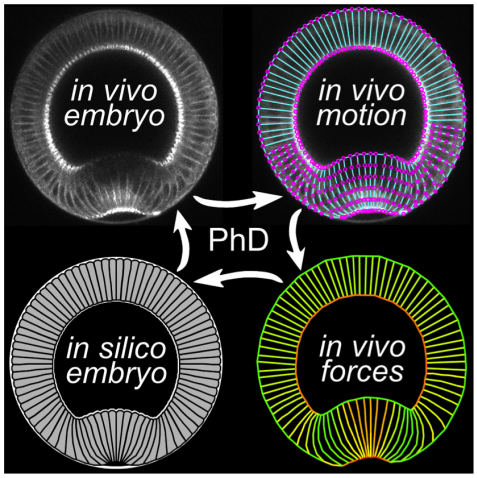
INPhINIT
"la Caixa" Fellowship Programme

IBEC
Institute for Bioengineering of Catalonia

EXCELENCIA SEVERO OCHOA

IBEC participates in INPhINIT, "la Caixa" Doctoral Fellowship Programme with a set of stimulating PhD projects and excellent research groups to host the fellows



Mechanics of development and disease group
Group leader: Vito Conte (vconte@ibecbarcelona.eu)

Biomechanics of tissue folding

The Mechanics of Development and Disease group – led by Dr Vito Conte at the Institute for Bioengineering of Catalonia (IBEC) in Barcelona advances cross-disciplinary research at the interface between engineering, biology and physics. We are interested in deciphering physical mechanisms of development and disease in biological tissues and organisms.

Specifically, we are interested in deciphering the physical mechanisms driving epithelial tissue folding and understand how this collective phenomenon arises from gene expression at the single cell level. Tissue folding is a morphogenetic process that is key to the design of organoids, the metastatic transition of some instances of cancer disease and to the healthy development of embryos. During this process, epithelial cells must generate force and propagate intercellular stress transmission to collectively sustain the collective bending and folding of the epithelium.

As a model system to study the link between the biochemistry and biomechanics of tissue folding we utilise in vitro cultured epithelia as well as in vivo fruit-fly embryos (Drosophila melanogaster). Understanding how the biomechanical folding at the tissue level is regulated by gene expression at the single cell level is of fundamental importance because gene mutation may lead to abnormal or failed tissue folding and – in the case of embryos – to diseased or deceased phenotype [1-3]. To address these questions, we combine in vivo experiment and biophysical techniques to quantify cell and tissue mechanics from microscopy time-lapse images of folding tissues [1] . Images are then processed to provide large sets of measurements relative to cellular motion and epithelial forces. We further combine physical theory and computer simulation to integrate this experimental biophysical data into in silico models of the folding epihtleium [2], which we use to make predictive biomechanical analyses of normal and pathological folding [3].

REFERENCES

[1] Brodland G.W., Conte V. et al. Video Force Microscopy Reveals the Mechanics of Ventral Furrow Invagination in Drosophila. PNAS 107 (2010)

[2] Conte V. et al. A Biomechanical Analysis of Ventral Furrow Formation in the Drosophila Melanogaster Embryo. Plos One 7 (2012)

[3] Perez-Mockus G. et al. Spatial regulation of contractility by Neuralized and Bearded during furrow invagination in Drosophila. Nature Communications (2017,in publication)

Job position description

We are looking for an exceptionally talented and motivated predoctoral student to tackle the fundamental questions detailed in our research project within a highly multidisciplinary environment. A variety of scientific backgrounds will be considered at the interface between biology, engineering and physics (e.g. biophysics, bioengineering, etc…).

The student's background along with their research interests will be specifically taken into account to shape the research project with the supervisor.

Research project potentially involves a broad range of techniques including time-lapse microscopy, quantitative image analysis and computational modelling. Mastering these techniques will require a substantial degree of willingness and skilfulness in developing custom software routines in ImageJ and Matlab, as well as in utilising software for quantitative analyses that might happen to be relevant to the research project.

We invite to apply for this PhD position all students who are passionate and resolute about doing research, and are willing to embrace team effort unreservedly.