THE KENNEDY LAB
Laboratory for Electromagnetically Inspired Biomaterials and Biosystems

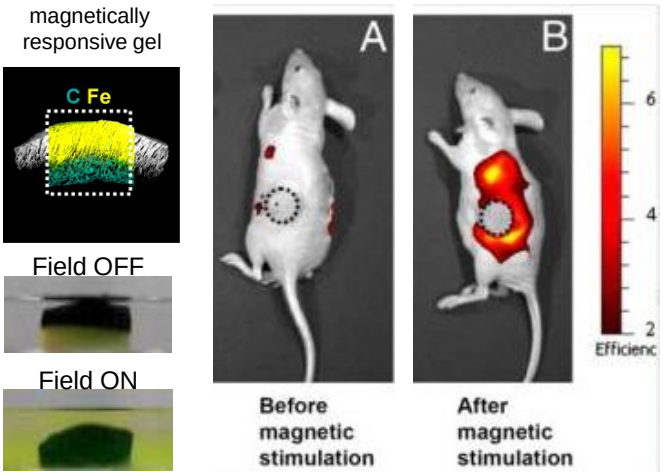
THE UNIVERSITY OF RHODE ISLAND

Pharmacy Room 410
7 Greenhouse Road
Kingston, RI 02881

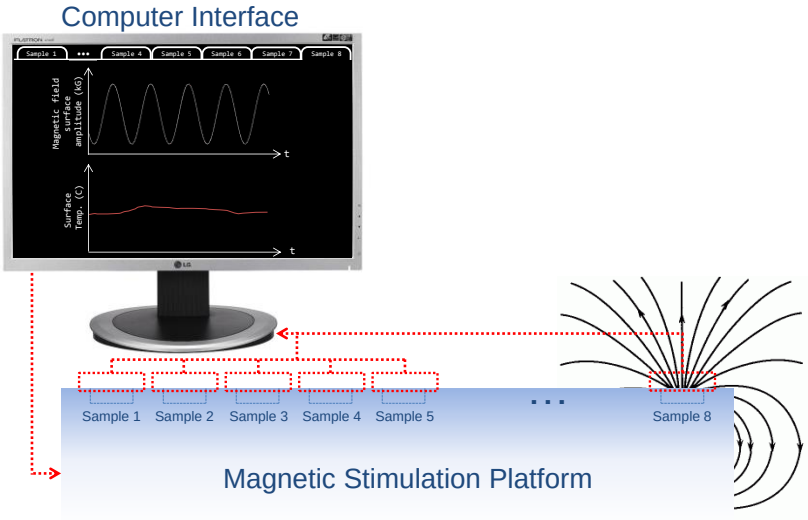
Platform System for Regulating the Amplitude and Frequency of Magnetic Stimulation

Overview:

The Laboratory for Electromagnetically Inspired Biomaterials and Biosystems aims to develop new paradigms in gene & drug delivery, tissue engineering, wound healing, cancer therapies, pain management, and orthopedics using simple, but powerful electromagnetic principles as inspiration. One of our systems involves implantable biomaterials that can be instructed to release drugs (and other biological payloads) from within a patient's body, when stimulated remotely with magnetic fields. Essentially, we are developing bio-compatible materials for remote-controlled drug delivery. These magnetically responsive biomaterials have already been demonstrated to release drug in response to magnetic stimulus and to exhibit excellent *in vivo* delivery capabilities (see figure at right). However, many therapies require explicit control over the timing and rate of drug delivery. Furthermore, many therapies require this sort of flexibility (control of the timing and rate) for multiple drugs. Our lab has promising data that suggests this sort of drug delivery flexibility can be achieved by tuning these biomaterials to respond to magnetic fields of various amplitudes and frequencies. In order to robustly pursue this concept, we will require a platform system capable of exposing these biomaterials (or animals with implanted biomaterials) to magnetic fields of specified amplitudes and frequencies.



System Diagram:



Specifications:

- Magnetic stimulation platform
  - Expose at least 8 samples to spatially graded magnetic fields with surface fields ranging from 0 to 5 kGauss.
  - Control the frequency of magnetic stimulation from 0.01 to 1000 Hz.
  - Maintain a platform surface temperature within 1°C of ambient.
  - Measure the magnetic surface field and temperature as a function of time for each sample and stream this data to the Computer Interface
  - Receive instructions from the Computer Interface regarding the magnetic field amplitude and frequency at which to stimulate.
- Computer Interface
  - Provide a graphical interface for the user to input desired magnetic amplitude and frequency.
  - Receive measurement data from the Magnetic Stimulation Platform and plot/present them as indicated by the user (e.g., average over time, plotted vs. time, etc.).
  - Provide easy transfer of data to document files on computer (e.g., Excell files).
  - Serve as a controller for the Magnetic Stimulation Platform.

Team Description:

- 1 Electrical Engineer and 1 Computer Engineer
- Strong drive, work ethic, independence, and resilience to troubleshooting are a must.
- Experience with machining hardware and interfacing with Labview are a big pluses.
- Experience and interest in electromagnetics is a big plus.
- The desire to expeditiously develop this system so that the student(s) can start using this system to conduct drug delivery experiments is a big plus.

Team Division of Labor:

Electrical Engineer 1. This engineer will design and build the Magnetic Stimulation Platform. He/she will be responsible for developing a system capable of delivering magnetic fields of various amplitudes and frequencies to at least 8 samples while maintaining a stable temperature during magnetic stimulation. Additionally, he/she will design the system so that the real-time magnetic field and temperature can be accurately measured for each sample. Finally, he/she will work with Computer Engineer 1 to appropriately interface the Magnetic Stimulation Platform with the Computer Interface.

Computer Engineer 1. This engineer will develop a computer interface for transmitting to and receiving information from the Magnetic Stimulation Platform. This computer system must provide a clean user graphical interface that allows the user to control the system's magnetic field amplitude and frequency. He/she must also design the Computer Interface to observe received data in the manner specified by the user. All system calculations for proper functioning (e.g., regulation of temperature and maintaining a consistent magnetic field amplitude across frequencies) are to be calculated by the Computer system.

If you have any questions about the project, its objectives, or any of the abovedescribed roles, please contact Prof. Steve Kennedy: skennedy@ele.uri.edu

For further reading see:
(1) http://www.pnas.org/content/early/2010/12/08/1007862108
(2) http://onlinelibrary.wiley.com/doi/10.1002/adhm.201400095/abstract
(3) http://www.nature.com/nmat/journal/v12/n11/full/nmat3758.html