

Engineering



Theatre Arts



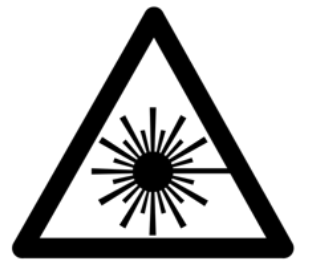
International
Development

Engineering + Arts Portfolio

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Time-Resolved Skin Spectroscopy for Bio-sensing

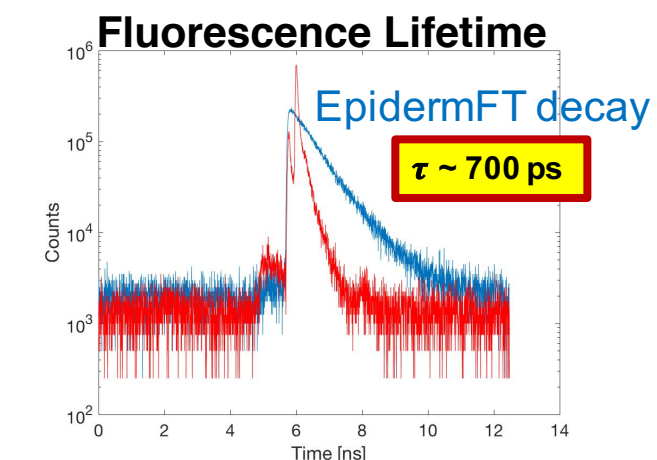
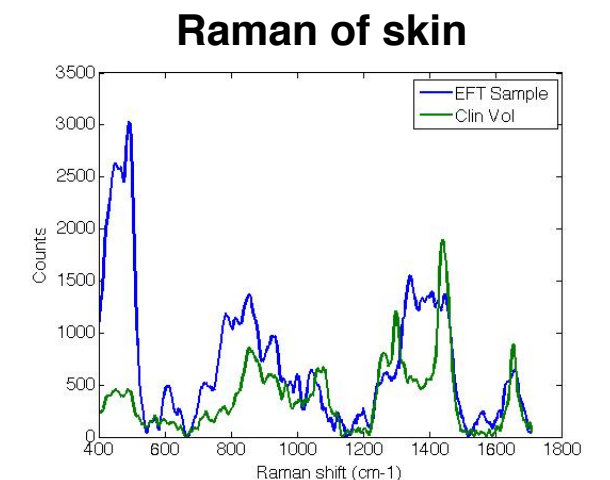
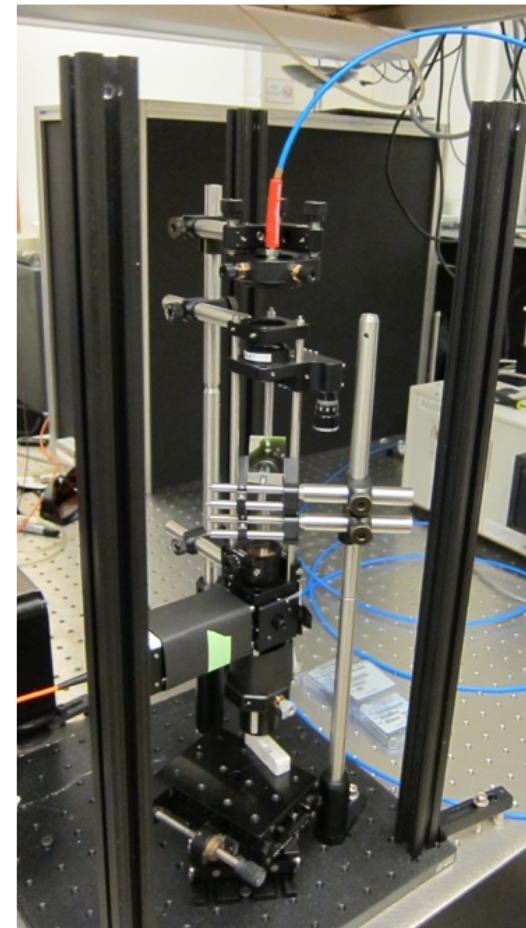
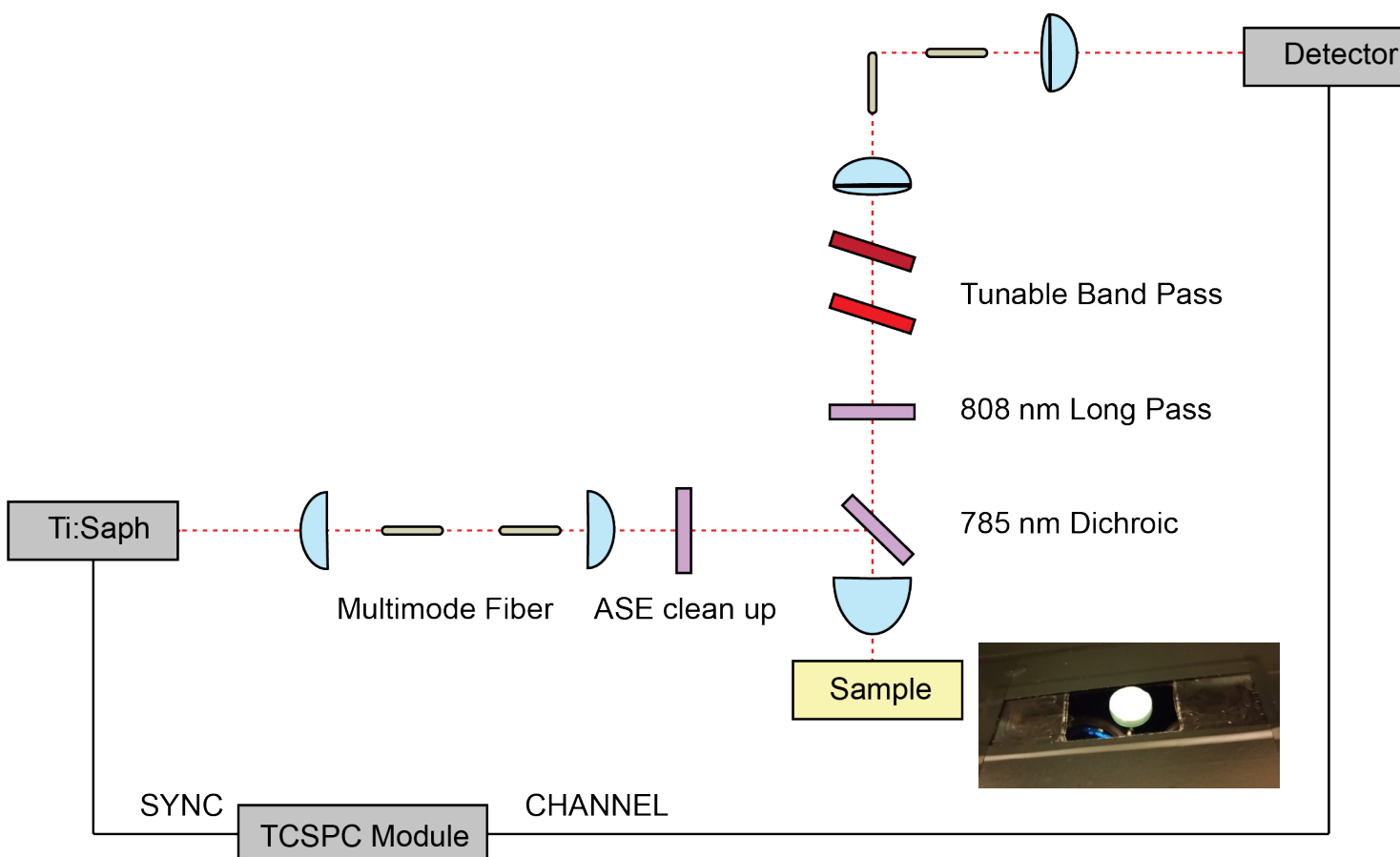


