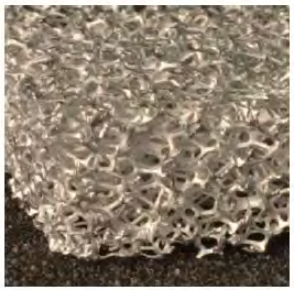






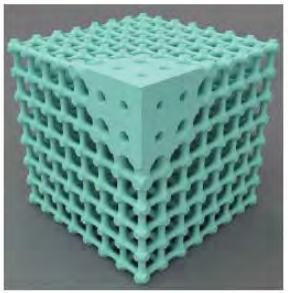
- **Occupant protection for next generation self-driving vehicles**

- **Machine learning based design of lightweight cellular solids for energy absorption**



Random

Ordered



Ordered and location specific

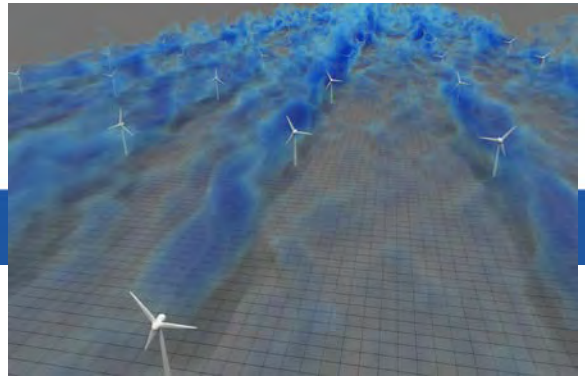
Meneveau & Gayme project on wind farm modeling

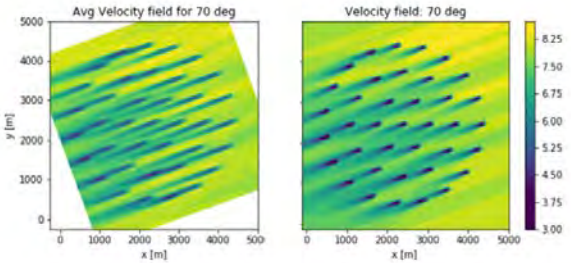
Master's Essay project starting Fall 2020:

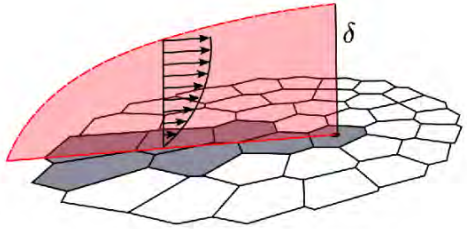
"Modular coding implementation for the ALC wind farm model"

Research tasks and required skills:

- Incorporation and testing of the *Area Localized Coupled (ALC)* Model, a new wind farm model, with the wind plant optimization tool (FLORIS) from the National Renewable Energy Laboratory (NREL).
- Preparation of the python code and integration of the ALC wake model into the FLORIS framework.
- Validation of the code using wind farm field data for various configurations.







$$\min_{\alpha} \sum_{n} \left(\bar{u}_{h,n}^{wm} - \bar{u}_{h,n}^{td} \right)^2$$

