2019 MSE Expo

Rajat Mittal
Director of Graduate Studies
Mechanical Engineering
November 5, 2019

Agenda
- 5:15 Rajat - Welcome & Overview
- 5:35 Mark Savage - Life Design Lab
- 5:50 Nathan Scott - Master’s Design options and Essay options offered by Industry
- 6:00 Luke Thorstenson – Co-Op Essay Option for ME Students
- 6:10 MSE Essay Presentations
  - Chuanxin Ni
  - Garrett Ung
  - Chengda Li
  - Yue Hao
- 6:35 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 (530.600 MSE Graduate Research can be one)
- Master’s Essay (530.602 MSE Thesis Research and Writing)
- Co-Op Essay
Master’s Essay
(530.602 MSE Essay Research and Writing)

• Identify a research advisor

• Conduct research
  • 6 total credits of 530.602 (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 thesis defense!

• Advantages of MS 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
  - 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 2019-2020

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<thead>
<tr>
<th>Name</th>
<th>Energy &amp; Environment</th>
<th>Fluid Mechanics &amp; Thermal Sci.</th>
<th>ME in Biology and Medicine</th>
<th>Mechanics and Materials</th>
<th>Micro/Nano Scale Science</th>
<th>Robotics, Systems, Control</th>
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Potential projects in Kang group

Bone-inspired materials with self-adaptive mechanical properties (Air Force Office of Scientific Research)

Architected liquid crystalline elastomers with adaptive and extreme energy dissipation/damping (Army Research Office)
- Collaboration with Army Research Lab and Air Force Research Lab

Low cost underwater pressure sensor (National Oceanic and Atmospheric Administration)
- Collaboration with JHU APL

Tunable energy harvester and acoustic transducers (Office of Naval Research)
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
Transform multiphase flow research to drive energy savings and streamlined processes.

http://me.jhu.edu/rui_ni
Inertial cell ordering single-cell analysis and implantation

Vortex-integrated BioEditors

Critical factors for lateral migration of soft matters

Membrane stiffness
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:


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

Effect of particle size and shape on inertial focusing in microfluidics

High performance wing for UAV/MAV

CFD Modeling of food digestion in stomach
Master’s Essay projects starting Spring 2020

- High Reynolds number reduced order wall-turbulence modeling tools
  - Model validation through simulation over a range of conditions
  - Characterizing the role of the physics in refining the model reduction approach
- Research tasks and required skills
  - Simulations of channel flow using existing codes model
  - Analysis of results
  - Modification of tools to simulate improved models based on findings

Restricted nonlinear flow representation comprising a streamwise constant large-scale interacting with dynamically restricted perturbations reproduces salient flow features at vastly reduced computational costs.
Available Robotics Industry Projects
Nathan Scott

• **SRT robotics**
  – SRT-GCC: Global command center for robots & humans
  – SRT-2D3D: 2D to 3D map extrapolation
  – SRT-PCS: Point Cloud Selfie.

• **Thorlabs Quantum Electronics**: automated test rig for VCSEL arrays

• **Space Telescope Science Institute** STUF Lab: Characterization of DMDs for multi-object spectrography *(some citizenship restriction)*

• **Marlin Wire & Steel**: cell productivity improvement *(U.S. citizens only)*
Best of luck to you this year!

Questions? Contact the DGS