My Masters research at MIT focused on Raman spectroscopy of skin for noninvasive diagnostics (glucose sensing, cancer detection). Over two years, I designed and built several high sensitivity electro-optic instruments for demonstrating new measurements on *in vitro* skin tissue.

MIT Research Laboratory of Electronics 2016-2018
Advisor: Rajeev Ram; Research Sponsor: Samsung

Concepts/Skills:

- perseverance through lots of failure
- optics/photonics/applied physics
- electro-optic design/instrumentation
- time correlated single photon counting
- tissue culturing/biology



Compact Proton Beam Energy Modulator

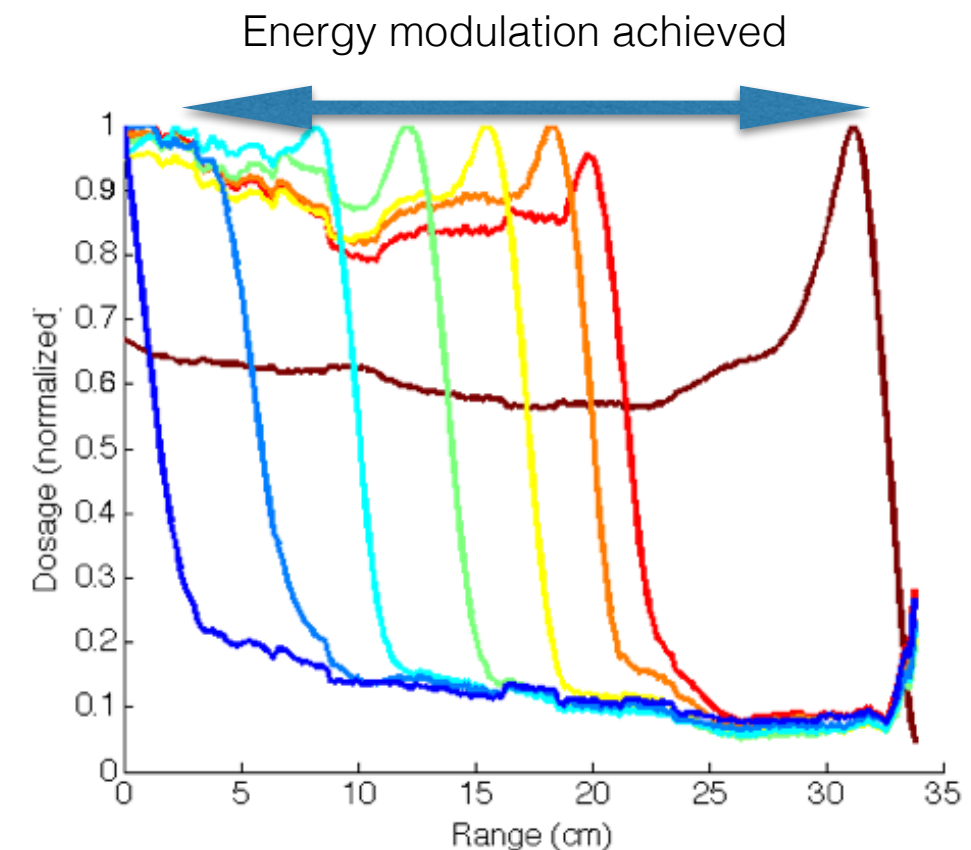
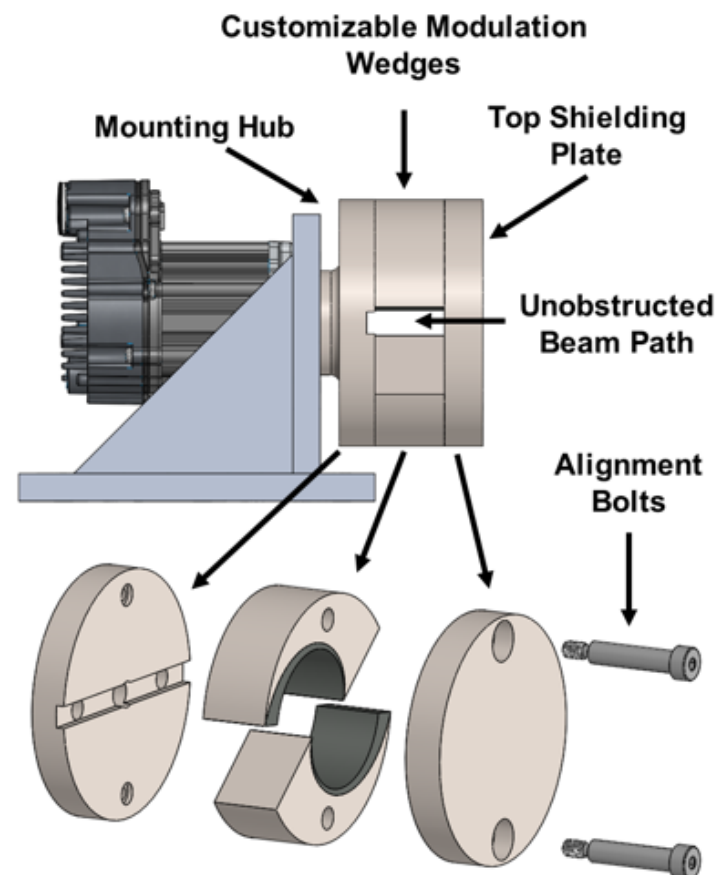
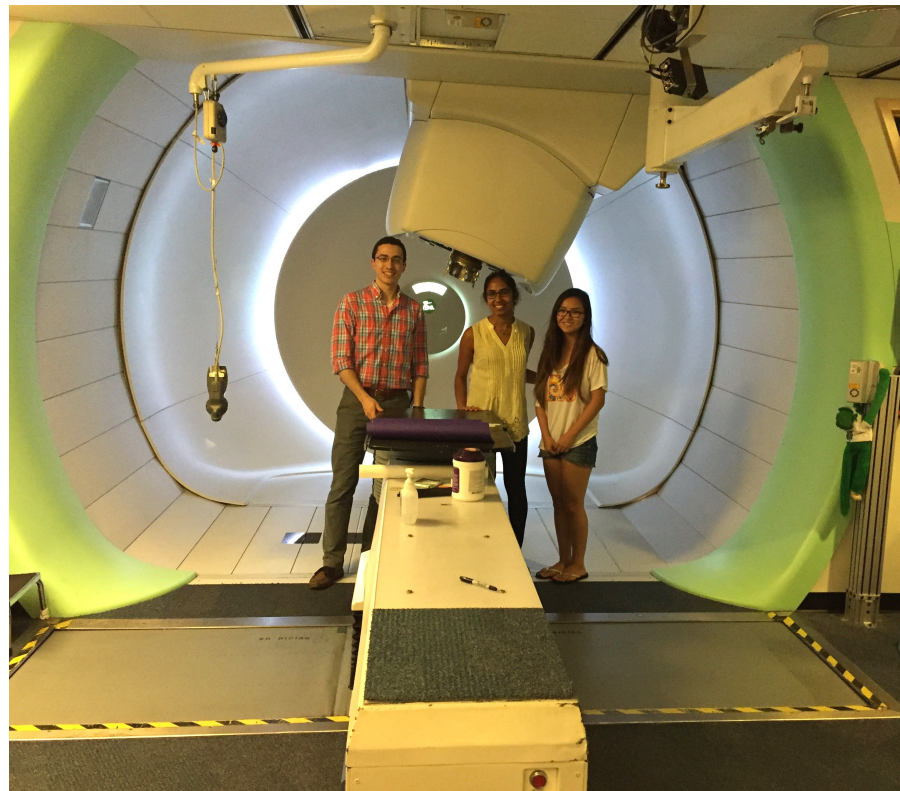