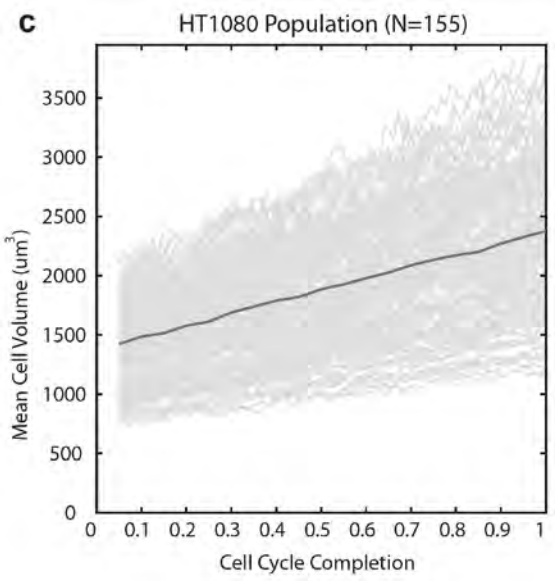
JOHNS HOPKINS UNIVERSITY

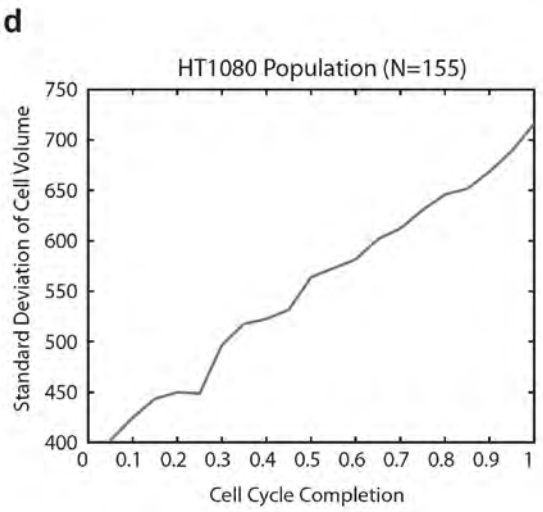
Dynamics of Cell Grown & Division

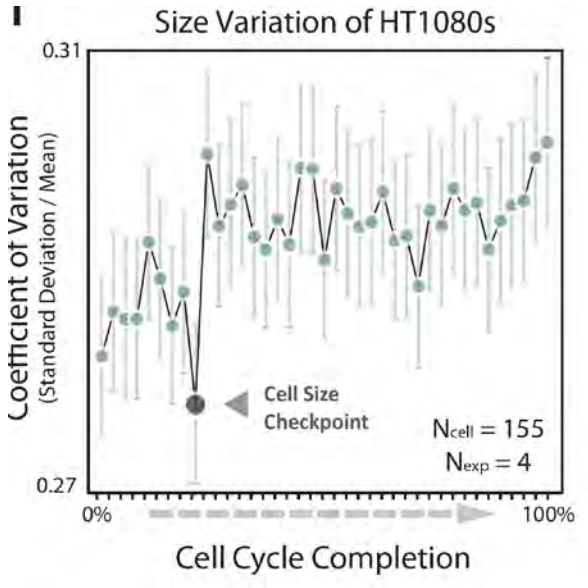
Sean X Sun and Noah J Cowan

ssun@jhu.edu and ncowan@jhu.edu

- Goal: understand cell-cycle dynamics using dynamical systems theory
- Approach:
  - Create simplified models to explain cell growth
  - Make model-based predictions for experiments
  - Analyze cell-cycle data from the Sun laboratory
- Who should consider this?
  - Required: hardworking, ***curious*** student with solid background in dynamical systems
  - Desired: skilled in dynamical system simulation in Matlab, Mathemica, or Python



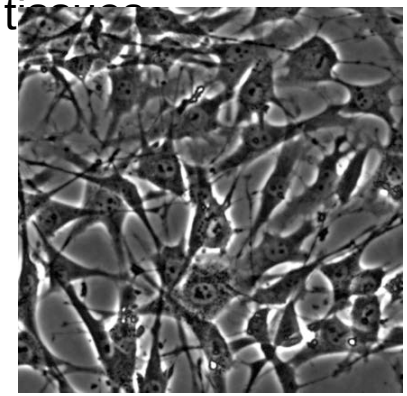


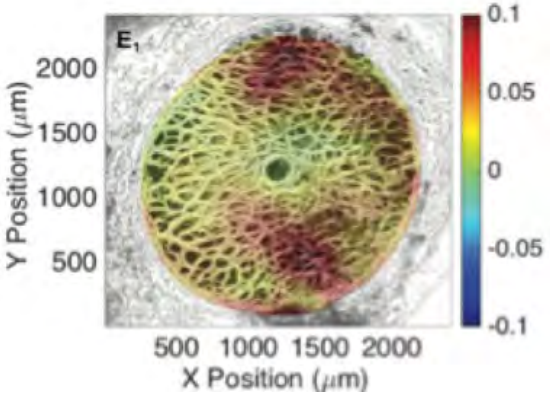


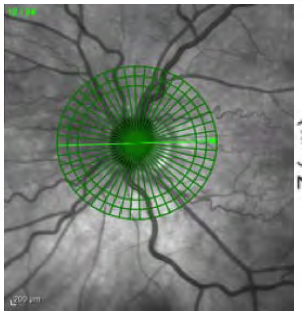
Nguyen Lab: Mechanics of Soft Adaptive Materials

