University of Pavia

Ph.D. School of Microelectronics

SEMINAR

Brain Machine Interfaces for Artificial Retinas

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Abstract: A healthy retina transduces incoming visual stimuli into patterns of neural activity, which are then transmitted to the brain via the optic nerve. Degenerative diseases, like macular degeneration or retinitis pigmentosa, destroy the ability of the retina to transduce light, causing profound blindness. A retinal prosthesis[1] is a device that replaces the function of retinal circuitry lost to disease. Present-day devices can elicit visual percepts in patients, providing a proof of concept. However, the patterns of neural activity they produce are far from natural, and the visual sensations experienced by patients are coarse and of limited use to patients.

A main hurdle is that there are many types of cells in the retina. For example, some cells respond to increases of light intensity, while other cells respond to decreases of light intensity. In order to reproduce a meaningful neural code, it is crucial to respect the specificity and selectivity of these cells. Because cells of different types are intermixed in the circuitry of the retina, cell type specific activation of this kind requires that a future prosthesis be able to stimulate at single cell resolution, over a significant area in the central retina.

To achieve this goal, we are designing an epi-retinal interface that operates in two modes: calibration and runtime. During calibration, the interface learns which cells and which cell types are available for stimulation, by recording neural activity from the retina. During runtime, the interface stimulates the available cells to best approximate the desired scene. I will present a system architecture we are developing that can accomplish the overall performance goals, and the implications of this architecture for brain-machine interfaces.

1. G. Goetz, D. Palanker, “Electrical Approaches to Restoration of Sight”, Rep. Prog. Phys. vol. 79, no. 9, 096701, 2016.

Bio: Dante Muratore received the B.S. degree and the M.S. degree in Electrical Engineering from Politecnico of Turin in 2012 and 2013, respectively. He received the Ph.D. degree in Microelectronics from University of Pavia in 2017. From 2015 to 2016 he was a Visiting Scholar at MTL labs at the Massachusetts Institute of Technology, USA. Since 2017 he is a Postdoctoral Fellow at Stanford University, USA. His research interests include brain-machine interfaces, bioelectronics and sensor interfaces.

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Seminar in English

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