Proton radiation is used to treat cancers near vital organs. Our novel, compact proton beam energy modulator enables imaging of tumors using protons which improves the precision of treatment.

US Patent Pending: N. Aggarwal, M. Cavuto, M. Li, N. Rodman
MIT 2.75 Medical Device Design 2016 class project in collaboration with Mass General Hospital.

Concepts/Skills:

- proton physics/medical physics
- CAD/SolidWorks
- fabrication/prototyping
- engineering design process
- team work, project planning



Tabletop Nuclear Magnetic Resonance System



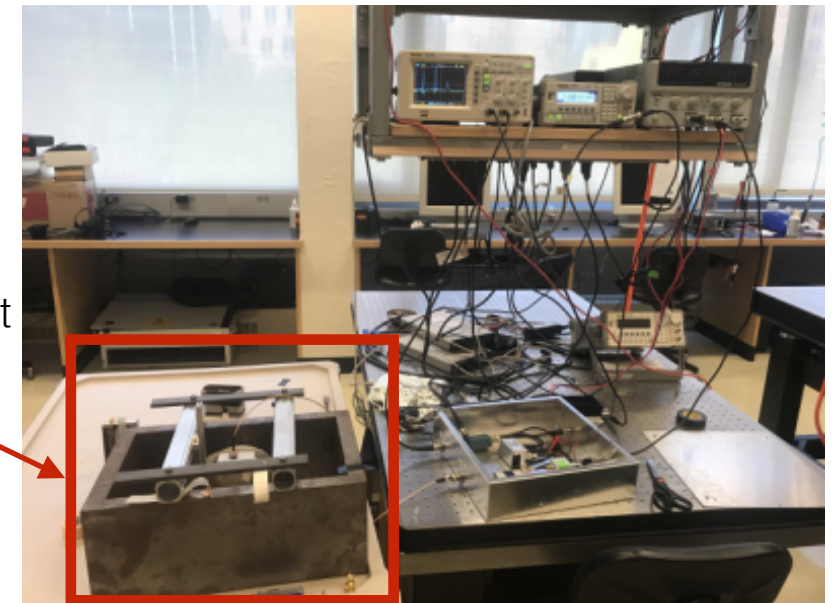
We built a tabletop NMR spectroscopy system - essentially a single pixel MRI machine - to analyze and differentiate between chemicals. We designed the RF probe to match the resonance of our magnet and impedance of the electrical chain.

