Title (tentative): Connecting biological and artificial neurons to restore injured neuronal networks

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Motivation and application domain

The goal of this project is to test the capability of a hybrid neuromorphic device to either modulate the dynamics of a biological neuronal system or to restore its functionality in case of an injury. This thesis falls within the multidisciplinary domain named ‘neuroengineering’.

General objectives and main activities

The general objectives and activities are following:
1. To learn how to prepare and maintain in vitro experimental models, in particular multi-modular patterned neuronal cultures.
2. To perform experiments on the developed experimental model aimed at demonstrating two hypotheses: i) the neuromorphic device, where an artificial neural network is implemented, can modulate the dynamics of a biological neural network; ii) the neuromorphic device can ‘replace’ one biological sub-network which is not functioning any more due to an injury.
3. To analyze and interpret the results obtained during the experiments, also developing specific pieces of code.

Training Objectives (technical/analytical tools, experimental methodologies)

• Manipulation and maintenance of biological tissue
• Learn how to program a neuromorphic device
• Testing neuronal in vitro model systems
• Data analysis and statistical testing

Place(s) where the thesis work will be carried out: Istituto Italiano di Tecnologia

Pre-requisite abilities/skills: basic MATLAB programming skills

Maximum number of students: 1