The **Biological Algorithms** group offers a

Master Thesis Project

to students in, *e.g.*, physical sciences (or applied mathematics)

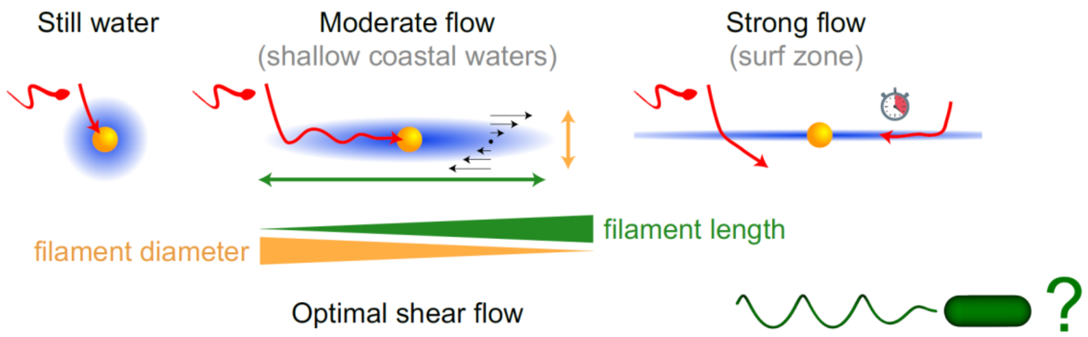
Bacterial chemotaxis in turbulent flow.

Bacteria play a crucial role in the ecosystem of our oceans. A key task in bacterial life is to navigate in the open sea to find nutrient patches of sinking marine snow. Foraging bacteria are attracted to these patches by dilute diffusing molecules, via a process known as *chemotaxis*. While such chemotaxis is well understood for idealized conditions of still water, the habitat of bacteria is more challenging and characterized by external flows and small-scale turbulence, which distort concentration gradients of nutrient molecules. Surprisingly, experiments suggest the existence of an optimal turbulence strength at which chemotactic foraging is more effective than for still water. While the origin of such an optimum has been recently explained by our group for a more specialized form of chemotaxis employed by sperm cells of marine invertebrates, the physical mechanism of this optimum is still unknown for bacterial chemotaxis.

In this project, we will study bacterial chemotaxis as a specific biological example of autonomous motility control. This project will combine: (i) multi-scale simulations, which combine agent-based bacterial chemotaxis with flows corresponding to small-scale turbulence and (ii) theoretical modeling for a quantitative description of the effectiveness of bacterial foraging at different turbulence strengths. By studying sperm navigation in complex environments, we theoretically address a prime example of navigation of single cells in dynamic and disordered environments.

If you share our motivation to understand what makes biological systems robust, and are not afraid of analytical work as well as programming, we will be happy if you contact us for further information and details.

Biological Algorithms Group. Our mission is to identify simple paradigms of robust motility control and pattern formation in complex biological systems. We reverse-engineer these biological algorithms in close collaboration with experimental biologists, using tools from physics, information theory, and engineering. https://physics-of-life.tu-dresden.de/en/research/core-groups/friedrich



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More information:

Lange et al. Sperm chemotaxis in marine species is optimal at physiological flow rates according theory of filament surfing, *PLoS Comp. Biol.,* **17**(4): e1008826