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Neurocontrol in sensory cortex[1] JASON RITT, Boston University, ANIRBAN NANDI, Washington University, St. Louis, JOSEPH SCHROEDER, Boston University, SHINUNG CHING, Washington University, St. Louis — Technology to control neural ensembles is rapidly advancing, but many important challenges remain in applications, such as design of controls (e.g. stimulation patterns) with specificity comparable to natural sensory encoding. We use the rodent whisker tactile system as a model for active touch, in which sensory information is acquired in a closed loop between feedforward encoding of sensory information and feedback guidance of sensing motions. Motivated by this system, we present optimal control strategies that are tailored for underactuation (a large ratio of neurons or degrees of freedom to stimulation channels) and limited observability (absence of direct measurement of the system state), common in available stimulation technologies for freely behaving animals. Using a control framework, we have begun to elucidate the feedback effect of sensory cortex activity on sensing in behaving animals. For example, by optogenetically perturbing primary sensory cortex (SI) activity at varied timing relative to individual whisker motions, we find that SI modulates future sensing behavior within 15 msec, on a whisk by whisk basis, changing the flow of incoming sensory information based on past experience.

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