Fully-funded 3-years PhD position in theoretical physics – start: Oct 2023
CINaM, Turing Center for Living Systems, Marseille, France
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Learning the stochastic dynamics of living systems

Keywords: *stochastic processes, biophysics, inference/machine learning*

Context. The dynamics of biological systems, from proteins to cells to organisms, is complex and stochastic. To decipher their physical laws, we need to bridge between experimental observations and theoretical modeling. Thanks to progress in microscopy and tracking, there is now an abundance of experimental trajectories reflecting these dynamical laws. Inferring physical models from noisy and imperfect experimental data, however, is challenging. In our group, we develop and apply data-efficient tools to learn stochastic differential equations and discover physical models, employing methods from statistical physics and machine learning. Collaborating with experimentalists, we then use these tools to analyze data and search for new physics in the dynamics of living systems.

Project. The candidate will participate both in the theoretical development of inference methods and their application to experimental data. Several directions are possible on each aspect, depending on the interests and skills of the candidate. On the theoretical side, improvement of stochastic inference methods include making them more robust and data-efficient, quantifying the information-theoretical limits of inference, and leveraging deep learning techniques to better represent unknown models. On the applications side, possible collaborations include the study of condensate-mediated interactions between genomic loci in the cell nucleus, pattern formation by migrating cells in embryo development, and visual interaction between fish leading to collective motion.

Expected profile. A strong training in statistical physics; a taste for programming (in Python); interest in the physics-biology interface and data-driven science.

Contact. Please apply by contacting me directly: pierre.ronceray@univ-amu.fr. Applications will be considered until position is filled.

References.

- Frishman, A. & Ronceray, P. Learning Force Fields from Stochastic Trajectories. Phys. Rev. X 10, 021009 (2020).
- Brückner, D. B., Ronceray, P. & Broedersz, C. P. Inferring the Dynamics of Underdamped Stochastic Systems. Phys. Rev. Lett. 125, 058103 (2020).