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Optical imaging of subcortical brain function

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The whisker system of nocturnal rodents is an excellent model to study peripherally evoked neural activity in the brain. Discrete neural modules represent each facial whisker in the somatosensory cortex (barrels), thalamus (barreloids), and the brain stem (barrelettes). Experimental or natural stimulation of a single whisker evokes neural activity in its corresponding barrel, barreloid, and barrelette. Imaging methods have been pivotal in enabling studies of functional mapping in the brain. Conventional optical imaging has generally been limited to surface structures such as the cerebral cortex. To gain access to deep subcortical structures and image sensory-evoked neural activity, we designed a needle-based optical system using gradient-index (GRIN) rod lens. We performed voltage-sensitive dye imaging (VSDi) with GRIN rod lens to image neural activity evoked in the thalamic barreloids by deflection of a single whisker *in vivo*. We stimulated two or three whiskers together in order to determine the sensitivity of our approach in differentiating between different barreloid responses. We also carried out stimulation of different whiskers at different times. Our results show that it is possible to obtain functional maps of the sensory periphery in deep brain structures such as in the thalamic barreloids. Our approach can be broadly applicable to functional imaging of other deep brain structures.

Biography

Yu Chen is an Associate Professor of Bioengineering at the University of Maryland, College Park. He received his BS degree in Physics from Peking University in 1997, his PhD degree in Bioengineering from University of Pennsylvania in 2003, and his Postdoctoral training from MIT. His research interests encompass the areas of biomedical photonics and imaging, including optical coherence tomography (OCT), multiphoton microscopy (MPM), needle-based endoscopy, and biomedical applications such as kidney imaging, brain mapping, and cancer detection. He has published > 60 papers. He is a Fellow of the American Society for Laser Medicine and Surgery.

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