Rehabilitation Engineering

Goal: restore mobility, independence & health to individuals with disabilities through advances in science and technology
3000 sq. ft. motion analysis lab
3000 sq. ft. of engineering lab & fabrication space

engineering.vanderbilt.edu/create
1. Studying the science of human movement (biomechanics)
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2. Developing assistive tech (prostheses, exoskeletons, smart clothing)
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3. Performing experiments to measure benefits & refine devices
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4. Training next generation of engineers, scientists & innovators
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Research Groups Within CREATE

Zelik & Goldfarb Labs
Zelik Lab  Applied  Goldfarb Lab

Human  Theoretical  Robot
biological insights motivate design & control

assistive devices as tools to probe biological function
biological insights motivate design & control

assess performance

control performance

assistive devices as tools to probe biological function
CREATE extended family (VUMC clinical collaborators)

Gerasimos Bastas, MD, PhD
(care for prosthetic users)

Leon Scott, MD
(orthopedics, stress fracture)

Chrissy Durrough, PT, DPT, NCS
(spinal cord injury)

Aaron Yang, MD
(low back pain, rehabilitation)
Zelik Lab

Example Research Projects Merging Biomechanics & Robotics
Robotics + Biomechanics

Restoring bio-inspired ankle-knee coupling for prosthetic users

**Example Project 1**

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**Aim I:** Parameter Sweeps to Find Optimal Behavior...
- Train
- Train
- Train
- Test

... by varying ankle-knee spring stiffness and set point, & net positive work

break (>1 day)

**Aim II:** Gait With Optimal vs. Without Gastroc.

- Train
- Test

ABAB reversal experiment design

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**Lab-based robotic actuator + prosthetics + biomechanics ➔**

enhance how assistive power is transmitted from the device to user, & better understand human ankle-knee muscles (gastrocnemius)
Robotics + Biomechanics
Using toe dynamics to improve powered & passive prostheses

Example Project 2

Vanderbilt powered ankle prosthesis + enhanced foot/toe design + biomechanics → enhance ambulation for prosthetic users on inclines, stairs and uneven terrain, & better understand biological ankle-foot dynamics