Neuronal Systems and Modeling

3998-Pos Board B726
Indocyanine Green is a Voltage-Sensitive Fluorescent Dye
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Indocyanine green (ICG) is an infrared fluorescent dye with widespread use in clinical applications, including hepatic function tests, cardiac output monitoring, and ophthalmic angiography. Using Xenopus laevis oocytes under voltage clamp, we have found that ICG is voltage-sensitive and capable of responding to changes in cellular membrane potential with a roughly linear voltage dependency. ICG's voltage response does not display the sub-millisecond kinetics characteristic of electrochromic dyes; however, it is faster than many so-called slow-response voltage probes. Tests of oocytes performed under current clamp-like conditions show that ICG can clearly follow action potentials produced at approximately 70 Hz. ICG has low expected cytotoxicity; an infrared wavelength amenable to deep tissue imaging; and the ability to label excitable cells, including cardiac myocytes and neurons. Consequently, the voltage-sensitivity of ICG presented here may have significant implications for novel applications in research and the clinic. Support: NIH GM030376.

3999-Pos Board B727
Targeting Single Cell Networks for Gene Expression using Mechanical Stamping
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To understand fine scale-scale structure and function of single mamilian cellular networks, we developed and validated a strategy to genetically target and trace monosynaptic inputs to single neuron initro and invivo using mechanical stamping of viruses on a single cell. this technique, broadly applicable works with single cell resoltuion invivo and invitro and may help shed new light on many mechanisms in which cellular netowrks are involved.

4000-Pos Board B728
Optical Sensing of Action Potentials in Semiconductor Microtubes using In(Al)GaAs Quantum Wells
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We suggest an advanced method of optical action potential sensing of neuronal networks based on semiconductor microtube arrays [1].
GaAs/InGaAs microtubes are fabricated using the well-established principle of self-rolling strained semiconductor layers where the lattice constant of InGaAs is slightly higher than the one of GaAs. By selective etching of the sacrificial layer (AlAs), the strain is reduced and the double-layer starts rolling up [1,2]. In order to protect the neurons from toxic As, the tubes are coated with parylene C. The neurons are selectively positioned in the areas of the tubeś openings so that the growth of the axons is guided by the microtubes.
To ensure the optical activity in the microtubes, a quantum well (QW) is embedded inside the microtube. To activate the quantum well we use a 532 nm laser. In case of an action potential passing through the tube a shift in the emission spectrum of a microtube is expected. First results of the photoluminescence spectrum of the tubes show higher intensity and a blue shift of the tubes coated with parylene C in contrast to the uncoated tubes.
[1] A. Koitmäe et. al Soft Nanoscience Letters 3 (4), to be published October 2013.
[2] C. Bausch et. al arXiv:1305.1218.

4001-Pos Board B729
A New Assay to Quantify the Connect-Ability of Neurons and the Neurite Extensions
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The capability of neurons to recognize the extracellular environment and to establish physical connections among them (''connect-ability'') is altered in several neuropathologies. The quantification of these alterations is important for the investigation of pathogenic mechanisms as well as for the development of neuropharmacological therapy, but current morphological analysis methods are very time-intensive.
Here, we present and characterize a novel on-chip approach that we propose as a rapid assay. Our approach relies on the use of patterned substrates, where the alternation of chemical cues is exploited to guide neural cell adhesion and development. Discrete arrays of adhesion protein spots, such as poly-D-lysine, characterized by controlled inter-spot separations of increasing distance (30 - 100 μm), are locally adsorbed on an adhesion repulsive agarose layer. Wild type (WT) hippocampal neurons are observed to grow and form connections among multiple spots only for inter-spots separation shorter than 50 μm, whereas connections result prohibited for distances longer than 80 μm. Based on this finding we demonstrate the design of specific patterns for identifying connect-ability defects by comparing the maximal inter-spot distance that allows connections in neuronal cultures prepared from WT animals and from disease animal models (22q11.2 deletion syndrome/DiGeorge syndrome)[1].
The presented results demonstrate the reliability of this on-chip-based connect-ability approach and validate the use of this method for faster and unbiased assessment of neuronal connect-ability deficits in neuropathologies.
[1] Petrelli A., Marconi E., Salerno M, De Pietri Tonelli D., Berdondini L. and Dante S. ''Nano-volume drop patterning for rapid on-chip neuronal connect-ability assays'', Lab on a Chip (on line DOI 10.1039/C3LC50564B).

4002-Pos Board B730
The Neurochip: A New Multielectrode Device for Stimulating and Recording from Cultured Neurons
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The human nervous system consists of billions of Neurons plus supporting (neuroglial) cells. Neurons are able to respond to stimuli (such as touch, sound, light, and so on), conduct impulses, and communicate with each other (and with other types of cells like muscle cells). A Neurochip is a chip that is designed to interact with neuronal cells. A neuron is an electrically excitable cell that processes and transmits information through electrical and chemical signals. A chemical signal occurs via a specialized connection with other cells. Neurons connect to each other to form neural networks. Neurons are the main components of nervous system. This paper provides a Designing process of a Neurochip, its fabrication stages as well as what neurons are, and neural diseases and chip application in neurological diseases.

4003-Pos Board B731
Olfactory Searches with Limited Space Perception
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Various insects and small animals can navigate in turbulent streams to find their mates (or food) from sparse pheromone (odor) detections. Navigation is a complex task involving olfactory coding, motion perception, space perception and integration of all these information to compute the paths to be chosen. Insects' access to internal space perception and use of cognitive maps are still heavily debated, but for some of them, limited space perception seems to be the rule. However, this poor space perception does not prevent them from impressive search capacities. Here, as an attempt to model these behaviors, we propose a scheme that can perform, even without a detailed internal space map, searches in turbulent streams. The algorithm is based on a standardized projection of the probability of the source position to remove space perception and on the evaluation of a free energy, whose minimization along the path gives direction to the searcher. An internal ''temperature'' allows active control of the exploration/exploitation balance during the search. We demonstrate the efficiency of the scheme numerically, with a computational model of odor plume propagation, and experimentally, with robotic searches of thermal sources in turbulent streams. In addition to being a model to describe animals' searches, this scheme gives a framework to model complex neuronal task where experimental neural recording are not accessible. This scheme offers the possibility to actively control the exploration/exploitation balance when dealing with complex tasks with limited information. Finally, we show experimental searches of insects with on-board recording of pheromone plume detection and comment search strategies.
[1] J.-B. Masson, ''Olfactory searches with limited space perception'', PNAS, vol. 110, No 28, p11261-11266.

4004-Pos Board B732
The Complexity of Larval Class IV Sensory Neurons in Drosophila is Accounted for by a Set of Statistical Branching Rules
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One key to the function of a neuron is the morphology of its dendritic arbors. In this work, we address the question of which branching rules are necessary to