Application Note

NeuroPG: Open-Source Software for Optical Pattern Generation

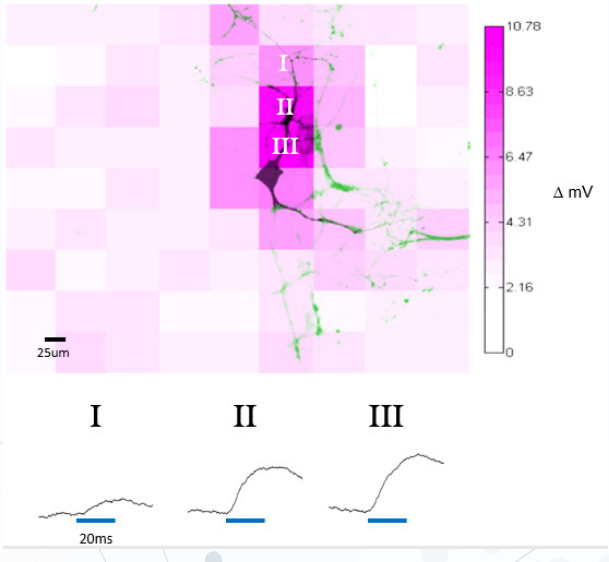
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A patterned illuminator capable of producing complex spatiotemporal illumination patterns is a powerful tool for optogenetics, as it enables scientists to probe neural circuits by selectively manipulating the activity of many individual cells or many subcellular regions at the same time. Compared to a scanning laser, a digital micromirror device (DMD) based patterned illuminator is inexpensive and can easily create complex illumination patterns. In addition, unlike a laser scanner, a DMD based patterned illuminator is capable of illuminating multiple areas of interest, simultaneously.

To use DMDs to study neural activity, scientists must develop specialized software to coordinate optical stimulation patterns with the acquisition of electrophysiological and fluorescence data. To meet this growing need, scientists at Robinson Lab of Rice University have developed an open source optical pattern generation software for neuroscience, NeuroPG, that combines, DMD control, sample visualization, and data acquisition in one application. Built on a MATLAB platform, NeuroPG can also process, analyze, and visualize data. The software is designed specifically for the Mightex Polygon400; however, as an open source package, NeuroPG can be modified to incorporate any data acquisition, imaging, or illumination equipment that is compatible with MATLAB's Data Acquisition and Image Acquisition toolboxes.

Application Example:
Mapping optically induced depolarization in ChR2-expressing hippocampal neurons using NeuroPG and Polygon400

E18 Sprague-Dawley rat neurons were transduced with CamKII-ChR2-GFP lentivirus. Somatic activity was recorded via whole cell patch-clamp electrophysiology. Each field was illuminated by the Polygon400 at 100% power and 20ms exposure time. Intensity of magenta pattern represents depolarization with respect to the instantaneous resting potential prior to stimulation with the Polygon's 470nm LED. In the image, green represents the magnitude of GFP signal and black represents the fluorescence intensity of AlexaFluor 594 backfilled by the patch pipette. (NeuroPG: open source software for optical pattern generation and data acquisition." Frontiers in Neuroengineering (2015).



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