



Neuro-Engineering Workshop with EEG-focused Brainstorm Training

Welcome!

October 9, 2020



College of
Engineering
Electrical and Computer Engineering

The University of Kentucky



The University of Kentucky

Founded in 1865 in Lexington, Kentucky

Flagship research university for the state

30,000 students: 23,000 undergrad + 7,000 graduate

Ranked 133 among National Universities in U.S.

Academics include 16 different colleges

- More than 90 undergraduate programs
- More than 90 MS programs and 60 doctoral programs
- 1 of only 8 universities in country with medical, law, engineering, agricultural, on a contiguous campus

UK Research

- ◆ \$429 million in FY20 research expenditures
More than 1700 individual awards
College of Engineering \$47million
- ◆ Research excellence designations in cancer, aging, and translational science
- ◆ Neuroscience is 1 of 6 research priority areas
\$38 million research expenditures FY20

ECE Department

- ◆ 500+ Undergraduate students
- ◆ 50-100 Graduate students
- ◆ 30 Faculty



◆ Hired seven new faculty in past two years

- 2 in Computer Architecture and Cybersecurity
- 1 in Power and Energy
- 1 in Machine Learning (ML) + Bio + Robotics
- 1 in Bio-electric + ML
- 1 in Smart Manufacturing + ML (joint with ME)
- 1 in Robotics and Controls + ML



Core Research Areas

- ◆ Computational Electromagnetics
- ◆ Power and Energy
- ◆ Computer Architecture and Cybersecurity
- ◆ Nano technology and devices
- ◆ Signal Processing and Machine Learning
- ◆ Controls, Robotics and Manufacturing

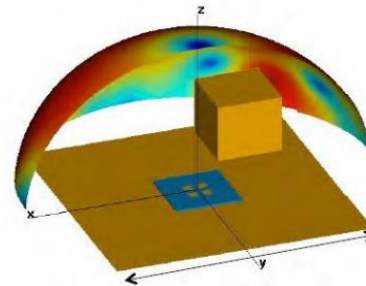
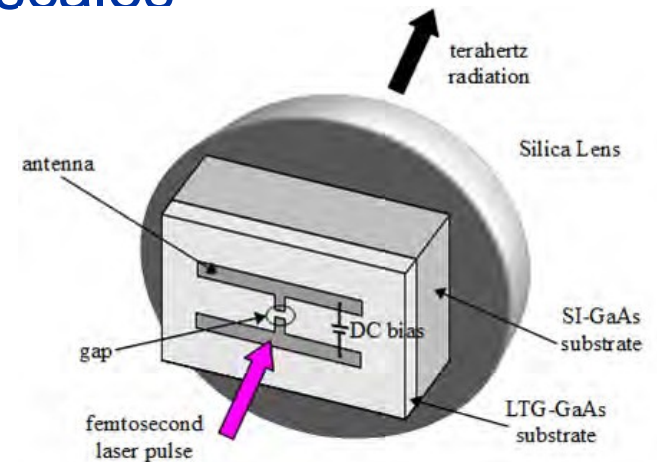
◆ Computational Electromagnetics

- Wave propagation
- Scattering
- Fast Solver techniques at large scales

◆ Magnetic Modeling

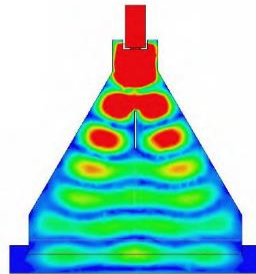
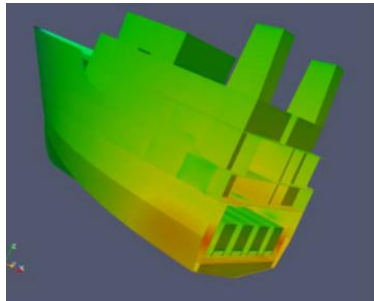
◆ Microwave Engineering