MIT Bioinstrumentation Class Project 2017
N. Aggarwal, N. McCoy, R. Waldman, C. Zimmerman

Concepts/Skills:

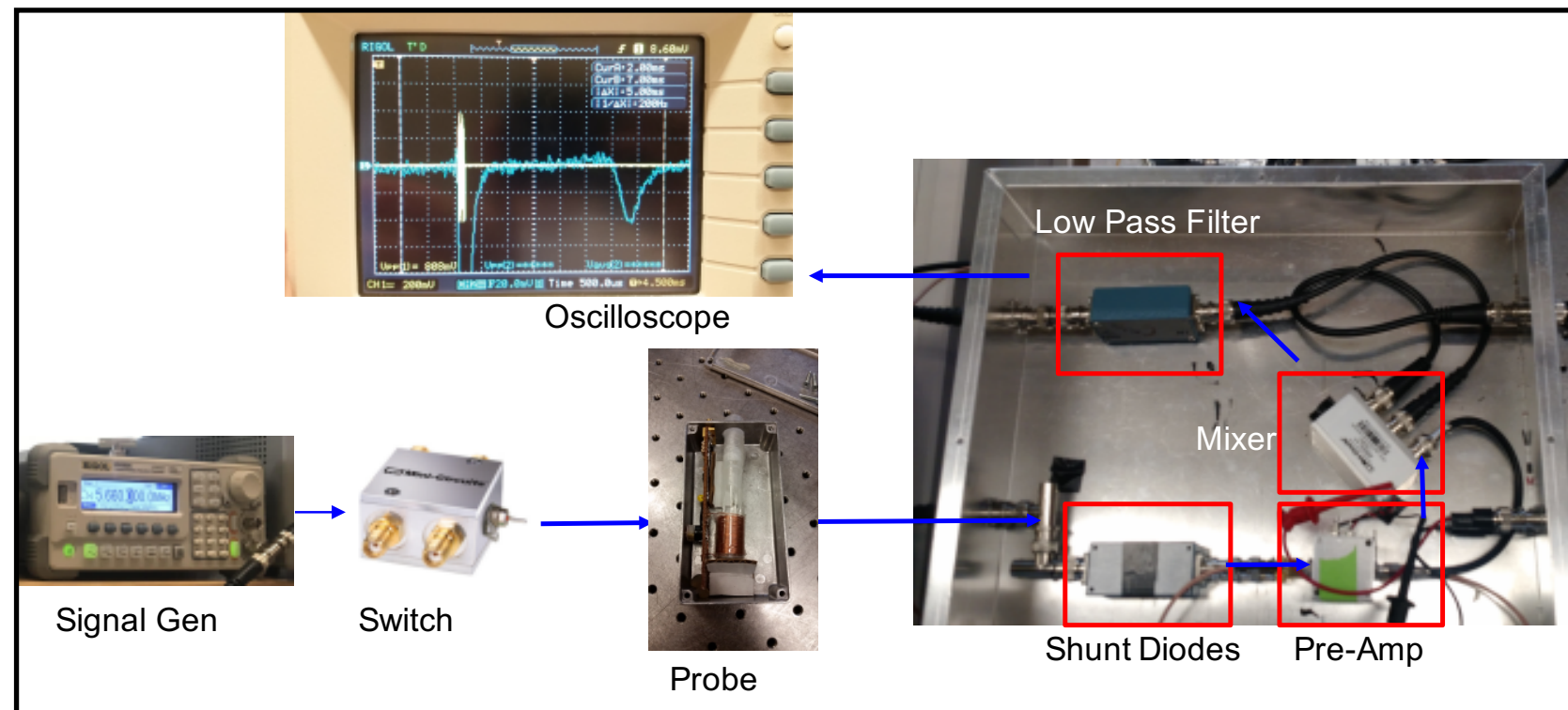
- radiofrequency (RF) electrical design
- instrumentation and debugging
- teamwork and project planning

