PHOTOACOUSTIC & ULTRASONIC SYSTEMS ENGINEERING LAB

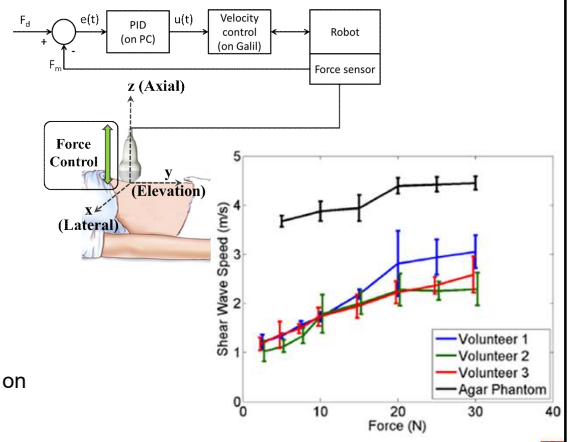
Force-Controlled Robot for Elasticity Imaging

- Maintain consistent contact with patients during shear wave elasticity imaging to detect differences in tissue mechanical properties

What Students Will Do:
Use integrated force sensor to write force control laws that maintain probe contact

Deliverables:
- Prototype system with Sawyer robot
- Demonstration with ultrasound phantom
- Compare new method to existing standards

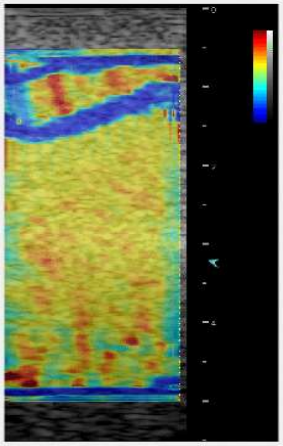
Bell MAL et al. IEEE Transactions on Biomedical Engineering, 2016



PHOTOACOUSTIC & ULTRASONIC SYSTEMS ENGINEERING LAB

Force-Controlled Robot for Elasticity Imaging

- **Size group:** 2-3
- **Skills:**
  - ultrasound imaging knowledge
  - experience with robotics
- **Faculty Mentor:** Muyinatu Bell (mbell36@jhu.edu)



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PULSE
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da Vinci-Compatible Shear Wave Imaging

- Bring benefits of shear wave elasticity imaging to minimally invasive surgeries
- **What Students Will Do:**
  - make existing da Vinci drop in probes compatible with shear wave imaging
- **Deliverables:**
  - Build connector for custom research scanner
  - Interface drop in probe with shear wave imaging script
  - Demonstrate working prototype
- **Size group:** 2
- **Skills:** circuit analysis and design, ultrasound imaging knowledge
- **Mentors:** Muyinatu Bell (mbell36@jhu.edu)

http://bkultrasound.com/products/flex-focus/transducers/proart-robotic-drop-in-8826-ultrasound-transducer

PULSE
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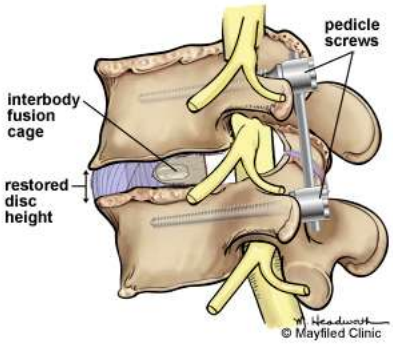
Photoacoustic-Guided Spinal Fusion Surgery

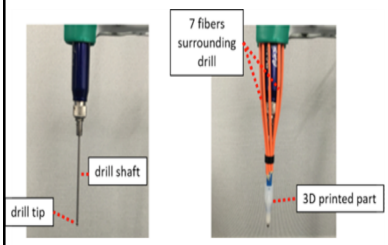
- Determine the feasibility of using photoacoustic imaging to guide spinal fusion surgeries
- **What Students Will Do:** perform photoacoustic imaging experiments with sine specimens
- **Deliverables (choose 3):**
  - Distinguish cortical from cancellous bone
  - Visualize pedicle boundaries
  - Visualize nerves
  - Determine optimal entry point
  - Evaluate imaging resolution
  - Define energy requirements

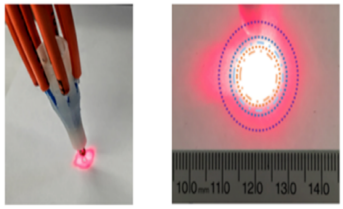


http://www.mayfieldclinic.com/PE-FusionPreparing.htm

- **Size group:** 2
- **Skills:** experience with ultrasound imaging, experience with lasers and laser safety, hands-on experimental skills
- **Faculty Mentor:** Muyinatu Bell (mbell36@jhu.edu)

Light Delivery Systems for PA-Guided Surgery





Eddins and Bell, JBO, 2017

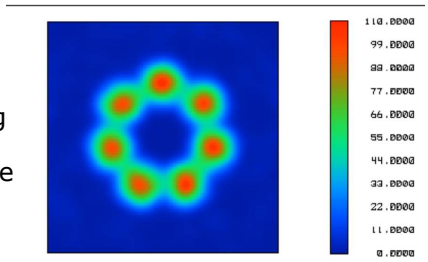
Develop a specialized light delivery system for photoacoustic-guided surgery

What students will do:

- Choose a compatible surgical tool
- Answer design questions:
  - How many fibers? (Zemax Simulations)
  - How far apart? (Monte Carlo Simulations)
- Build working prototype and demonstrate surgical photoacoustic task with the da Vinci

Light Delivery Systems for PA-Guided Surgery

- **Deliverables:**
  - Design custom light delivery system
  - Build phantom for chosen clinical application
  - Demonstrate working prototype with integrated photoacoustic system and da Vinci surgical system
  - Perform task with and without photoacoustic guidance
- **Size group:** 2-3
- **Skills:** programming for simulation software (Monte Carlo, Zemax), Solid modeling (SolidWorks, Creo), hands-on experimental skills, experience with lasers and ultrasound desired but not required
- **Faculty Mentor:**
  Muyinatu Bell
  (mbell36@jhu.edu)



Eddins and Bell, JBO, 2017