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Modeling Bodies Locomoting through Fluids

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Locomotion of an organism through a fluid is one of the most fascinating fluid-structure interactions. How an organism accomplishes this feat depends on many things, such as whether the fluid is inertial (i.e., big bodies, high Reynolds number), overdamped(small bodies, low Reynolds number), or somewhere in between. The presence of boundaries, or of other moving bodies in the fluid, or non-Newtonian behavior of the fluid, makes the problem richer. I will not discuss the biology of locomotion per se, but rather focus on what mathematical models and simulations of prototype physical systems reveal of the core physical interactions that underlie locomotion. This includes how bodies can locomote by taking advantage of symmetry breaking instabilities in fluidic response, the instability and persistence of orientational order in active suspensions, and the effect of visco-elasticity at low Reynolds number.