

For engineering, the goal is to solve important problems which matters to our world. The essence of research is to explore the unknown and discover the hidden secret and eventually lead to 10x, 100x, or even 1000x improvement over the established technology. Information technology has profoundly transformed our world. New ideas are quickly spread over the globe. Very often, we witness the convergence instead of singularity in science and technology. Convergence is not all bad, which leads to broad adoption or successive improvement of key inventions. However, singularity (the discovery of a new route, the birth of a new method, the transition from 0 to 1) should be the main focus of research, which is what our lab aspires to accomplish.



**Whole mammalian brain neurophotonic interface**. The rapid advances of genetic indicators and actuators have enabled high spatiotemporal resolution recording and modulation of brain functions. However, they all rely on using light to form optical focus inside brain tissue. Even with the advance of imaging technology and laser sources, the access depth remains superficial. Our lab is working on a new invention which is aimed to achieve whole mammalian brain neurophotonic interface. The application is not only to address to the key problems of studying mammalian brain but also to provide a new route for brain computer interface.



**High-throughput high-resolution 4D imaging**. To understand systems as complex as mammalian brain, one needs the capability of recording from huge population of neurons at kHz volume rate. We are working to develop a powerful and flexible high-through high-resolution system to achieve this goal.



**Ultra-low light videography**. Recording images and videos at the extremely low illumination dosage has broad applications across medicine and biology. Leveraging the advance of computational image processing and the physics of single photon level video recording, we are working to develop technology that allows high-quality video recording with photon flux less than 1 photon/pixel.