Abstract:

Active propulsion allows agents to explore their local environment and forage nutrients or perform vital tasks. The interest in such active agents is manifold, originating from understanding true non-equilibrium processes at a fundamental level as well as from their anticipated fundamental role in the nanotechnology of the 21st century, in particular, for biomedical engineering, controlled drug delivery, and environmental cleansing of soil and polluted water.
In this talk, we first focus on exactly solvable models for single active Brownian particles (ABP). In particular, we provide an analytical solution for the time-dependent Fokker-Planck equation for a two-dimensional ABP trapped in an isotropic harmonic potential. Then we move our attention to target-search problems, showing how enhanced sampling methods such as transition path sampling can be used to efficiently samples the reactive pathways leading to successful target search by active particles when this implies crossing high-energy barriers.
Finally, we exploit the reinforcement learning framework to understand how evolution shaped the navigation and search strategies of microswimmers, living in homogeneous and complex environments.