◆ Antenna Design

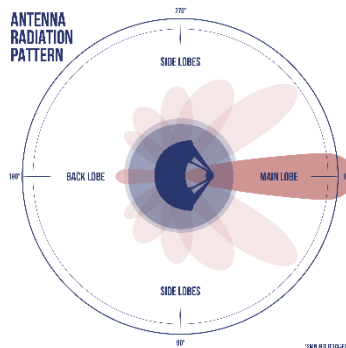


Projects:

ONR: Simulation tools to predict magnetic fields in and around vessels under dynamic conditions



NASA: Accurate modeling of antenna radiation patterns around spacecraft

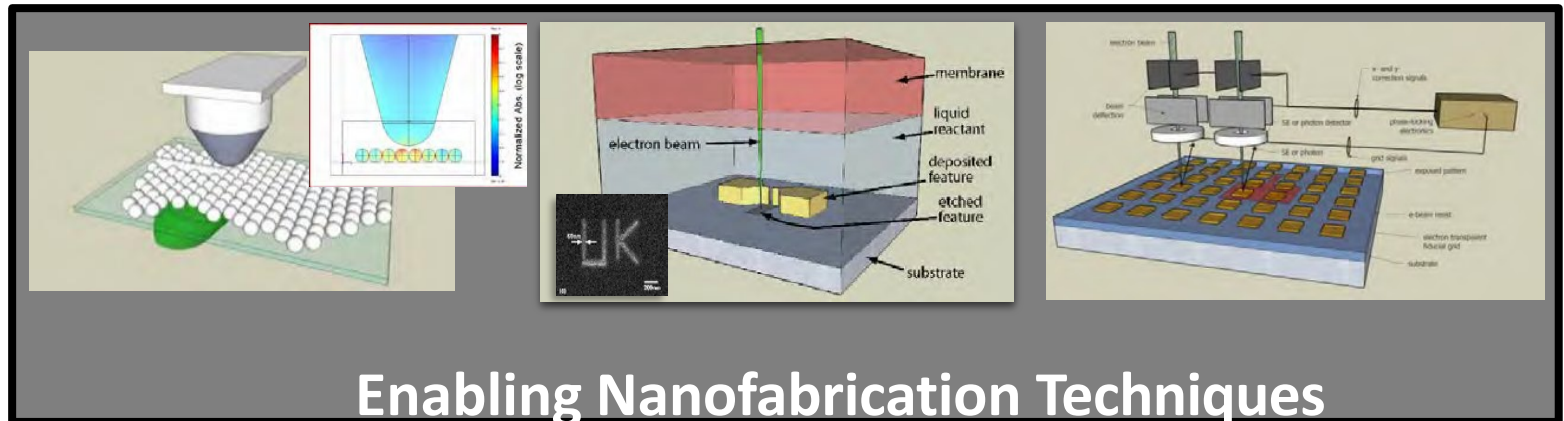


Nano devices

Projects

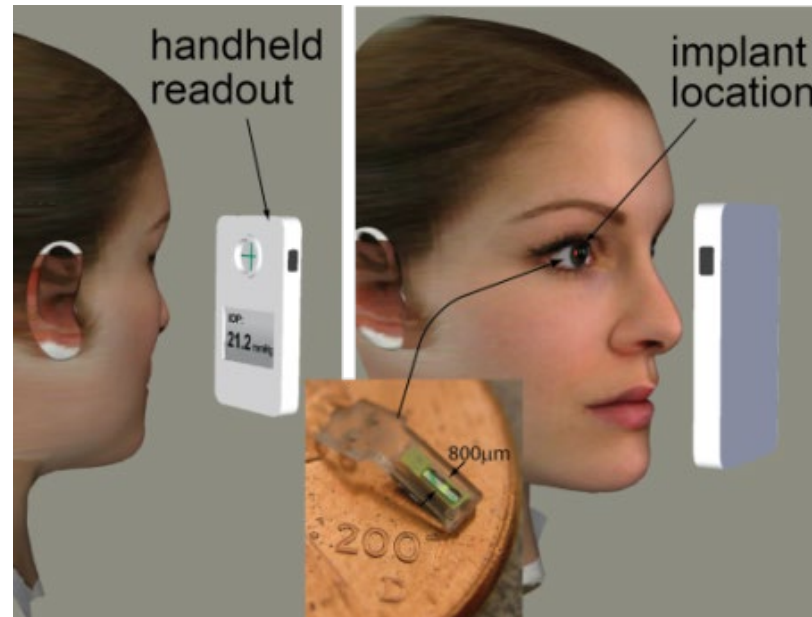
NNCI: The Kentucky Multi-scale manufacturing and Nano Integration Node (one of 16 sites).

