Quantifying the dynamics of mitochondrial networks

The dynamics of mitochondrial networks is an important parameter to describe the fitness of the cell for example, in cells that have been subjected to radiation and/or mutations. However, quantifying these dynamics remains a practical challenge. The main reason is that, for such systems, routine tracking algorithms do not apply because the objects (mitochondria) can change shape, merge, divide, etc. A new theoretical approach was described recently [1,2,3] to analyze high-resolution movies of biological networks -in particular the calculation of the dissipative components in a movie and the corresponding force fields. The subject of this internship is to explore whether this approach is suitable to analyze movies acquired with one of our microscopes [1,2,3]. First, we will consider movies of glass beads attached to a glass surface by DNA molecules and trapped with acoustic waves (of variable amplitude). After the analysis of this simple system, allowing us to validate the analysis method, we will turn to movies of complex mitochondrial networks in healthy and diseased cells. Finally, we note that the applicability of such an approach should not be limited to mitochondrial networks but can be applied to a wide variety of biological problems and even to problems in other fields such as geophysics.

[1] Frishman, A. and Ronceray, P., Learning Force Fields from Stochastic Trajectories, Physical Review, Vol.10, pp.021009, 2020.

[2] Brückner, D.B. and Ronceray, P. and Broedersz, C.P., Physical review letters, Vol.125, pp. 058103 ,2020

[3] Gnesotto, F.S. et al., Learning the non-equilibrium dynamics of Brownian movies, Nature Communication, Vol.11, pp.5378, 2020

Prerequisites:

Good command of Python, the candidate should also be able to analyze standard mathematical formulas and code them in Python. **No specific knowledge in Biology is required**.

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