SCHOOL PROGRAM

Tramariglio (Alghero) April 29 - May 03, 2019

April 29th

Morning sessions.

First lecture

Speaker: Dr. Paola Perin, University of Pavia, IT

Abstract:

Neural tissue contains cells which displays very complex shapes and interrelations. For neurons, shape strongly affects electrical properties; for glia, shape is related to functional states. In order to reconstruct shapes and spatial relations within the neural tissue, special tools in tissue labeling, stereology and morphological analysis are used. In this lecture we are going to introduce the more commonly employed techniques.

Second lecture

Speaker: Dr. Giuseppe Talani, Institute of Neuroscience CNR Cagliari, IT

Abstract:

In this first section we'll discuss about how neuronal function and signaling may be addressed in an electrophysiological aspect. How do neurons work and how they talk with each other? What are the signals that can be observed experimentally and what are the laws that regulate their onset? We will review the various and most known electrophysiological techniques and how these can be used in order to understand the function of the mazy and fascinating neural network, surfing from the action potential to the main action of neurotransmitters.

Afternoon.

Hands-on time: The NEURON simulator. Basic concepts.

April 30th

Morning sessions.

First lecture

Speaker: Dr. Paolo Enrico, University of Sassari, IT

Abstract:

In mathematical modeling, we translate our qualitative knowledge into the quantitative language of Mathematics. This has many advantages, in fact: 1) Math is a very precise and concise language, with well-defined rules for manipulations; 2) all the tools that mathematicians have developed over hundreds of years are at our disposal; 3) computers can be used to perform numerical calculations. If your understanding of Math is less than rock solid, don't worry! The point here is to learn enough of the mathematics to understand what is going on, not necessarily how to do it yourself.

Second lecture

Speaker: Dr. Michele Migliore, National Research Council, ITA

Abstract:

This lecture will guide the students through the scientific issues that should always be taken into account in implementing a realistic model based on experimental recordings. Students will learn how, why, and to what extent each ion channel, and its dendritic distribution, is able to affect the intrinsic electrophysiological properties of neurons.

Afternoon.

Hands-on time: Implementation of neural models using NEURON + Python: basics. Group projects presentation.

May 1th

Morning sessions.

First lecture

Speaker: Dr. Maria Laura Idda, National Research Council, ITA

Abstract:

Cells heterogeneity in a multicellular organism determine specific functions by activation of cell-type-specific gene regulation. Identifying heterogeneity of cells gene expression and organization is the key step to understand the function of each organ and tissue. Advanced single-cell RNA processing and sequencing (scRNA-seq) technologies are revolutionising our ability in this field. Indeed, scRNA-seq enables identification of cellular heterogeneity in detail. In this lecture, we'll discuss the existing scRNA processing and sequencing technologies and discuss potential applications.

Second lecture

Speaker: Eugenio Piasini, University of Pennsylvania (USA)

Abstract:

TBA

Afternoon.

Hands-on time: Implementation of neural models using NEURON + Python: advanced topics. Group projects.

May 2th

Morning sessions.

First lecture

Speaker: Pietro Balbi, Istituti Clinici Scientifici Maugeri IRCCS (ITA)

Abstract:

Neurocomputational modelling has the ultimate goal of enhancing the understanding of the behavior of neural cells and circuits. The aim is usually reached by starting from the experimental phenomena, then by postulating hypotheses or conceptual models of the biophysical events, and finally by transforming them in computational models. In this seminar the considered experimental phenomena are represented by the axon-somatic back-propagation and the recurrent discharge, which are the basis of a clinical test known as the F wave. It results from the backfiring of antidromically activated spinal motoneurons. By modelling the axon-somatic back-propagation and the recurrent discharge, a clearer insight is gained about the relations between the F wave and the spinal excitability.

Second lecture

Speaker: Mitchell Goldfarb, Hunter College, The City University of New York (USA)

Abstract:

Inactivation gating of voltage-gated sodium channels profoundly influences action potential generation and conduction in excitable cells. Our lab studies FHF proteins that binding to the cytoplasmic carboxyl-terminal domain of sodium channels and modulate the voltage dependence of channel inactivation. *Fhf2* gene knockout mice have temperature-sensitive defects in cardiac conduction and heat sensation. We have generated computational models of wild-type and *Fhf2* knockout cardiomyocyte strands with the gating of sodium channel conductances modeled to reflect empirically recorded sodium current data in wild-type and mutant cardiomyocytes. The *Fhf2* mutant model successfully recapitulates temperature-dependent conduction failure. Furthermore, the *Fhf2* mutant model predicts that cardiac conduction in mutant mice should be sensitive to impairments in calcium conductance or gap junctional coupling between cardiomyocytes. Both of these predictions have been borne out by pharmacological and genetic experiments on *Fhf2* knockout mice.

Afternoon.
Hands-on time: Implementation of neural models using NEURON + Python: advanced topics. Group projects.

May 3th

Morning sessions.

First lecture
Speaker: Dr. Sergio Solinas, Institute of Neuroinformatics, CH
Lecture: Simulation and data processing workflow: from ideas to documented applications
Abstract:
Running computer simulations does not suffice to produce good science. Computational modeling can be a painstaking job if proper tools and care are not used in the process taking ideas from experimental design and data to neuron models and practical applications. The community of Computational Neuroscience has developed a set of tools to complete the neural simulators at its core. Revision control, data management and analysis, data visualization, progress report tracking, and last but not least standard representation of neuronal models can save your scientific life more than once. We will see how to use software as: Git, Sumatra, Neo, PytNN, Netpyne, Mozaik, NeuroML, Geppetto, and the OSB web portal.

Second lecture
Speakers: Gabriela Michel, Saray Soldado-Magraner
Lecture: Work you way in computational neuroscience
Abstract:
Computational neuroscience offers an enormous innovation potential in the quest to understand brain function, by combining the expertise of biologists, mathematicians, physicists, physicians, psychologists, computer scientists and engineers, in a true interdisciplinary approach. Models can be used to investigate many phenomena, including: neural dynamics, neuromodulation, neural coding, plasticity, vision, audition, and much more.
However, in such a large field of research is easy to get lost and waste too much time perusing things that are unimportant. Further, computer programming is a skill that can be learned in many way, and NEURON programming is no exception. On these basis one can be tempted to work his own way by just writing code. While there is considerable value in doing your own work privately, if you want to evolve you need to communicate with others. Doing research in computational neuroscience means not just dumping code, but actually being a scientist and do science within the scientific community.

Afternoon.

Hands-on time: Group projects: final discussion and results evaluation