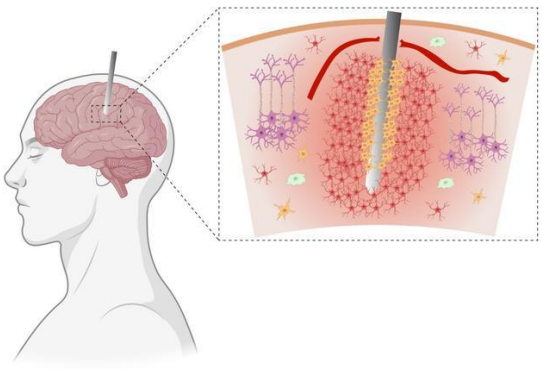
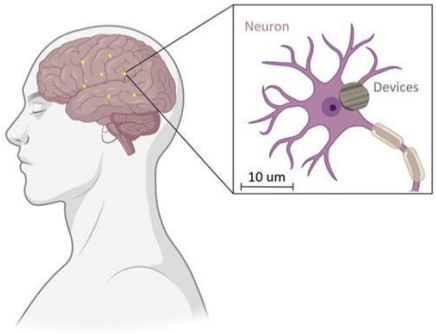
Nano-Implants for Wireless Brain Interfacing



State of the Art
(highly invasive, destroys brain tissue)



New Era: Wireless Sub-Cellular Sized Nanoelectronics distributed in brain
(coexist with brain cells without destroying them)
Multi-site stimulation with high spatio-temporal resolution
going beyond symptomatic benefit: cure diseases

We are developing **nano-devices using meta-materials** that can **non-invasively and remotely monitor** and modulate our biological system. The requirements of the system are: 1> they should be as small as possible such that the volume displacement of tissue due to the placement of the device is minimal, 2> They should be **untethered/wireless** such that they can be remotely controlled. Such a device will sense the biological environment and send the information to a system outside the body in real time. The device will also have the capability to do internal analysis of the sensed data and depending on the analysis results, take further action such as electrical stimulation or drug delivery. The device will **harvest energy from external applied fields** for its functioning and also **modulate the external fields for communicating** sensed data.

The possibilities with such bioelectronic devices are endless, and we are exploring, among others, brain activity recording at a large scale with a precision of single neuron, activity recording in spinal cord and peripheral nervous system, monitoring tumor microenvironment, observing response to pathology development or external stimulus at a single cell level along with integrated functionalities such as stimulation and drug delivery.

For this work, the National Institute of Health has awarded a perfect and rarely achieved impact score and the NIH Director's New Innovator Award. We achieved an impact score of "10"—the highest score possible.

Relevant talks
Deblina Sarkar, "Seamless fusion: Transcending humans beyond biological limitations" TEDxBoston, May, 2023
Deblina Sarkar, "Curing the Incurable: Radical Therapeutics for Neurodegenerative Diseases to Refractory Cancer", MIT Future Therapeutics Workshop, October 2023
Deblina Sarkar presented the NCB group research overview at the MIT Media Lab Members' Week, October 2023

Deblina Sarkar, "Transcending humans beyond diseases and biological limitations", MIT Future Worlds Workshop, October 2023

Deblina Sarkar, "Women's Health: Novel Treatment for Alzheimer's Disease to Breast Cancer Brain Metastases", MIT Women's health Innovation forum, October 2023
https://www.media.mit.edu/projects/wireless-sensing/overview/