Tabletop system

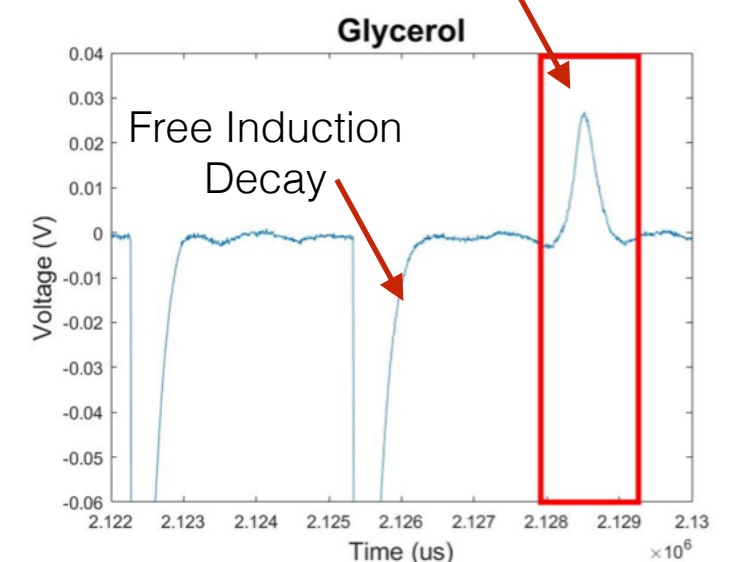


Permanent magnet with probe

Electrical chain schematic



Spin Echo signal



Wearable high power laser for Raman biosensing



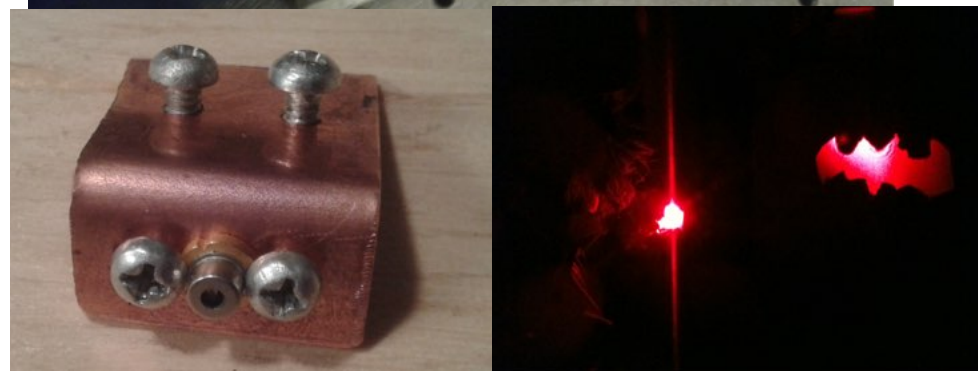
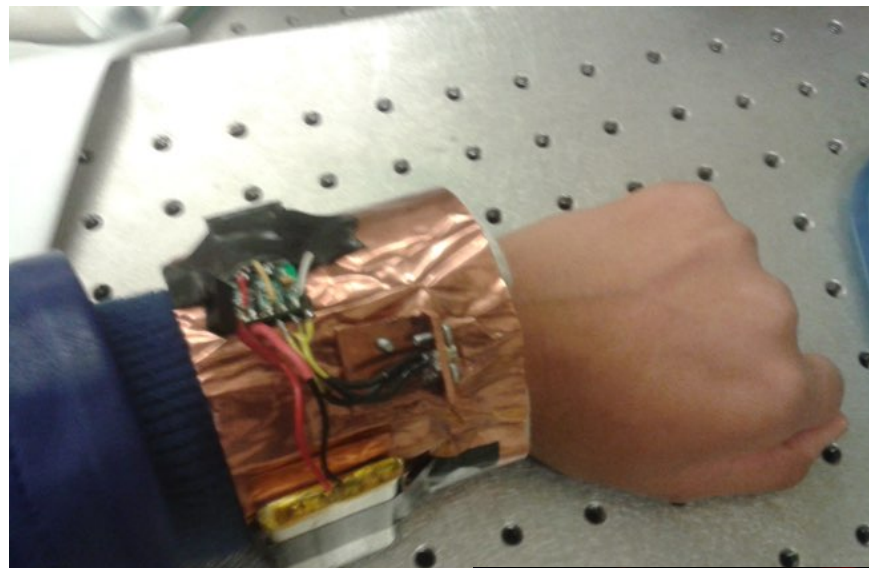
Independent research project in EECS 2015

Design and fabricated a passive heat sink to stabilize a high power diode laser

Power and wavelength stability was achieved for Raman spectroscopy applications

Concepts/Skills:

- lasers, spectroscopy
- heat transfer
- basic electronics
- mechanical design (SolidWorks), component selection, fabrication (machining, soldering)

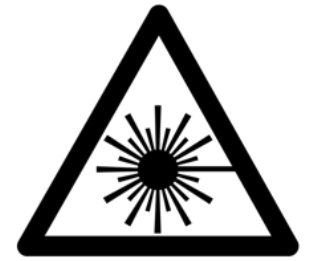


1st & 2nd heat sink prototype
for laser above

Photoplethysmography Sensor (PPG)

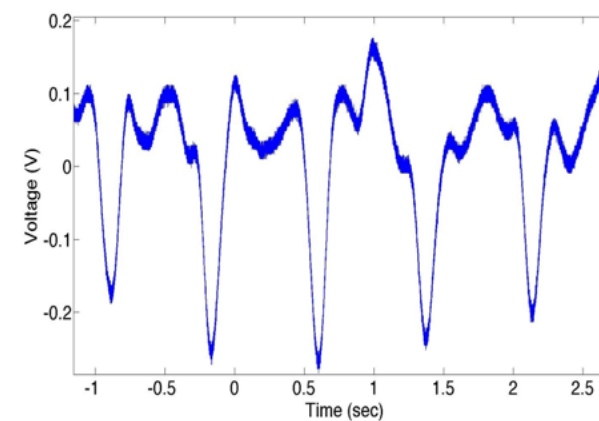
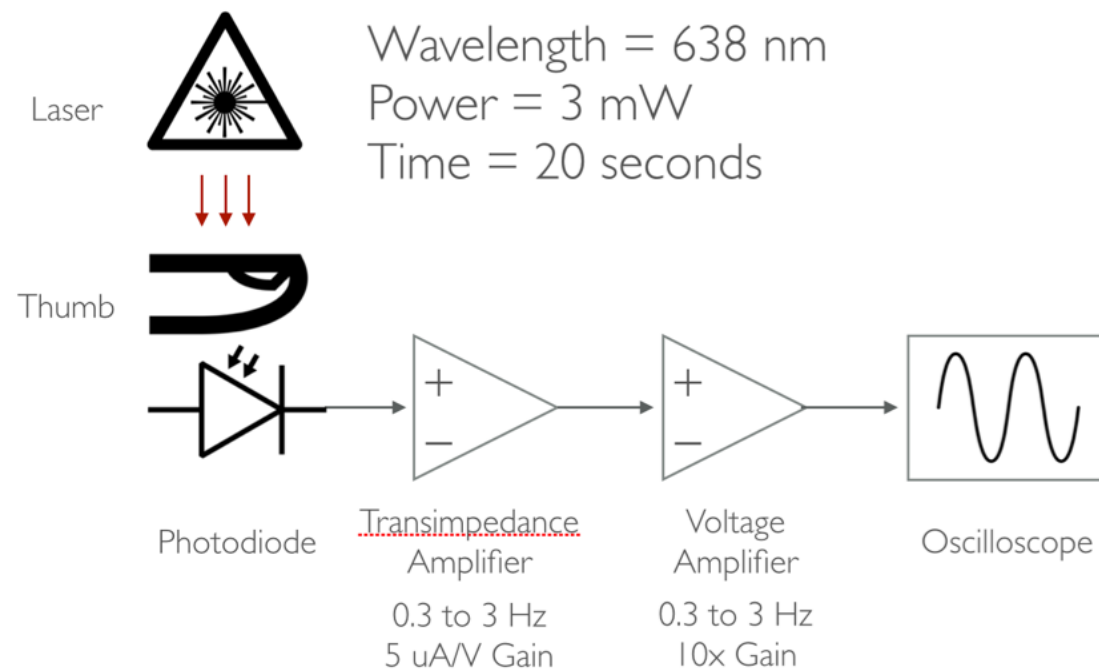
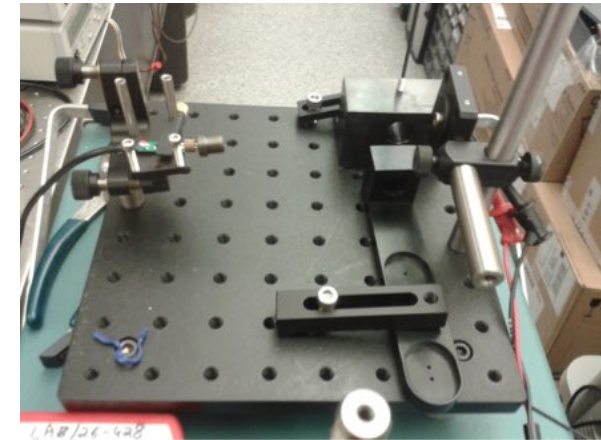
MIT Modern Optics Lab class Final Project 2014

