

Abstract 5528

Single-axon dynamics of serotonergic neurons in ex vivo systems

Type: Abstract Submission

Topic: S_I. Computational and Theoretical Neuroscience / I.2 Data driven modelling / I.2.c Development, axonal patterning, and guidance

Authors: Melissa Hingorani¹, Ryan Stowers², Chris Bates³, Skirmantas Janusonis¹; ¹University of California, Santa Barbara, Psychological & Brain Sciences, –, CA, United States of America, ²University of California, Santa Barbara, Mechanical Engineering, –, United States of America, ³University of California, Santa Barbara, Materials Science, –, CA, United States of America

Abstract Body

Our group has shown that the self-organization of the brain serotonergic matrix depends in part on the spatiotemporal dynamics of individual serotonergic axons (fibers). The trajectories of these axons are strongly stochastic and can be described by step-wise random walks or fractional Brownian motion (a time-continuous process). The success of these modeling efforts depends on experimental data that can validate their mathematical frameworks and constrain the values of model parameters. However, visualizing this dynamic behavior in vivo is currently extremely difficult. In this study, we developed an ex vivo system of primary mouse brainstem neurons. Using a combination of methods such as confocal microscopy, digital holotomography, STED super-resolution microscopy, and novel 3D hydrogel systems, we investigated serotonergic axons with unprecedented spatiotemporal precision. The dynamics of axon growth cones, branching events, and other key processes were analyzed with respect to the properties of the tunable extracellular environment and to intracellular movements reflected in refractive index changes. These experimental data include the first holotomographic images of serotonergic neurons and axons and provide essential information for predictive modeling of the serotonergic matrix. In addition to the importance of these findings for fundamental neuroscience, they can also support future efforts in the restoration of brain tissue (serotonergic fibers are almost unique in the mammalian brain in their ability to robustly regenerate). The novel approaches developed in this study may be applicable to other "stochastic" axons in the ascending reticular activating system.

Print