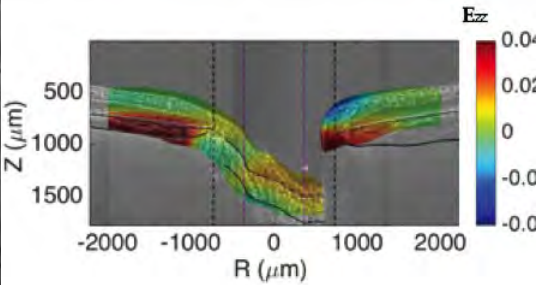
- Develop experimental and modeling methods. Collaborative, multidisciplinary
- Focus on physical mechanisms and structure-properties relationship.
- **Available projects: mechanical properties of tissues, hydrogel soft robots, viscoelastic dissipation of liquid crystal elastomers. Experiments and FEA modeling**

Biomechanics and Mechanobiology structure-properties-function of tissues

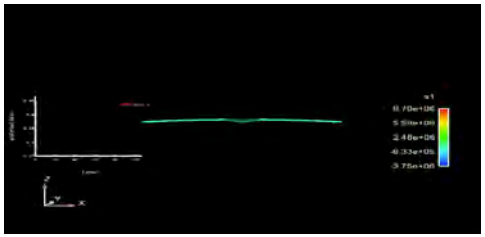


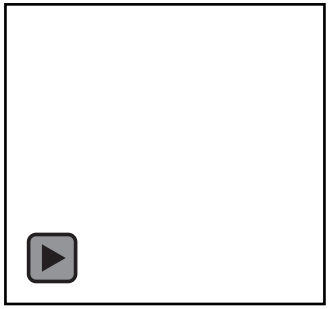


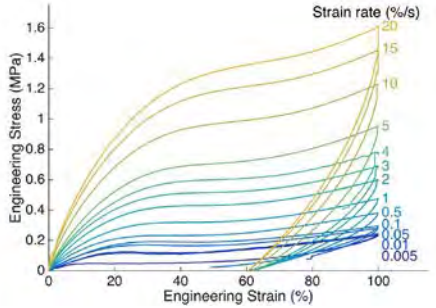


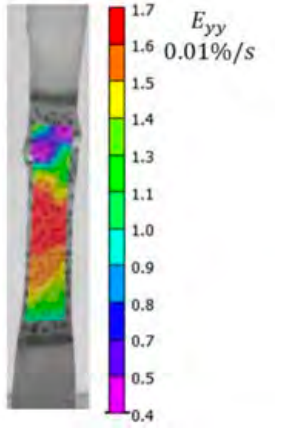


