Universitat Pompeu Fabra Barcelona | Master in Bioinformatics for Health Sciences

Master project 2024-2025

Personal Information

Supervisor	Oriol Gallego
Email	oriol.gallego@upf.edu
Institution	Universitat Pompeu fabra
Website	
Group	Live-cell structural Biology

Project

Structural bioinformatics

Project Title:

Modelling and machine learning to time-resolve molecular networks in vivo

Keywords:

Deep Learning, Modelling, Protein network, Structural dynamics, image analysis

Summary:

The mechanisms regulating biological processes are central questions in biomedicine. However, these mechanisms rely on protein networks, structures and dynamics that are often unknown. The complexity of the protein machinery involved, and fast cycles of assembly-activity-disassembly have prevented full understanding of the molecular basis that control human biology. For instance, in our group, we investigate the mechanism that drives exocytosis, a process that is essential in neurobiology and cell growth and whose mechanism of function remains as a long standing (and unsolved) question in the field. We have developed a new method of fluorescent microscopy capable to resolve the 3D architecture of protein assemblies directly in living cells. Using this approach and computational integration of structural data we reconstructed de novo the exocytic machinery at the nanometre scale (Picco et al 2017 Cell). Our unpublished data indicates that the exocytic machinery organizes in transient higher-order structures with dimensions similar to the Nuclear Pore Complex, but with a highly dynamic behavior that prevents its purification and reconstitution in vitro. For these reasons, high-resolution structures and dynamics necessary to understand the mechanism of exocytosis remain elusive. We offer a paid position for a Master student to continue the work published in Cell (Picco et al 2017 Cell). The student will use IMP (Integrative Modelling Platform, developed in A. Sali's lab), Python and machine learning to integrate in vitro and in cellulo datasets (i.e. live-cell imaging, cryo-EM, homology modelling, super resolution microscopy…) and to reconstruct the high-resolution structure and dynamics of the supra-assembly that controls exocytosis. The project can accommodate more bioimage analysis or structural modelling depending on the student's priorities. In consequence, the project might involve collaboration with other groups such as Daniel Castaño (Biofisika institute) and Alex de Marco (New York Structural Biology Center, USA). The student is expected to contribute, together with experimentalists, in a larger project aiming to resolve the mechanism of exocytosis.

Expected skills:

Expertise with Python is required. Previous experience in a lab and basic concepts of structural biology are a plus.

Possibility of funding:

Yes

Possible continuity with PhD:

Yes