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Slow and fast swimming with a reciprocal stroke MARCUS ROPER, SEAS, Harvard University, JON WILKENING, Applied Mathematics, UC Berkeley, HOWARD STONE, SEAS, Harvard University — Millimeter-sized swimmers often employ different sets of limbs or locomotory gaits for fast and slow swimming. It is believed that these bifurcations in swimming behavior reflect fundamental constraints upon how propulsive force may be generated in the world of small Reynolds numbers inhabited by such swimmers. We explore these constraints using a rigid foil flapped in a time-reversible manner as a simulacrum of a propulsive limb. We show that, if shaped appropriately, the limb is always capable of generating useful thrust by imparting momentum to coherent masses of fluid, and continues to do so even if the rate of energy expenditure in flapping is allowed to become arbitrarily low. However, the most effective targets of this momentum transfer shift from steady coherent eddies to vortices shed from the fin edges as the foil is scaled up.

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