

Open PhD positions – starting Nov 1st, 2016

A number of PhD positions are available in the field of ‘Sensorimotor Systems’ and ‘Computational Neuroengineering’, as part of the PhD course in Bioengineering and Robotics, at the Department of Informatics, Bioengineering, Robotics, and Systems Engineering, University of Genoa, Italy.

The PhD will be fully funded, including stipend (about EUR 1230 per month after taxes), fees, and a research training and support grant (EUR 1650 per year).

Applications are invited on one of the following research projects:

1. MODELING THE IMPAIRED BINOCULAR VISUAL SYSTEM

The main goal is to characterize and to model how sensory and motor impairments affect the normal binocular functionality and development of the visual system. The PhD student will work on two complementary tracks: a) designing biologically inspired models of the early visual system, grounded on previous research, to mimic different impairments; b) developing specific 3D visual and visuomotor experimental protocols to investigate binocular performance of healthy subjects and patients. Experiments will be based on 3D visual displays integrated with binocular eye tracking technologies.

The resulting framework, integrating neural modeling with psychophysical experimentations, will be used to investigate the computational principles of the impairments, and their impact on binocular visual processing and perception.

Expected results will concern: 1) a better understanding of the neural mechanisms that underlie the healthy and impaired visual system, 2) developing and assessing diagnostic and therapeutic methodologies for visual impairments, 3) inspiring design principles for artificial visual systems.

2. ACTION-PERCEPTION TRANSFER IN VISUAL AND VISUO-HAPTIC BEHAVIOR

[in collaboration with Vittorio Sanguineti, Neuro-engineering and Neuro-robotics lab (NEUROLAB)]

Experiencing the sensory feedback gained from movements allows us to learn the contingencies and correlations between actions and sensory events. Accordingly, sensing “educates” motor action, but, conversely, and more elusively, motor practice can “educate” sensing. The proposed research aims at investigating the interplay between action and perception at different levels:

- (1) modelling early action-perception transfer in visual feature extraction (cf. neural coding of visual properties) and perceptual judgement processes (decoding stages);
- (2) experiments on bidirectional perceptual-action influence - including the development of systems and devices that integrate vision and haptics;
- (3) applications in neuromotor and cognitive rehabilitation, in which action is used to educate perception and perception is used to educate action.

3. SENSORY PROCESSING IN LARGE-SCALE HIERARCHICAL NETWORKS OF INTERACTING NEURONAL ASSEMBLIES

[in collaboration with Paolo Massobrio, Neuro-engineering and Bionanotechnology lab (NBT)]

Feed-forward networks provide a minimal framework to study coding and decoding strategies as well as to interpret certain aspects of cortical information processing. Following this architectural paradigm, deep networks have been proposed to specialize for different perceptual tasks, for taking decisions, or planning motor acts. However, such networks rely on an over-simplification in which single nodes model homogeneous population of cells and connections represent average interactions among populations (i.e., meta-network approach).

The proposed project aims to increase the complexity and the realism of this model by designing and analyzing the behavior of large-scale hierarchical network of interacting neuronal assemblies. Each node

should be modeled as an assembly composed of excitatory and inhibitory neurons with their own dynamics. The neurons of each assembly will respond to properties of the visual signal through their afferent receptive fields. Yet, their overall behavior will emerge from recurrent interactions, and will be ruled by network-parameters, like balance between excitation and inhibition, kind of connectivity, number of neurons of each of these assemblies.

The goal is to develop a new model and to investigate the role of specific vs. unspecific inhibition on the tuning properties of the single cells, and on the efficiency of the code provided by the emerging functionally homogeneous populations, and on their attendant adaptation capabilities. The dynamic properties of the network will be analyzed in relation with the interconnections topology, and eventually related to its sensory processing capabilities.

All the projects will provide the opportunity to work on neural modeling, visual psychophysics, robotics, or a combination of them. Experimental, modeling, and theoretical approaches might be pursued with a different accent according to personal attitude.

Ongoing cooperation, at international level, with research groups of different disciplines, will ensure a highly interdisciplinary and stimulating environment.

Successful applicants would have a good honors Master degree in Engineering, Computer Science, Physics or related disciplines, strong interest in computational neuroscience, and an open mind for interdisciplinary research.

Online application are available from April 7, 2016 at 12.00 noon (Italian time) to June 10, 2016 at 12.00 noon (Italian time).

Full details on the call and the application procedure are available at:

<http://www.studenti.unige.it/postlaurea/dottorati/XXXII/ENG/>

<http://phd.dibris.unige.it/biorob/index.php/how-to-apply>

Prospective students, please contact Silvio Sabatini (silvio.sabatini@unige.it), providing your CV and qualifications, the name and contact details of two references, and a description of your research interests indicating which of the three positions you are interested in.

Our labs are located in Genoa, a small beautiful town in northern Italy, both from historical (its historical center is the largest of Europe) and naturalistic point of view (sea and mountains coexist creating a unique landscape). Genoa is only 1.30h away from Milan by train and connected by plane to Rome (1.00h), London (2h) and Paris (1.30h).