Presenter: Sumner Norman

Title: Single trial decoding of movement intentions using functional ultrasound neuroimaging

Author(s): Charles Guan, Tyson Aflalo, Carey Zhang, Richard Andersen

Abstract: New technologies are key to understanding the dynamic activity of neural circuits and systems in the brain. Recently, functional ultrasound (fUS) was introduced as a revolutionary hemodynamic imaging technique that is minimally invasive (i.e. epidural) and portable while maintaining excellent spatiotemporal resolution (100 μm, up to 10 Hz) and wide field of view (~2 cm). Here, we show that fUS can be used to detect the neural correlates of movement planning – including timing, direction and effector – with single trial sensitivity. We trained non-human primates (NHPs) to perform memory-guided eye or hand movements. We then used fUS neuroimaging to record changes in cerebral blood volume while the monkeys performed the task. We recorded from outside the dura above the posterior parietal cortex, a brain area important for spatial perception, multisensory integration, and movement planning. We used fUS signals from the delay period before movement and successfully decoded the animals' intention to move, including the direction of movement and effector to be used. Single-trial decoding is a prerequisite to brain-machine interfaces (BMIs), a key application that could benefit from this technology. These results are thus a critical step in the development of neuro-recording and brain interface tools that are less invasive, high resolution, and scalable.