Bioelectronics Lab - The Yoshida Lab

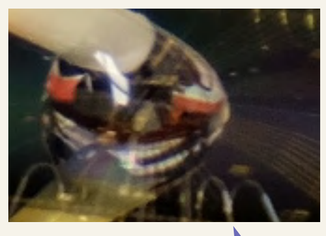
Exploring the bioelectric phenomenon to translate bioelectric modulation into therapies and bioelectronic medicines to improve of the quality of life of those with sensory-motor injuries & autonomic dysfunction.

The Team

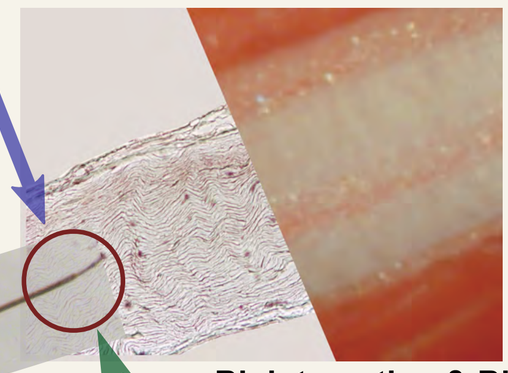
7.2022

Research Areas and Projects

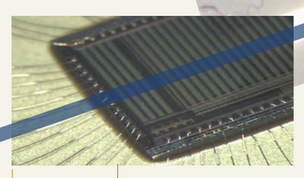
Disruptive Technologies
- GraFET Bioelectric Interface
- Configurable Artificial Neural Net Chip
- PS1 Light Activated Muscle
- **Low Frequency Alternating Current Nerve Block and Activation**



Basic Science
- Characterization of Tissue Properties
- Biophysics of Membranes and Channels
- Sensory Motor Electrophysiology

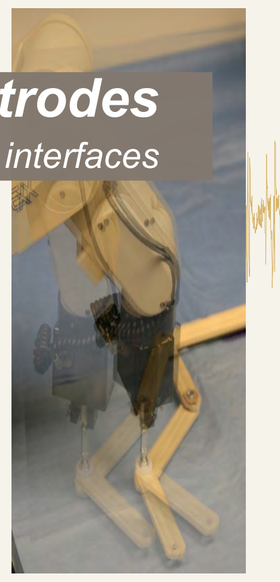


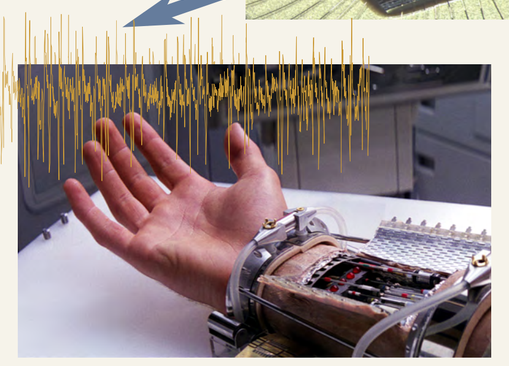
Instrumentation, System Control, Signal Processing
- Spike Detection and Tracking
- Closed Loop Control of FES
- MEA Unit Decomposition
- Universal Invertible Amplifier
- Rapid Impedance Measurement



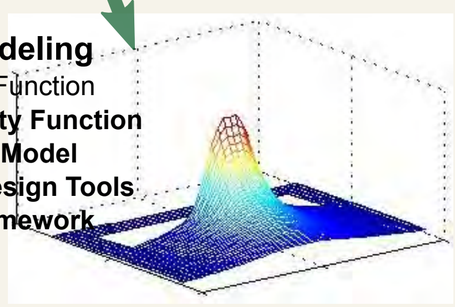
Neural Interfaces
- thin film LIFE
- TIME
- microTIME
- **3D Printed C Cuff**
- **PEDOT:PSS+CB contacts**

Biointegration & Biocompatibility
- *in-vivo* Testing
- Histology
- Shaping of Glial Scarring
- Softening Electrode Structures





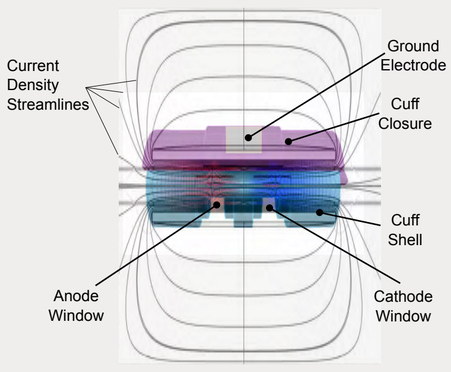
Biophysics & Modeling
- Electrode Coupling Function
- **Electrode Sensitivity Function**
- **Active Nerve Fiber Model**
- **Neural Interface Design Tools**
- ***In-silico* Model Framework**



