Next Generation neural interfaces: from physical implants to virtual implants

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Abstract:
The development of new neural technologies will revolutionize our understanding of the brain function enabling us to mitigate nervous system disorders and also advance brain-machine interfaces (BMIs). We will witness major changes in our life when BMIs enable us to connect with different gadgets directly with the power of our brain.

In this talk, I will introduce the needs and opportunities to make next generation neural interfaces. I will discuss ongoing research in my lab on developing hybrid implantable optrodes (optical-electrical probes) for neural recording and stimulation. Benefiting from the best of both silicon and polymer material properties, these probes have greater than ten times the density and are two orders of magnitude more compliant than the state of the art, exerting minimal tissue damage and tethering forces while still providing full-volume cortical sampling. I will also introduce a novel parylene-in-parylene (PiP) photonics platform that can be monolithically integrated with our probes for high-resolution optogenetic stimulation in ECoGs.

I will also discuss a radical complementary approach to guide and steer light in the brain for targeted optogenetic stimulation. In this approach, non-invasive ultrasound will define and guide the trajectory of light without physically implanting either a waveguide or a light source. To reach brain structures >2 mm deep, we are developing tetherless upconverting nanocrystal light bulbs that absorb guided near-infrared light and emit visible light to locally stimulate opsins.

Bio:
Dr. Chamanzar received his Ph.D. in Electrical and Computer Engineering from Georgia Tech in 2012. His dissertation on developing novel hybrid plasmonic-photonic on-chip biochemical sensors received the Sigma Xi best Ph.D. thesis award.

He is currently an assistant professor of ECE at Carnegie Mellon University. He was postdoc researcher at UC Berkeley before joining CMU. His current research is on developing novel electro-acousto-optic neural interfaces for large-scale high-resolution electrophysiology and distributed optogenetic stimulation.

Maysam has published more than 25 peer-reviewed journal and conference papers and he holds three pending patents. He is the recipient of a number of awards including the SPIE research excellence award and GTRIC innovation award, and became the finalist for the OSA Emil Wolf best paper award and Edison innovation award.