Active Polymers: Predictive modeling for material and device design



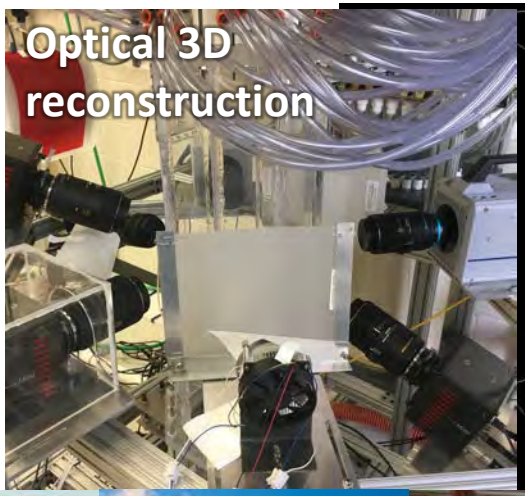


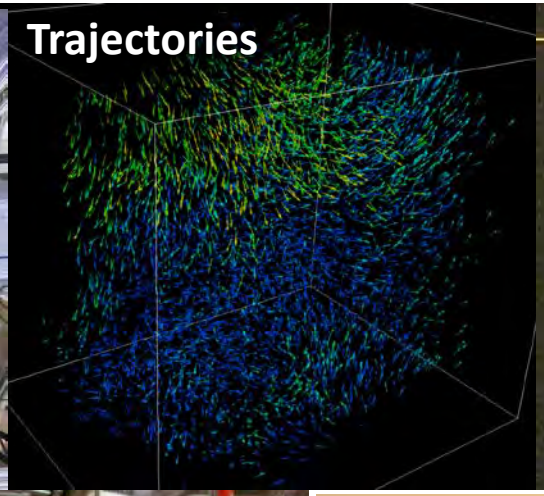


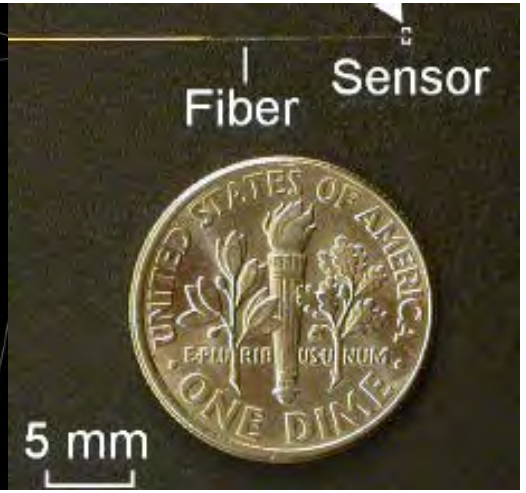


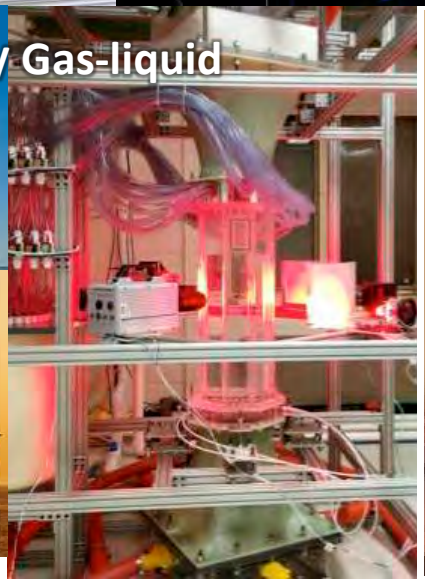
FLUID TRANSPORT LAB (Rui Ni)

Instrument Development









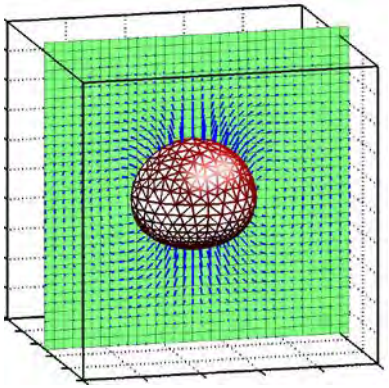
Multiscale
Multiphase
Multidisciplinary

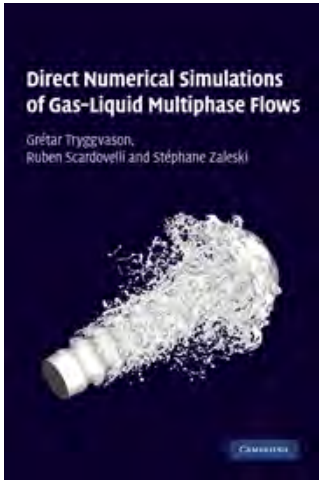
Transform multiphase flow research to drive energy savings and streamlined processes

http://me.jhu.edu/rui_ni

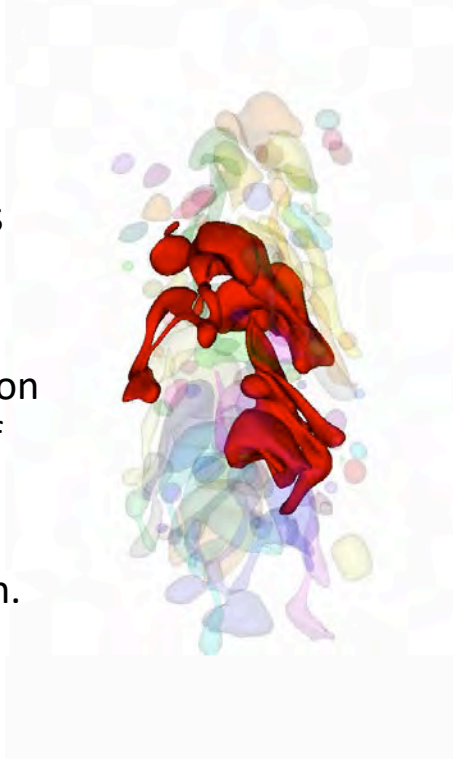
Computational Studies of Multiphase Flows