NSF, DoE: Nanofabrication - nanoscale printing and machining using electron beams in liquids



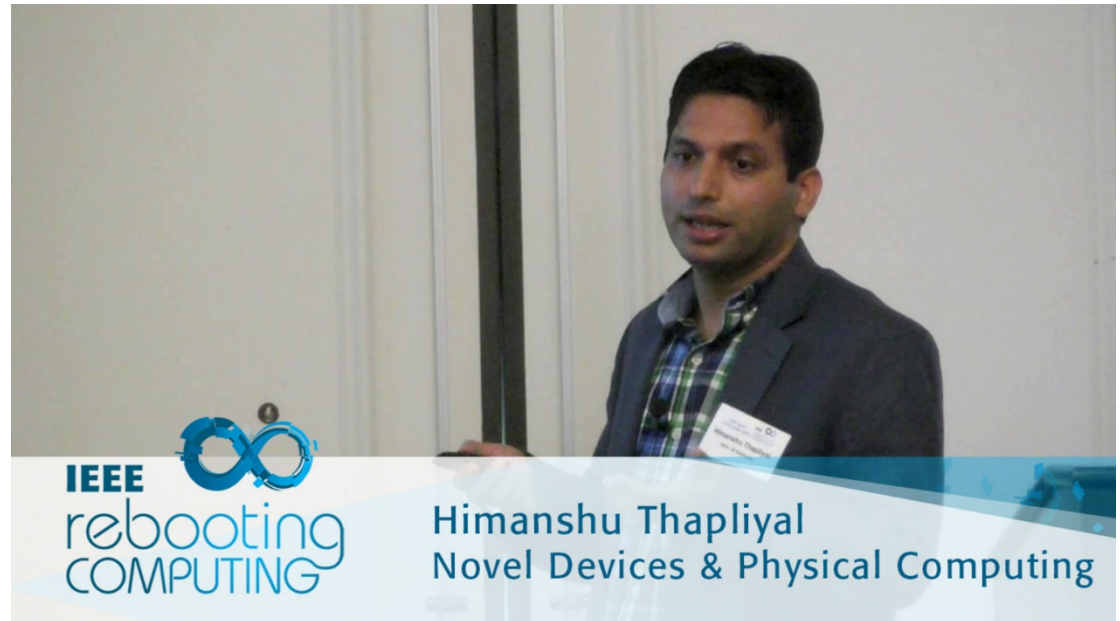
Technology transfer: Brockman-Hastings LLC, in SBIR Phase II testing

Brockman Hastings LLC seeks to reduce vision loss for glaucoma sufferers by creating a simple accurate and clinically acceptable system for monitoring intraocular pressure



Project

NSF (Thapliyal CAREER award): Goal is to produce low-energy, lightweight and secure devices, resistant against malicious attacks.



