
Design, Analysis and Validation of Biologically Plausible Computational Models.
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This project will attempt an engineering understanding for computation of the behavior of dissociated cortical tissue (DCT), a functional ensemble of neocortex neurons grown on a special chip (multiple electrode arrays – MEA) which allows dense read-ins and read-outs from a network of these neurons. Due to the difficulty of analyzing the spatio-temporal dynamics of spike trains from a large group of neurons, the approach taken in this work is to create an hybrid biological-computer system. The recently introduced liquid state machine (LSM) will be used as the computational model, where the dissociated cortical tissue implements the liquid and the computer implements the adaptive instantaneous readout. The application will be approximation of time functions, i.e. a known signal will be inputted to the dissociated cortical tissue and the spike trains will be fed to a computer where a readout will approximate a prescribed nonlinear function of the input. If successful, this application shows that the output of the DCT works as a functional basis to represent the past of the input. Reverse engineering, if successful, will provide understanding of how these neurons work as a functional engineering system at the circuit level. Because of its uniqueness and novelty, there will be serious risks in this work. One of the collaborators will be comparing the behavior of these networks of cells against his new model of neurons, the liquid state model (LSM). Another will be comparing the cells and the LSM against general-purpose learning applications which have been addressed using artificial neural networks, for real-world engineering tasks such as prediction and control and classification. The crossdisciplinary and international collaborations play a crucial role in developing this new research direction.

Project Website

http://www.cnel.ufl.edu/

Publications

Dilip Goswami, Klaus Schuch, Yi Zheng, Tom DeMarse, Jose C. Principe, "Towards the Modeling of Dissociated Cortical Tissue in the Liquid State Machine Framework", accepted in the Int. Joint Conf on Neural Networks, 2005.