Old Dominion University
Biomedical Engineering Overview

Michel Audette Ph.D.
Associate Professor,
Graduate Program Director,
Biomedical Engineering Institute
maudette@odu.edu
Why BME Minor/Grad Degree?

• **Exciting tangent** for Engineers with Electronics, Mechanical, or Chemical Eng., or Scientists with Biology, Chemistry, Maths, or CS: add clinical understanding or engineering R&D to their toolbox.

• Unique interface between engineering and healthcare: highly altruistic career path.

• Great range of expertise: electronics, software, mechanical & chemical design, & nanotech.

• Robust job growth, supported by demographics: aging population = more w. health issues.
Undergraduate BME Minor

12 CH total – Supervised by Prof. Anna Bulysheva

First course (3 CH):
- Biology students: Math course
- Engineering students: Physiology course

Two out of these four (6 CH):
1. BME 403 Mathematical Modeling in Physiology (3 CH)
2. BME 404 Introduction to Biomaterials (3 CH)
3. BME 405 Biomechanics (3 CH)
4. BME 409 Introduction to Regenerative Medicine (3 CH)

1 elective (3 CH, may be double counted with major).
- Linked BS/Minor-MS/PhD feasible: count 2 courses for grad degree.
Graduate BME Programs

**MS/ME: 30 CH total**

- **Choose 3 of 4 Core BME courses (9 CH):**
  - BME 722 Mathematical Modeling in Physiology (3 CH)
  - BME 720 Modern Biomedical Instrumentation (3 CH)
  - BME 726 Biomaterials (3 CH)
  - BME 792 Biomechanics (3 CH)

**MS with Thesis: BME electives (9CH), approved electives (6CH), research (6CH).**

**MS w/o Thesis/ME: BME electives (12CH), approved electives (9CH).**

**Ph.D. 48 CH total**

**Core BME courses (15 CH):**

- BME 822 Mathematical Modeling in Physiology (3 CH)
- BME 820 Modern Biomedical Instrumentation (3 CH)
- BME 826 Biomaterials (3 CH)
- BME 892 Biomechanics (3 CH)
- BME 847 Responsible conduct in research (2 CH)
- BME 830- Predoctoral Fellowship Grant Writing (1 CH)

**BME electives (9 CH).**

**24 CH courses in total.**

**24 CH dissertation research.**
Academic:
• Fei Xie PhD: Asst. Professor BME
  Chongqing Univ. (Cardiac ablation)
• Yalda Shahriari PhD: Asst. Professor BME,
  Univ. Rhode Island (Neural engineering)

Industry & Military:
• Johanna Neuber PhD: Research Scientist, Sara Inc.
  (Colorado Springs) (Pulse & lithotripsy therapies).
• Nicholas Waytowich PhD: Research Scientist,
  Army Research Lab (Baltimore) (Cognitive assistance).
Quick Look at Jobs

- Salaries for BMEs vary geographically in US. Median pay was $91,410 per year in 2019.
- Job growth slightly predicted to outperform rest of engineering from 2019 to 2029.
BME Research at ODU

(This could be YOU!)
Cellular and Molecular Scale Research

- Cellular Mechanics – Dr. Maruthamuthu.
- Ion Transport in stressed membranes – Dr. Vernier.
- 3D Bioprinting via Stem Cells – Dr. Sachs.
- Post-stimulation Cell Membrane Repair – Dr. Pakhomova.
- Molecular Simulation – Dr. Wriggers.
- Gene Therapy & Regenerative Medicine – Dr. Bulysheva.

8 weeks hpECM
Bioelectric & Plasma Therapies

- Tumor death by Nano-Pulse Stimulation - Dr. Beebe
- Cold Plasma Therapies (tumors) - Dr. Jiang
- Antenna for Deep Brain Stimulation - Dr. Xiao
- Immune Activation (tumors, bacteria) by NPS - Dr. Muratori
- Plasma Therapies (injury, infection) - Dr. Kong
- Targeted Tissue Stimulation - Dr. Pakhomov
Medical Devices & Biosensors

- Microsensors for vascular health - Dr. Hao.

- Polymerase Chain Reaction for copying of DNA – Dr. Baysal.
Biomechanics

- Dynamics of spine and lower extremities- Dr. Kakar.
- Control of complex nonlinear motor system– Dr. Russell.
- Foot, ankle, spine, and knee biomechanics- Drs. Ringleb & Bawab.
- Gait in persons with special needs – Dr. Bennett.
Therapy Planning, Simulation, & Delivery; Computer-assisted Diagnosis

- Surgical robotics for breast tumor removal - Dr. Kaipa
- Image Analysis for Diagnosis Assistance - Dr. Iftekharuddin.
- Speech Intervention for Stroke-Induced Aphasia - Dr. Raimer.
- Learning in rehabilitation after brain injury - Dr. Johnson
- AI in healthcare: wound classification - Dr. Kuzlu
My group innovates in patient-specific medical simulation and surgery planning/navigation, so far with applications to brain, spine and breast surgery and to geriatric fall injury mitigation.

Michel Audette, Ph.D., Associate Professor, Computational Modeling and Simulation Engineering
• Justification for BME. Minor: 12 CH; MS/ME: 30 CH; PhD: 48 CH

• Cellular & Molecular – biomechanics, bioelectrics, dynamics, stem cells.

• Bioelectric Therapy – electroporation, plasma, remote stimulation.

• Devices & Biosensors – microtactile sensors, portable DNA copy.

• MS Model, Biomechanics- human movement (spine, legs), motor control.

• Surgical planning, sim, delivery, robotics; computer-assisted diagnosis.
Questions?

• Ask now, or email me: maudette@odu.edu on MS/ME/PhD or Dr Bulysheva: abulyshe@odu.edu on BME Minor.