UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

Computational Biology and Complex Systems Research Group

Training Program in Computational Biophysics

TFG offer

Mathematical modelling of embryonic tissue elongation

Animal shapes are highly diverse with organs of unique morphologies and functions. A fundamental event across vertebrate embryos is the **generation of an animal body plan with a resulting coordinate system** – anterior-posterior (A-P), dorso-ventral (D-V), and medio-lateral or proximo-distal (Pr-Di) axis (see Fig. 1A, left). The embryonic tissues elongate along those axes to form the primordia such as the tail and limbs of the animal. With the advent of organoid technologies, it is now possible to reconstitute similar processes *in vitro* by controlling cell differentiation. Such systems termed "synthetic embryos" constitute a unique platform to study animal development. One such example are *gastruloids*: synthetic embryos generated from mouse embryonic stem cells that recapitulate the generation of the anterior-posterior (or head-to-tail) axis in mouse (see Fig 1.A, right and Fig. 1B). **How gastruloids elongate along the predefined axis is unclear from a biophysical perspective. The goal of this project is to explore possible biophysical models of tissue elongation and compare them with experimental data on gastruloids obtained in the group of Dr. Vikas Trivedi in EMBL Barcelona.**

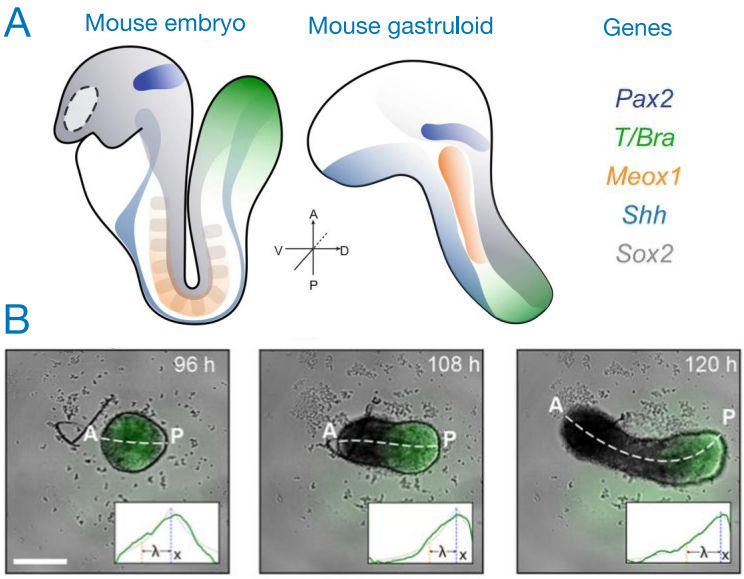

Fig. 1. A) Gastruloids as *in vitro* models of mouse development. (Left) Mouse embryo at stage E8.5. (Right) Mouse gastruloid at an equivalent developmental stage (image adapted from Anlas *et al*. 2020). B) Snapshots of gastruloids at different timepoints using a cell line containing a T/Bra GFP reporter. The timelapse images are segmented and elongation is quantified (image adapted from Gritti *et al*. 2021). Scale bar: 100 μm.

TFG proposal

We propose a TFG project to be conducted during the academic year 2022/2023. The different tasks are as follows: (1) Develop a 1D hydrodynamic model of tissue elongation, (2) Solve the hydrodynamic model considering different biophysical gradients driving tissue elongation, (3) Quantify the elongation rate of gastruloids from timelapse microscopy data and compare with the previous model.

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Candidate profile: Last course of Engineering Physics, Biosystems Engineering and/or Mathematics at Universitat Politècnica de Catalunya.

Centre: Escola d'Edificació de Barcelona EPSEB (Barcelona).

Application: Sent CV (including grades) and a motivational letter to the head of the program **before October 3rd** (Clara Prats, clara.prats@upc.edu).

Funding: Research group BIOCOM-SC will offer an INIREC contract to the three best candidates that want to carry out any of the TFG associated with this training program in *Computational Biophysics* in the academic year 2022/2023.