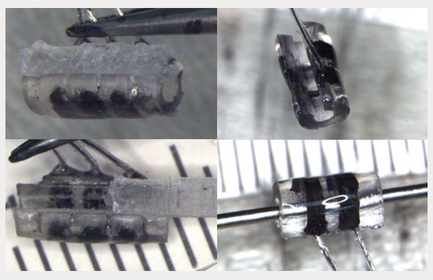
3D Printed Custom Cuff Electrodes

Rapid implementation of LFAC compliant interfaces

CAD Rendering and Simulation



Implemented Functional Structures

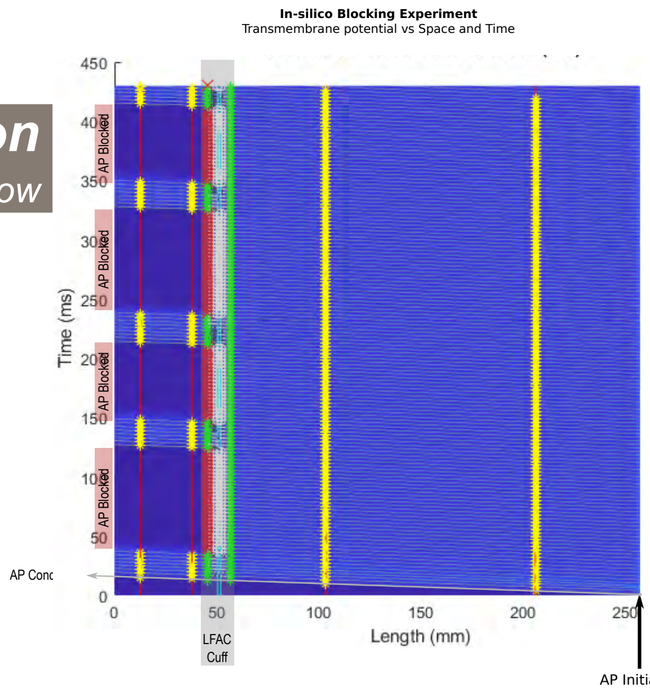


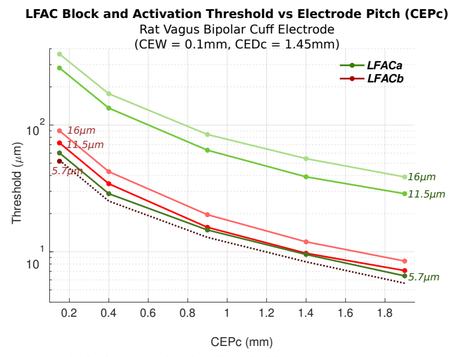
Sensory-Motor Bioelectronic Therapies
- Operant Conditioning and Sensory Replacement Therapy for Phantom Limb Pain
- Functional Electrical Stimulation
- Bioelectronic Medicines

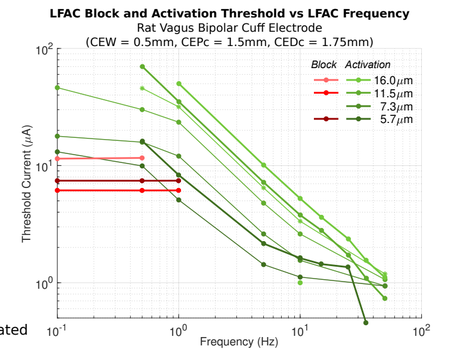
In-silico Predictions of LFAC Block & Activation

A realistic model to understand the biophysics and inform interface design

A. Effect of electrode geometry on LFAC block and activation. Activation is frequency dependent, while block is not. Block occurs at low LFAC amplitudes and transitions to activation with increasing amplitude.