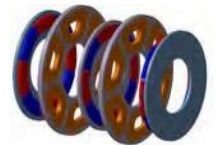
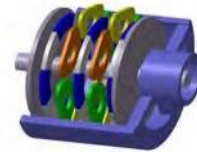
Power and Energy

Industry Projects:

- **LG&E KU** – Renewable Resource Integration
- **ANSYS** – Low-frequency electromechanical modeling
- **American Centrifuge** – Electric Motor design
- **Regal Beloit** – Motor topologies and optimization
- **Flex Power Control** – Solar Power Electronics

Federal

- ◆ **ONR** – Resource Modeling and Utilization
- ◆ **NSF** – Axial flux motors and power electronics
- ◆ **DoE** – Rare-earth-free traction motor



Signal Processing

- ◆ Image Processing
- ◆ Speech Processing
- ◆ Virtual/Augmented Reality

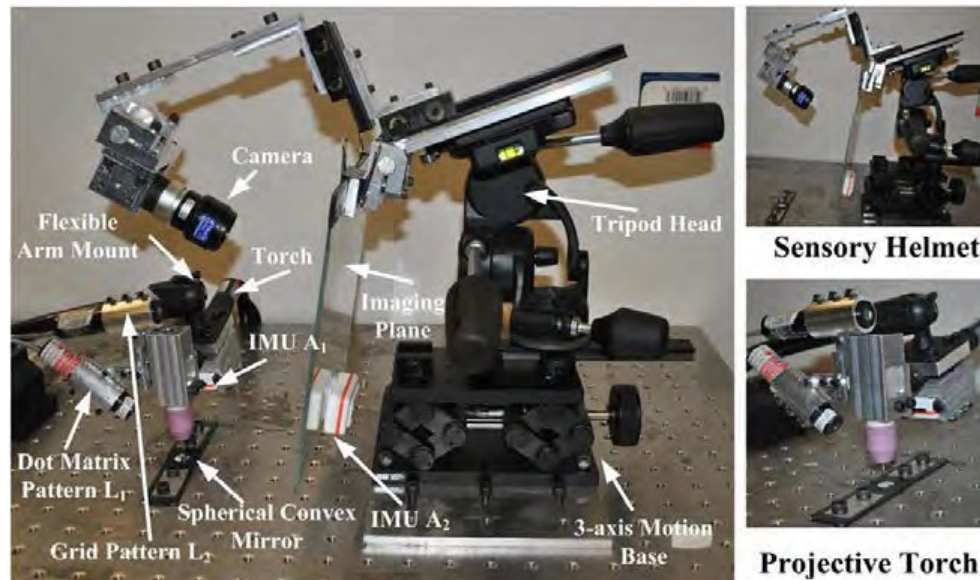


Project

NIH: Collaborative project using electromagnetic articulography combined with articulatory speech synthesis for improving speech dysarthria in Stroke and Traumatic Brain Injury patients

Smart Manufacturing

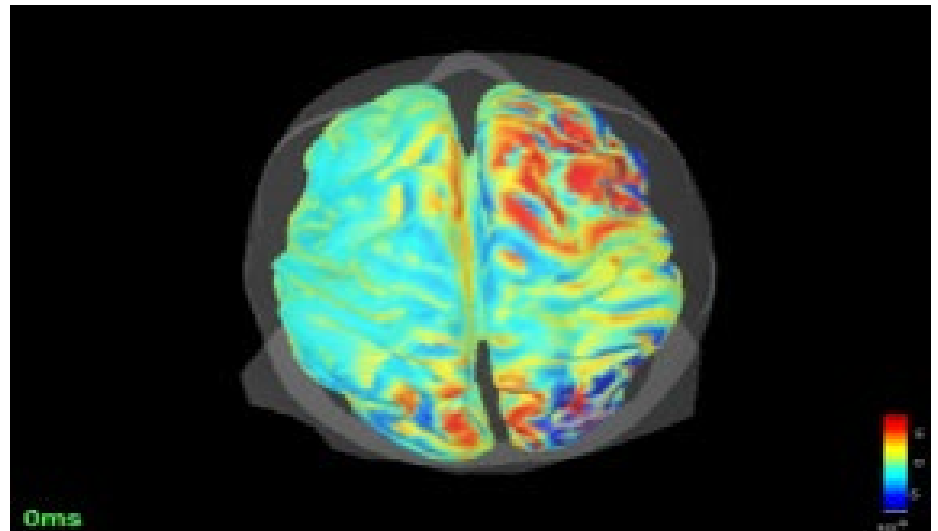
- ◆ Human/robot collaborative welding systems
- ◆ Predictive maintenance of manufacturing equipment using artificial intelligence