Designed an electro-optic setup for PPG: optical measurement of blood volume (correlates to pulse)

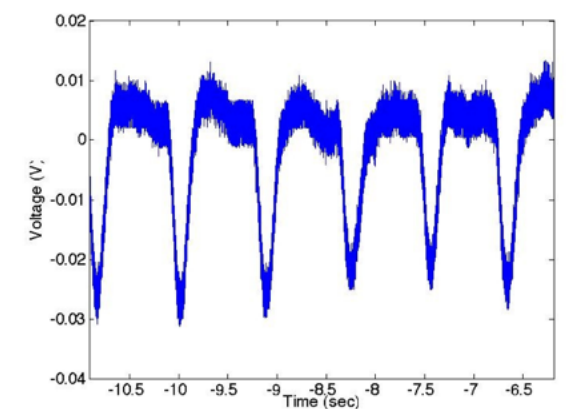


Concepts/Skills:

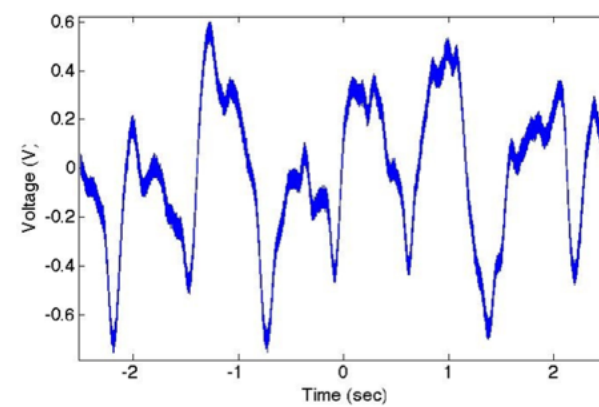
- independent project selection
- experimental design, setup, measurements, testing
- signal processing (Matlab)



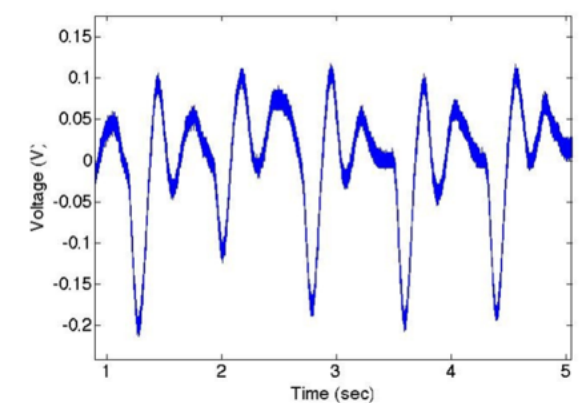
Subject A



Subject B



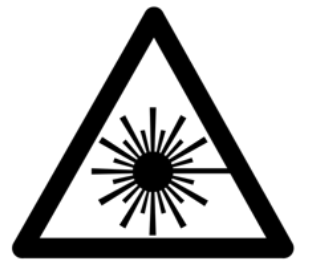
Subject C



Subject D

Experimental Setup

Form 2 Stereolithography Printer Heater Control Loop



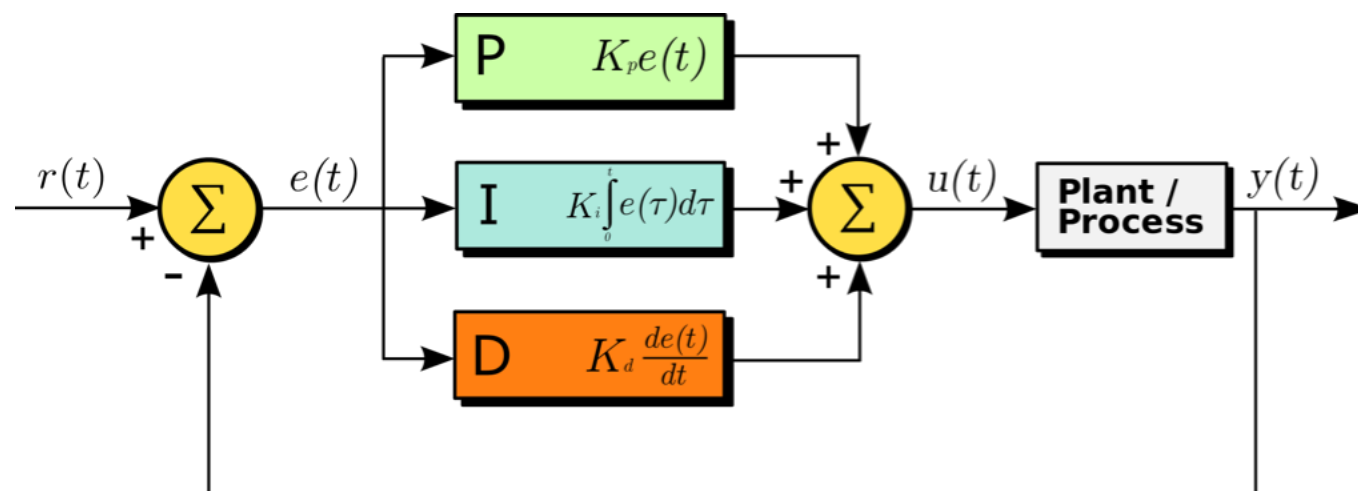
Print Process Engineer at FormLabs Summer 2015

