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Optimizing Locomotion

ANETTE HOSOI, Mechanical Engineering, MIT

In this talk we will discuss two optimization topics related to low Reynolds number locomotion: optimal stroke patterns in linked swimmers and optimal fluid material properties in adhesive locomotion. In contrast to many optimization problems, we do not consider geometry, rather we optimize the swimming kinematics or fluid material properties for a given geometrical configuration. In the first case, we begin by optimizing stroke patterns for Purcell's 3-link swimmer. We model the swimmer as a jointed chain of three slender links moving in an inertialess flow. The swimmer is optimized for both efficiency and speed. In the second case, we analyze the adhesive locomotion used by common gastropods such as snails and slugs. Such organisms crawl on a solid substrate by propagating muscular waves of shear stress on a viscoelastic mucus. Using a simple mechanical model, we derive criteria for favorable fluid material properties to lower the energetic cost of locomotion.