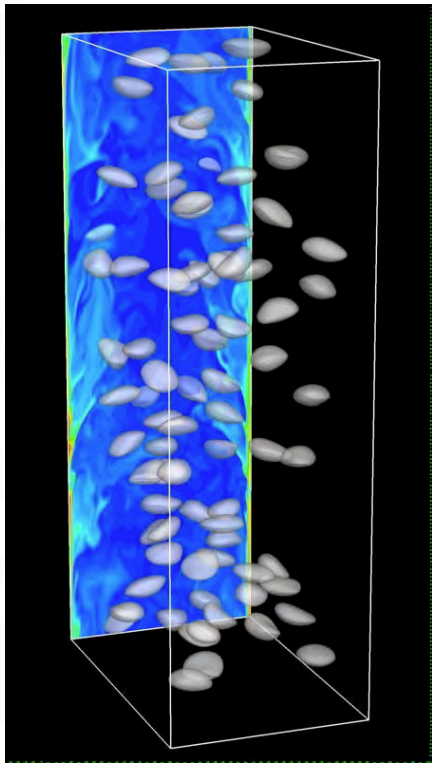
Gretar Tryggvason's Group





We study multiphase flows, such as flows with bubbles and drops, atomization, boiling, etc. by fully resolved numerical simulations.





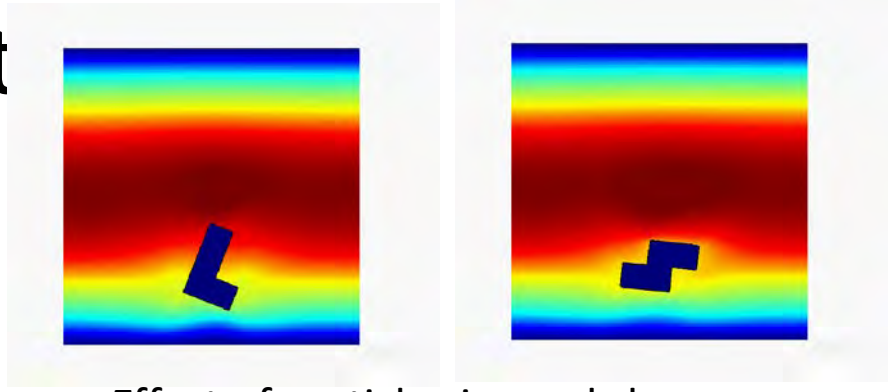
Possible MSE projects include using already existing codes to examine various physical problems or writing codes to explore new ideas for data processing. Examples include:

X. Chen, J. Lu and G. Tryggvason. "Numerical Simulation of self-propelled non-equal sized droplets." Physics of Fluids. 31 (2019), 052107.

Y. Qi, J. Lu, R. Scardovelli, S. Zaleski, and G. Tryggvason. "Computing Curvature for Volume of Fluid Methods using Machine Learning." Journal of Computational Physics. 377 (2019), 155-161.

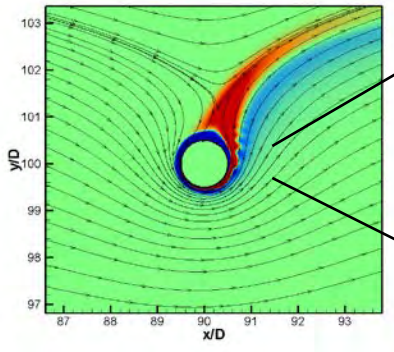
Profs. G. Tryggvason and J. Lu

Seo and Mittal – Flow Physics and Computat



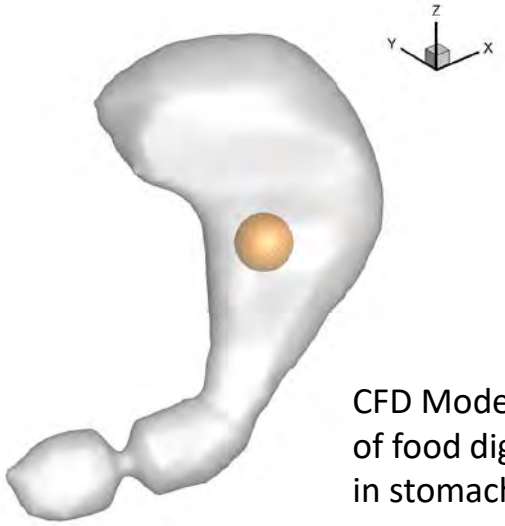
Effect of particle size and shape on **inertial focusing in microfluidics**

Flettner rotor



High performance wing for UAV/MAV

Control of **MAGNUS effect** for the improved wind energy harvesting



CFD Modeling of food digestion in stomach

Best of luck to you this year!

Questions? Contact

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