◆ Electrical and Computer Engineering

- Neural Interfaces and Signal Processing Lab
Dr. Jihye Bae

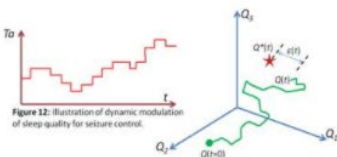
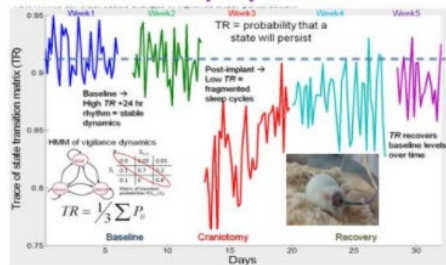
- ❖ Signal processing and machine learning
- ❖ Reinforcement learning based brain machine interfaces
- ❖ EEG source imaging and functional connectivity in Epilepsy



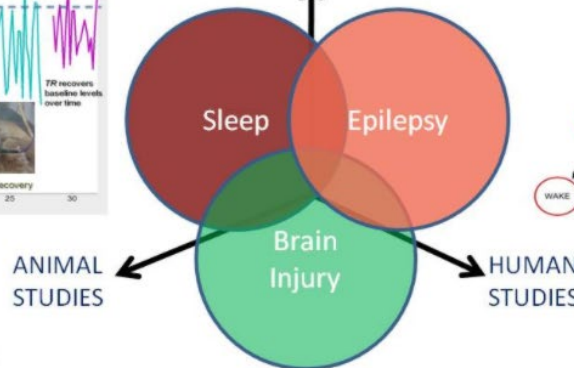
Neuro-Engineering Labs

- ◆ Department of Biomedical Engineering
 - Neural Systems Lab, Dr. Sridhar Sunderam
 - ❖ Computational neural engineering
 - ❖ Neural signal analysis for epilepsy
 - ❖ Brain machine interfaces for motor rehabilitation

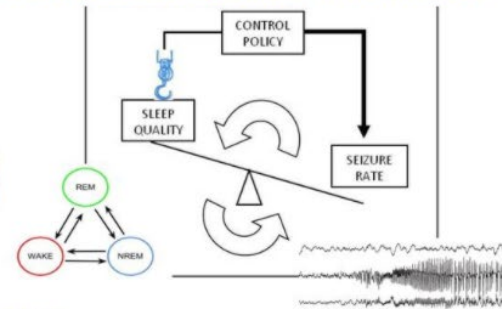
Modeling, perturbation and control of sleep dynamics



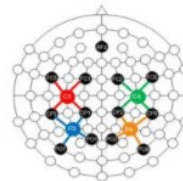
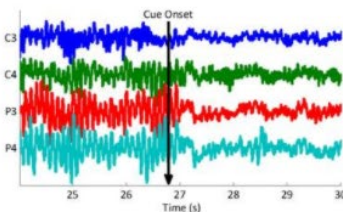
MODELING SIGNAL ANALYSIS



