THE KENNEDY LAB
Laboratory for Electromagnetically Inspired Biomaterials and Biosystems

THE UNIVERSITY OF RHODE ISLAND

Pharmacy Room 410
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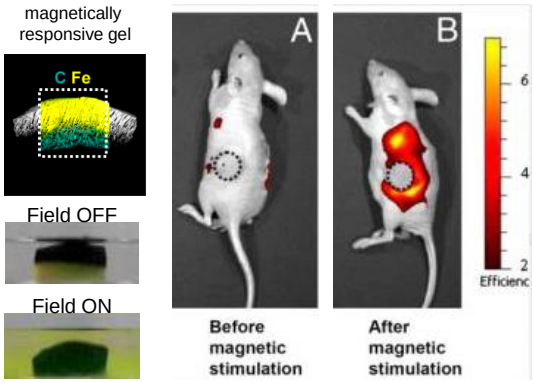
Kingston, RI 02881

Platform System for Regulating the Frequency of Magnetic Stimulation

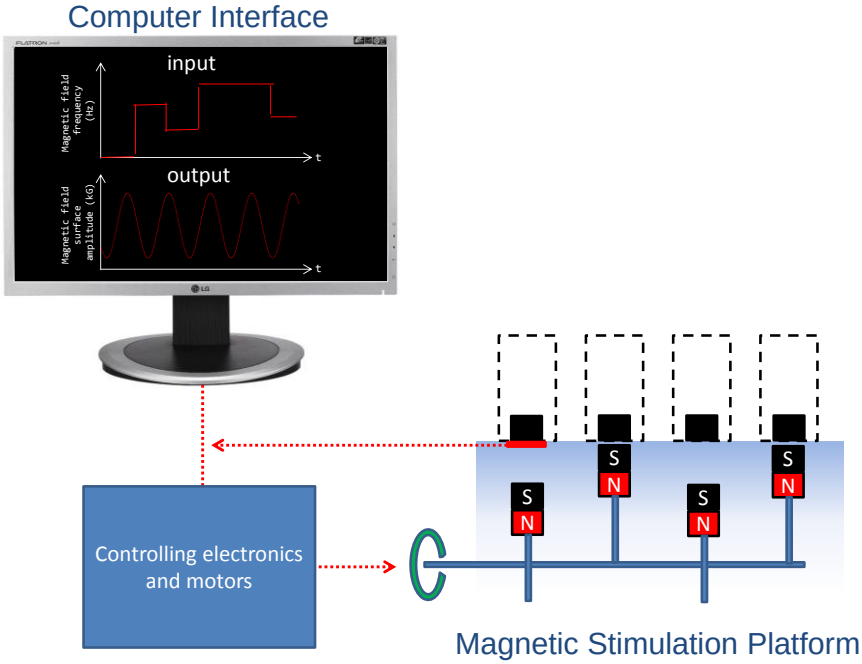
Overview:

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. Our lab has promising data that suggests the timing and rate of delivery can be controlled by exposing these biomaterials to magnetic fields of varying frequency. In order to robustly pursue this concept, we will require a platform system capable of exposing these biomaterials to magnetic fields of specific but alterable frequency.



Specifications:

- Magnetic stimulation platform
  - Expose at least 4 samples to spatially graded magnetic fields with surface fields of approximately 5 kGauss.
  - Control the frequency of magnetic stimulation from 0.01 to 100 Hz.
  - Expose samples to 0 magnetic field (< 100 Gauss)
  - Maintain a platform surface temperature within 1°C of ambient.
  - Maintain a platform with minimal vibration, stability, and safety.



    - Measure the magnetic field as a function of time when instructed to do so from the computer interface and send magnetic field vs. time data back to the computer interface to be displayed and saved.
    - Receive instructions from the Computer Interface regarding the magnetic field exposure regiment to be administered (i.e., a magnetic exposure protocol). The platform system must:
        - Be capable of transitioning from one frequency to another frequency in less than 10 seconds. This includes transitions from 0 magnetic field to any frequency.
        - Vary the magnetic frequency as programmed in 1-minute increments.
        - Received magnetic exposure protocols that last up to one month.
    - Hardware system must be clean, robust, and relatively portable (i.e., circuits boxed and isolated, hardwired electronics, soldered wires, etc.).
- Computer Interface
    - Provide a graphical interface for the user to input the desired magnetic exposure protocol.
        - Protocol must be programmable from 1 minute to 1 month.
        - Protocol must define periods of magnetic exposure in 1 minute increments.
        - Send protocol instructions to hardware.
    - Receive measurement data from the Magnetic Stimulation Platform and display them on the screen and save them in a format easily read in Excel.
    - Provide a user-friendly experience.
        - One executable file that seamlessly interfaces with the hardware.
        - Minimal connections to the hardware.

Team Description:

- 2 Electrical Engineers and 1 Computer Engineer
- Strong drive, work ethic, independence, and resilience to troubleshooting are a must.
- Experience with machining hardware, motors and interfacing with software are a big pluses.
- Mechanical aptitude is a big plus.

Team Division of Labor:

Electrical Engineers 1 and 2. These engineers will design and build the Magnetic Stimulation Platform. They will be responsible for developing a system capable of delivering magnetic fields of different frequencies over time to at least 4 samples while maintaining a stable temperature during magnetic stimulation for up to a month. The platform must minimize the vibration of the samples. These engineers will need to design and build a mechanical, motor-driven system for generating magnetic fields. They will also need to 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 magnetic fields vs. time. 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