Calibrated the temperature sensor and tuned the heater control for the Form 2

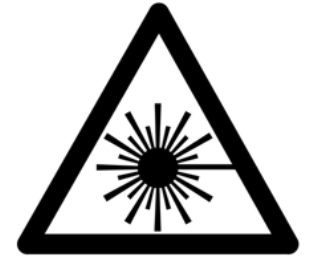
Diagnosed and solved print failures during preproduction of the Form 2

Concepts/Skills:

- PID controller
- lasers, motors, electronics
- systems integration, hardware engineering
- debugging and problem solving
- Python, Terminal



Fiber Optics Telemetry for Wireline/Perforating



Summer 2014 Internship at Halliburton R&D

First round of experiments on new project to use fiber optics for downhole sensing

Concepts/Skills:

- assembling fiber optics systems
- optoelectronic testing at high temperature
- Matlab data processing (Fourier transforms, filters, SNR)
- presenting to VP of Halliburton
- working with 6+ other full time engineers/scientists

Project images/details are confidential

Director/Creator - *Einstein's Dreams*



Year-long thesis project for Theater Arts degree

I directed the mainstage spring production for MIT Theater Arts (usually directed by faculty or professionals) working with a team of over 30 actors, designers, technicians - several of whom were professional artists in the Boston area.

Einstein's Dreams was adapted from the namesake novel and showcased different worlds where time ran differently. It explored space, time, the creative process, and also the cost of creativity.

WATCH the MIT News Feature Video: news.mit.edu/2017/featured-video-bringing-einsteins-dreams-to-life-0620



Director/Creator - *Einstein's Dreams*



Concepts/Skills:

- Entirely original - I wrote the script, collaborated on the music, costumes, everything
- final decision making on all performance and technical components
- led the creative vision for the production; collaborated with a 30+ team of actors and designers
- struggled for a year with the creative process, held “prototyping” workshops, explored new mediums (ex: light art)



Director - *Now Then Again*



Staged full length production of *Now Then Again*, a time-bending romantic comedy about two physicists. Explored themes of science theatre.

MIT Experimental Theatre Company Fall Show Nov 2015 in Kresge Theater RRA

Concepts/Skills (built on previous experience):

- final decision making on all performance and technical components
- led the vision for the production
- collaborated with a 12+ team of actors and designers
- work seen by over 250 people in audience



Creator/Performer - *Connections*

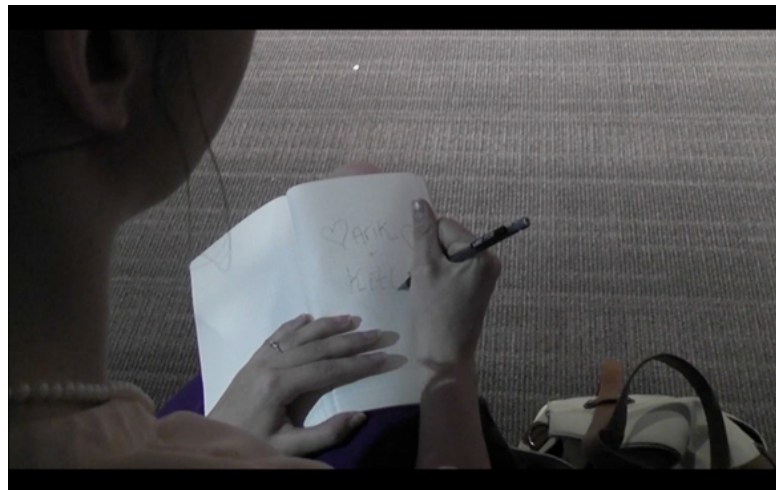


Short film about the human implications of personal data and social networking
Acting with the Camera Final Project in Spring 2016 filmed on MIT campus

Concepts/Skills

- character & story creation, screenwriting
- acting, directing, cinematography, filming
- editing using Adobe Premier Pro
- collaborating with three other artists

Watch the short film: https://www.dropbox.com/s/qxqk40m8zuoi1j0/Connections_Final_Cut.mov?dl=0





Creator/Performer - *Colours of Madness*

Explored nonlinear narratives and use of *Viewpoints*
Motion Theatre Final Project in Fall 2014 in Walker Memorial Building

Concepts/Skills

- ideation to reality (wrote, rehearsed, performed entire work)
- finding solutions to artistic design challenges (ex plastic sheeting)
- speaking, presentation, performance skills

Watch the performance: <https://vimeo.com/181834794>





Stage Director - *The Importance of Being Earnest*

Staged modern adaptation of Oscar Wilde's classic play
MIT DramaShop Fall One Acts Nov 2014 in Kresge Little Theater

Concepts/Skills:

- final decision making on all performance and technical components
- led the vision for the production
- collaborated with a 12+ team of actors and designers
- work seen by over 250 people in audience





