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PhD Call – 2018
Turing Centre for Living Systems

Ref offer: PHD2018-13

Mathematical modelling of cell migration in confined domains

Project abstract – The project aims at modelling the propulsion mechanism of amoeboid cells in confined geometries. On a 2D substrate, cells migrate by combining protrusive forces to deploy a strongly adhering lamellipodium at their front and contractile forces to detach their rear. In this scenario, the lamellipodium is highly spread and therefore very thin (around 200-400 nm). In contrast, when the same cells migrate through the constrictions of a 3D medium, the lamellipodium thickens to occupy the whole section of the constrictions (up to 3x3 µm2). Despite these major structural changes, cells still migrate efficiently. The precise mechanisms underlying this transition between 2D/3D migration modes remains poorly understood, but an hypothesis that will be explored in this project is that the lamellipodium is resposible for the main propulsive force. We will construct a mathematical and numerical model of the actin gel dynamics in the lamellipodium to reproduce the structural transition from 2D to 3D and estimate the resulting forces between the lamellipodium and its micro-environment. This model will be compared with novel experimental data on the lamellipod structural transition using advanced light-sheet microscopy in microfluidics, the internal actin dynamics by FRAP, and the forces developped by lamellipodium using pressure control systems and traction force microscopy in 2D and 3D.

Expected profile – Applying candidates are expected to have a main expertise in mathematical modelling, numerical analysis and computer science together with a strong interest in experimental and theoretical biophysics. They need not be well-versed in all fields as the project will help them acquire new, interdisciplinary skills.

Expected profile is therefore about applied mathematics graduates with an interest in biological systems, mechanics and experimentation.

Supervisors
Florence Hubert - I2M, UMR 7373 - Applied analysis
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Deadline for application: 15th April 2018

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