



Photons and Neurons 2014 (CNRS Thematic school : 2nd edition)

Photonic imaging for neurosciences

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9th-13th December 2014

Domaine Saint Joseph (<http://www.domaine-lyon-saint-joseph.fr/>)

Sainte Foy lès Lyon, France

Purpose of the School

The understanding of the mechanisms of the development of the information by the central nervous system and the development of neuronal pathologies are multidisciplinary scientific research fields of critical socio-economic issues.

In this context, among conventional imaging techniques (PET, fMRI), photonic techniques allow non-invasive functional and multiscale explorations. They are currently undergoing an important development, because of their flexibility of use and their sensitivity. For example, the anatomical and functional imaging of cerebral cortex, spinal cord, imaging of the hemodynamic processes for the study of the neurovascular coupling, all make use of photonic techniques at microscopic, mesoscopic and macroscopic scales. The development of these non-conventional imaging techniques poses both experimental and theoretical challenges, being strongly coupled and requiring close interaction with the neuroscience community, to fully identify the issues. The main objective is to examine the organ in a non-invasive way, not affecting the cognitive process: the physical problem of optical imaging in vivo in neuroscience is that of imaging in strongly scattering and heterogeneous environment.

There are roughly speaking two types of approaches:

1. micro/mesoscopic techniques, strictly reserved for animal examination, for a fine study of the phenomenon in situ: photonic approaches are 2D intrinsic imaging, confocal microscopy or multiphotonics, laminar optical tomography, etc.
2. macroscopic techniques for non-invasive examination of human and animal brain: diffuse optical imaging (2D or 3D), diffuse spectroscopy correlation.

These techniques address specific issues and are to some extent complementary. The goal of this school is to favor the exchange ideas on common theoretical, numerical and experimental techniques and solutions in the different areas and, ultimately, to foster the emergence of possible joint projects. The issues will be focused on the requirements and problems in functional imaging, that are the current locks for the advancement of knowledge in neuroscience.

Main lectures

The school proposes two types of lectures:

Fundamental lectures (~1h30)

- Neural network physiology
- Physics of light interactions with neural tissues
- Non-invasive probing of the brain; light propagation models
- Technology of microscopy imaging & methods
- Technologies for non-invasive probing of the brain & methods
- Brain's evolution and associated animal models.

These lectures will be given by experts in the domain (T. Durduran, ICFO-Barcelone, H. Dehghani, UoB- Birmingham, Torricelli, POLIMI-Milan, A. Liebert, IBIB-Varsovie, *to be confirmed*, I. Tachtsidis, UCL – Londres, N. Torres Clinattec – Grenoble, E. Hillman, Columbia University, *to be confirmed*, etc.....). The whole list will be updated and maintained on the web site.

Shorter lectures (~45 min) devoted to advances in the different fields exposed in the above mentioned fundamental lectures.

Innovations for this second edition

- This year, the 'Photons and Neurons' school involves two imaging platforms CLINATEC (Grenoble) and NEURODIS (Lyon) in its Organization Committee. A specific day is devoted to those platforms with visits, seminars and discussions (with a focus on clinical applications).
- To encourage constructive discussion between end-users, researchers and industrial partners, a specific seminar is scheduled with the opportunity given to our privileged partners to expose their technology (Maunakea, Newport-SpectraPhysics, etc.)

Photonics4Brain

A Photonics4Brain meeting is scheduled jointly to the school.

Scientific Committee

Da Silva Anabela, Institut Fresnel, AMU/CNRS/ECM UMR 7249, Marseille

Deumié Carole, Institut Fresnel, AMU/CNRS/ECM UMR 7249, Marseille

Dinten Jean-Marc, CEA-LETI, Grenoble

Durduran Turgut, ICFO, Barcelone

Latour Gaël, Université Paris Sud, IMNC, IN2P3, Orsay

Montcel Bruno, Université Lyon 1- CREATIS, Lyon

Planat-Chrétien Anne, CEA-LETI, Grenoble

Ray Cédric, responsable formation du Labex PRIMES, Université Claude Bernard Lyon 1, IPNL, Lyon

Song Ningning, Institut Fresnel, AMU/CNRS/ECM UMR 7249, Marseille

Torricelli Alessandro, Istituto Politecnico di Milano, Milan

Van der Sanden Boudewijn, Director National Platform for Intravital Microscopy Grenoble, France Life Imaging, Clinattec and Institut of Neuroscience Grenoble, France

Vanzetta Ivo, INT, AMU/CNRS UMR 7289, Marseille

Zacharakis Giannis, FORTH, Grèce

Web Link : **under construction**: <http://www.fresnel.fr/photonsneurones2014/index.php/fr/>