PeaceCorps Application Portal

International Development Hackathon 2014 project - 1st place

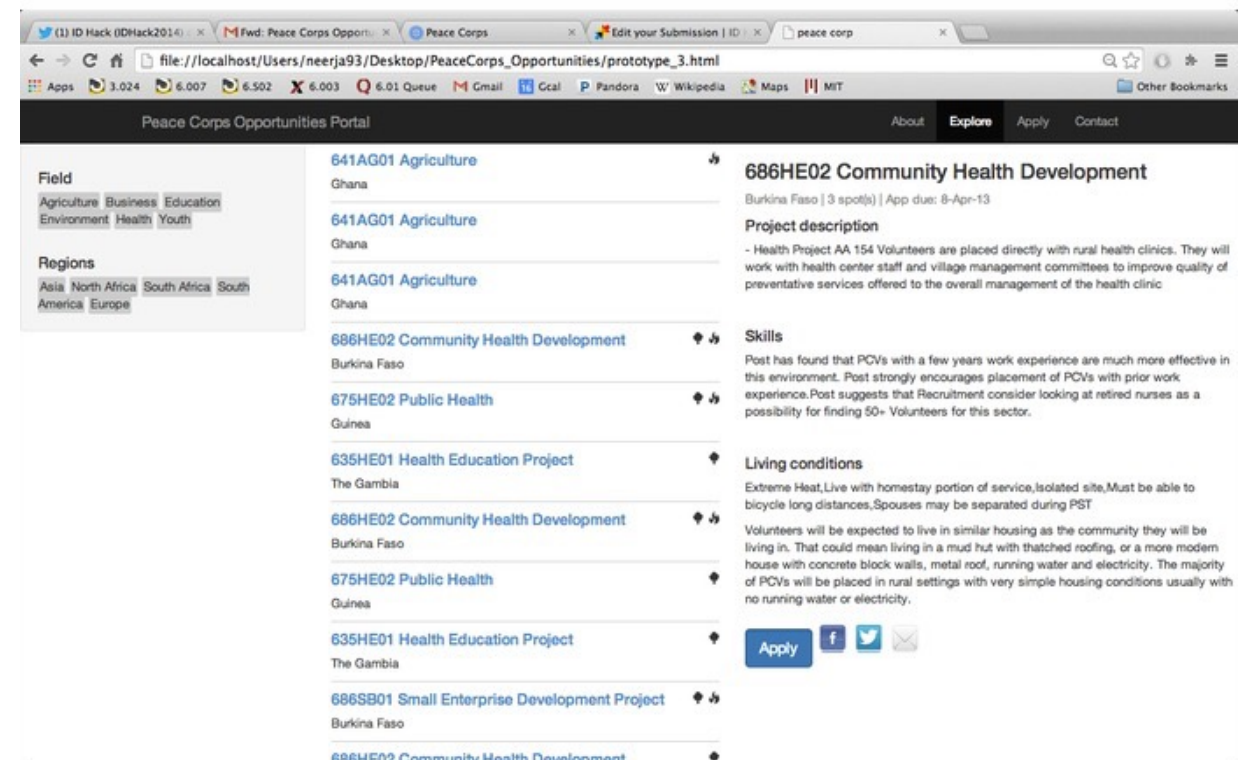
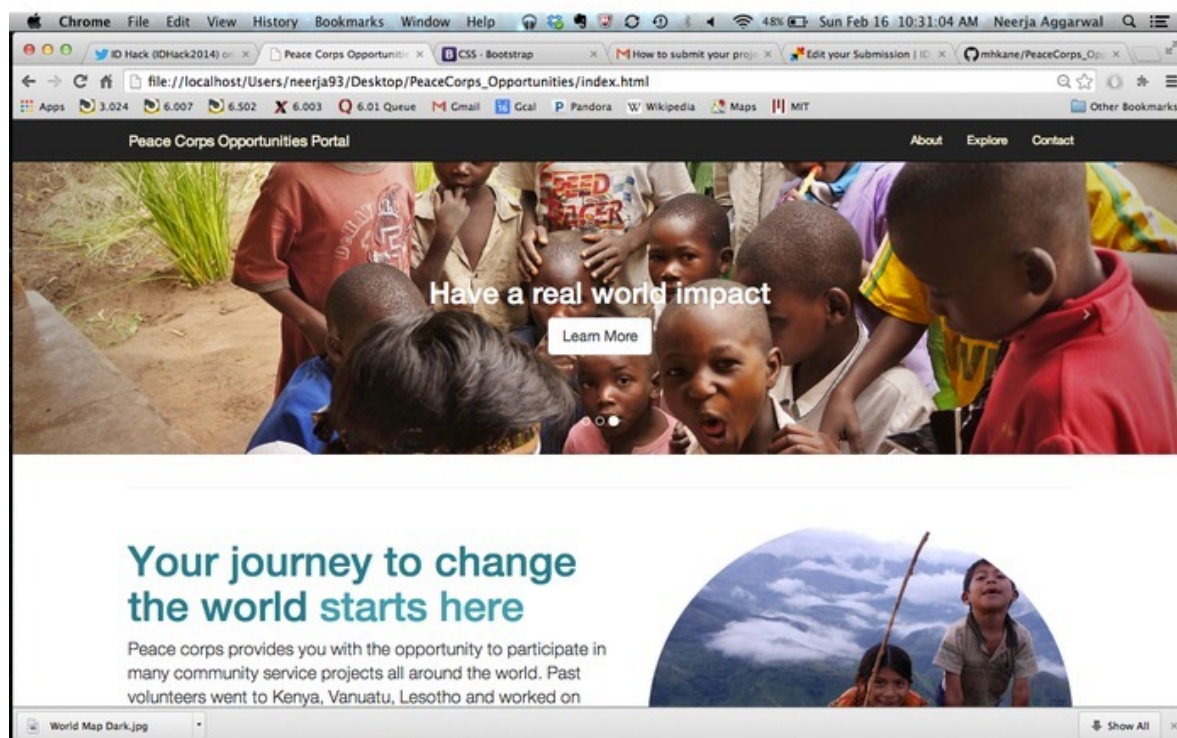
Designed an interface to apply to specific opportunities for Peace Corps - now becoming actual feature used by PeaceCorps

Concepts/Skills:

- first experience with CSS, HTML, JavaScript
- used the iterative design cycle to achieve a functional product in 12 hours
- had very little subject matter knowledge but still led a team of 6 developers who were not acquainted previously

<http://challengepost.com/software/peace-corps-opportunity-search-portal>

<https://github.com/PeaceCorps/Opportunity-Portal>



Solar Disinfection in a Box



D-Lab Design Class Project Spring 2014

Construct a water treatment system out of packaging materials for a family in Uganda refugee camps

Concepts/Skills:

- working with team of four to complete
- information gathering to design for community across the world
- my specific design focused on storage bladder:
heat-sealing plastic + Franzia nozzle



Final assembly



Storage Bladder