Modulation of sleep-seizure interactions



Brain-machine interfaces for motor rehabilitation



Neuro-Engineering Labs

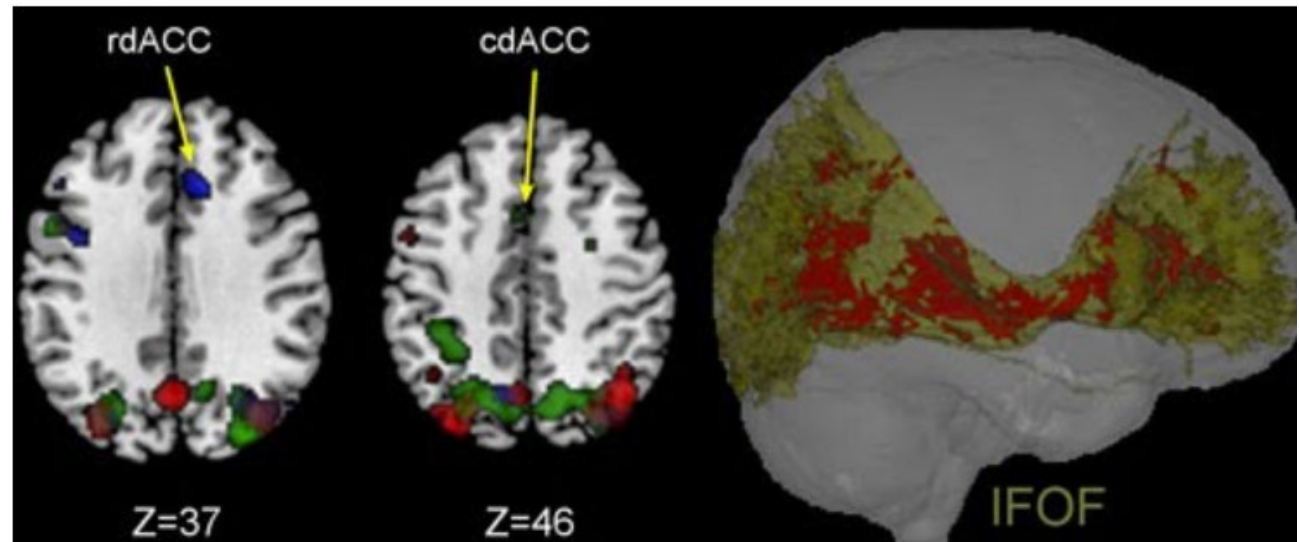
◆ Department of Behavioral Sciences

- Aging Brain and Cognition Lab, Dr. Yang Jiang
 - ❖ Behavior and cognitive science
 - ❖ Functional Magnetic Resonance Imaging (fMRI), Event-Related Potentials (ERPs), and Magnetoencephalography (MEG)



◆ Department of Neuroscience

- Cognitive Neuroscience of Aging Lab, Dr. Brian Gold
 - ❖ Cognitive Neuroscience of Aging and Alzheimer's Disease
 - ❖ Neuroimaging of Preclinical Alzheimer's Disease



Centers and Hospital Units

- ◆ **Magnetic Resonance Imaging and Spectroscopy Center** (<https://www.research.uky.edu/magnetic-resonance-imaging-and-spectroscopy-center>)
- ◆ **Sanders-Brown Center on Aging/Alzheimer's Disease Research Center** (<https://sbcoa.med.uky.edu/>)
- ◆ **Electroencephalogram (EEG) Lab** (<https://ukhealthcare.uky.edu/kentucky-neuroscience-institute/epilepsy/eeg-lab>)
- ◆ **Epilepsy Monitoring Unit (EMU)** (<https://ukhealthcare.uky.edu/services/epilepsy-monitoring-unit-emu>)
- ◆ **Cardinal Hill Rehabilitation Hospital** (<https://www.encompasshealth.com/locations/cardinalhillrehab>)

Workshop Agenda & Details

<http://neuroengworkshop.engr.uky.edu/>

<http://neuroengworkshop.engr.uky.edu/workshop/people>

If you need anything, let us know!

Opening Talk:

"Re-using MEEG data and maximizing its value: considerations of statistical power & white matter connectivity"

Dr. Aina Puce, Eleanor Cox Riggs Professor, Department of Psychological and Brain Sciences, Indiana University Bloomington.



ANY
QUESTIONS?