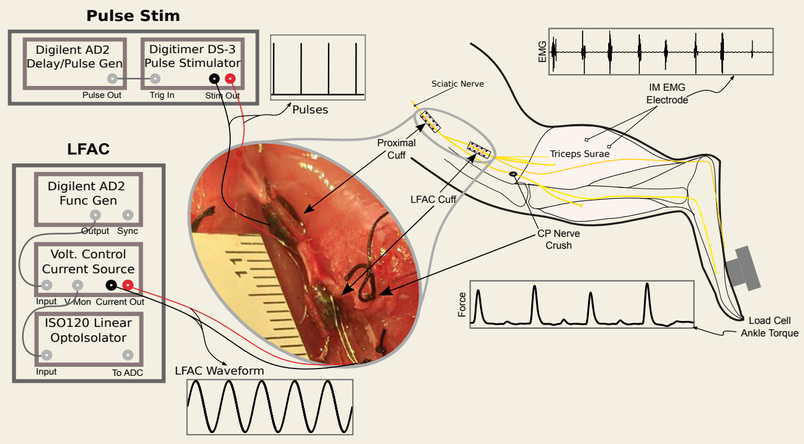




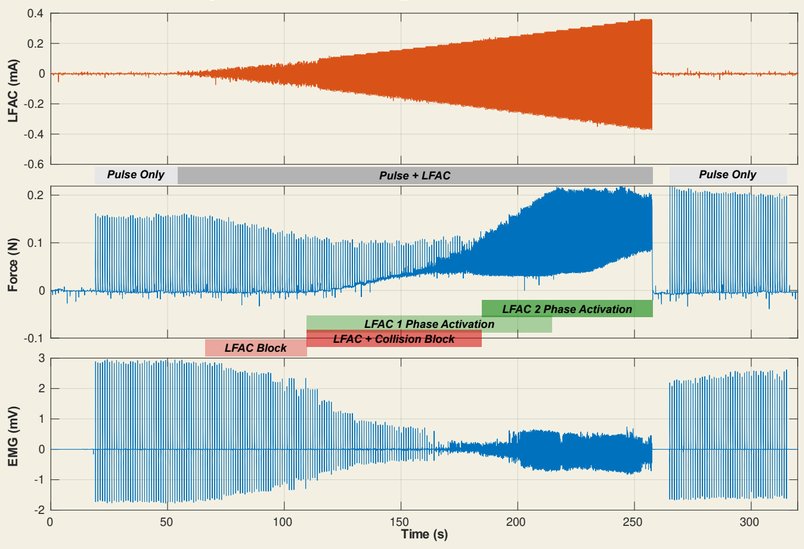
Low Frequency Alternating Current (LFAC) Stimulation

Experimental in-vivo measurement of the block-activation window

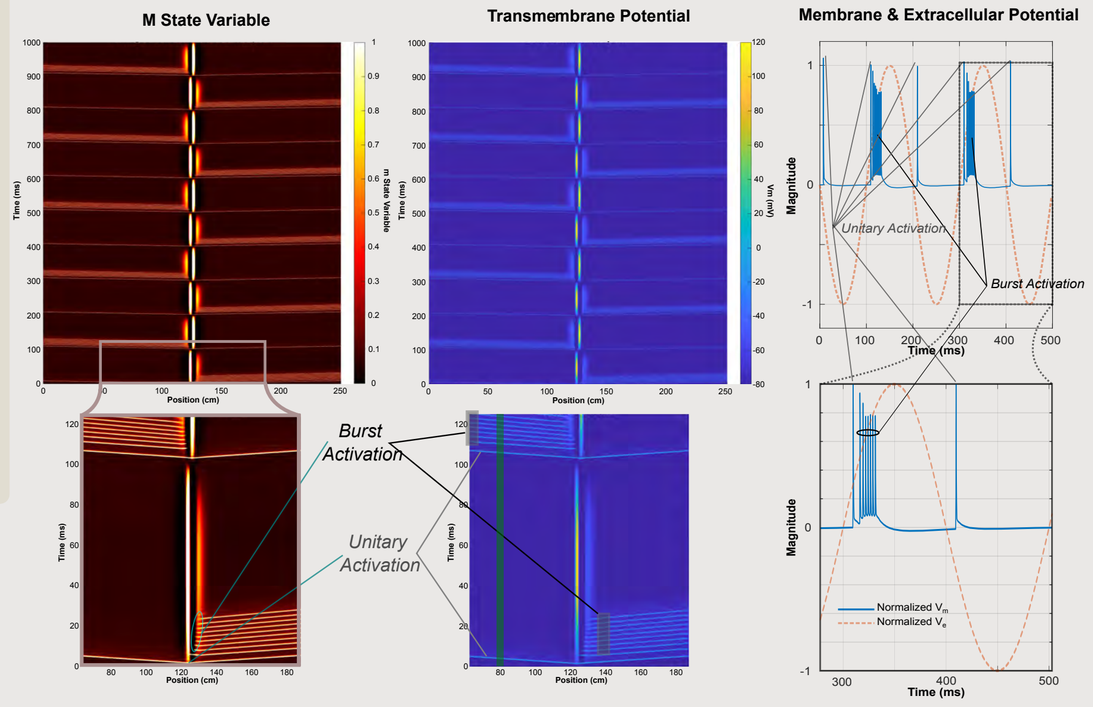
A. Instrumentation and in-vivo rat experimental setup



B. Block-Activation Sequence. Increasing LFAC first blocks then activates the nerve.



B. LFAC activation has unitary and burst modes. Unidirectional activation is predicted.



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