ORTVAY KOLLOKVIUM // Ortvay Seminar Series

2017. március 23. csütörtök 15:00-kor
23rd March 2017., Thursday 3pm

Rózsa Balázs (Laboratory of 3D functional network and dendritic imaging, Institute of Experimental Medicine, HAS, The Faculty of Information Technology, Pázmány Péter Catholic University)

Fast 3D acousto-optical imaging of visual computation at the level of spine, dendritic, and neuronal assemblies in behaving mice

Gergely Szalay[1], Linda Judák[1], Gergely Katona[1,3], Pál Maák[4], Katalin Ócsai[3], Tamás Tompa[2], Balázs Rózsa[1,2]

1. Laboratory of 3D functional network and dendritic imaging, Institute of Experimental Medicine, Hungarian Academy of Sciences, Budapest-1083, Hungary.*
2. The Faculty of Information Technology, Pázmány Péter Catholic University, Budapest-1083, Hungary.*
3. MTA-PPKE ITK-NAP B – 2p measurement technology group, The Faculty of Information Technology, Pázmány Péter Catholic University, Budapest-1083, Hungary. *
4. Department of Atomic Physics, Budapest University of Technology and Economics, Budapest-1111, Hungary.

Abstract:

Our long-term aim is to assess the feasibility of creating an “artificial sense” and, thereby, a possible sensory (visual) prosthetic. While working towards this goal, we have to address the question of how neural assembly activity relates to subjective perceptions and visual computation. Finding and understanding these functional dendritic and neuronal assemblies makes it possible to reactivate them in a precise, biologically relevant manner to elicit similar cortical activation as visual stimulation. To achieve this goal we developed a novel method for fast 3D imaging and 3D photo-stimulation which is orders of magnitude more effective and faster than the methods used previously.

The precisely timed and anatomically structured input activity of cortical neurons is nonlinearly transformed to neuronal output by the somatic and dendritic compartments of downstream neurons (Katona et al., 2011; Larkum et al., 2009; Losonczy and Magee, 2006, Poirazi et al., 2003; Polsky et al., 2004; Johnston and Narayanan, 2008). Nonlinear dendritic processing is achieved mainly by voltage-gated ion channels, which interact through locally propagating and attenuating membrane potential fluctuations; in this way, dendritic signal integration can be clustered in small dendritic computational subunits (“hot spots”). When more synaptic inputs are activated in synchrony, voltage-gated ion channels can also induce more global signals, i.e., regenerative dendritic spikes (Larkum et al., 2009; Schiller et al., 2000; Stuart et al., 1999). In this way, coding and computation within neuronal networks are generated not only by the somatic integration domains, but also by highly non-linear dendritic integration centers that, in most cases, remain hidden from

somatic recordings. Therefore, understanding the complexity of visual computation requires novel methods such as three-dimensional (3D) random-access point scanning that can simultaneously read out neural activity on both the somatic and dendritic scales (Duemani Reddy et al., 2008; Katona et al., 2012; Fernandez-Alfonso et al., 2014, Chiovini et al. 2016, Neuron). This method can increase measurement speed and signal-to-noise ratio by several orders of magnitude, but suffers from one main disadvantage: fluorescence information is lost during brain movement. In this work we also present a novel technology, 3D drift acousto-optical scanning, which can extend each scanning point to small 3D lines or surface or volume elements, preserving fluorescence information for motion correction. Our method effectively eliminates *in vivo* motion artifacts, allowing fast 3D measurement of over 150 dendritic spines with 3D lines, over 100 somata with squares and cubes, or multiple spiny dendritic segments with surface and volume elements in moving animals. Moreover, an over of four-fold improvement in total excitation efficiency resulted in a large, about 500µm × 500µm × 900µm, scanning volume with GECIs. Using our new 3D imaging and photo-stimulation methods we mapped activity of large neuronal and dendritic assemblies associated with different visual stimulation and found a new dendritic computational rule with which group of dendritic and neuronal assemblies code time in the visual cortex. Moreover, we revealed how the upcoming cholinergic input pathway from nucleus basalis can generate a broadcasted signal in the cortex by activating the VIP neuronal population and, therefore, generate enchanted dendritic activity and dendritic spikes thorough disinhibition in pyramidal neurons in V1 of behaving animals.

Minden érdeklődőt szívesen látunk! Az előadás előtt negyed órával az előadóban teát szolgálunk fel.

All visitors are welcome. Tea and biscuits are served 15 min prior the lectures at the location.

Helyszín: ELTE Pázmány Péter s. 1/A alatti épületében a földszinti 0.81 (Ortvay) terem.

Location Lágymányos Eötvös Campus (address: Pázmány Péter s. 1/A), Northern Building, Room Ortvay (0.81).

Az előadás-sorozatról az interneten az "**ortvay-koll.elte.hu**" címen található információ.

Further information available at the "**ortvay-koll.elte.hu**" website.