Representation of global motion in the mouse barrel cortex, a voltage sensitive dye (VSD) imaging study

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Abstract

Sensory whiskers in the mystacial pad of rodents are mapped onto layer IV of the primary somato-sensory cortex (S1) as discrete units named "barrels". Each barrel-related vertical column processes information coming primarily from its corresponding whisker in the snout of the animal. Previous experiments in our lab done with extracellular recordings showed that neurons in the rat S1 and thalamus not only show a direction preference for local stimulation of the principal whisker but also for the direction of a global motion across the whisker pad (Jacob et al., 2008; Ego-Stengel et al., 2012).
To further understand how the cortical network processes global tactile scenes, we performed VSD imaging of the mouse barrel cortex under anesthesia while applying global tactile stimuli using a 24-multi-whisker stimulator (Jacob et al., 2010).
Global motion was obtained by presenting multiwhisker stimuli that were locally invariant but globally coherent, resulting in 8 directions of apparent motion. Our results show that different directions of stimulation produce responses in the barrels of different magnitude and that there is a spatial organization of global motion direction selectivity with ventral motions preferentially activating barrels related to caudal and dorsal whiskers, and caudal motions preferentially activating barrels related to rostral and ventral whiskers.
When compared to responses evoked by single arcs/rows of whiskers, responses to global motions appear highly sublinear. Preliminary analyses indicate that these sublinearities, as well as the propagation of the responses across the barrel field, are likely to vary depending on the direction of the apparent motion.

Keywords: VSD imaging, mouse, barrel cortex, direction selectivity

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