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Asymmetry and stability of shape kinematics in microswimmers' motion YIZHAR OR, Faculty of Mechanical Engineering, Technion, Israel — Many swimming microorganisms governed by low-Reynolds-number hydrodynamics utilize flagellar undulations for self propulsion. Most of existing theoretical models assume that the shape kinematics is directly controlled, while in reality, eukaryotes actuate internal bending moments along their flagellum. Under control of the internal forces and torques, the swimmer's shape is dynamically evolving and periodic gaits may become unstable. In this work the problem is addressed by revisiting Purcell's three-link swimmer model where the joint torques are controlled. The swimmer's dynamic equations of motion are formulated and the underlying geometric symmetries are analyzed. It is found that certain symmetry properties of the input induce a reversing symmetry on the dynamics of the joint angles, under which periodic solutions are marginally stable. Moreover, it is proven that one has to break the front-back symmetry of the swimmer's structure and/or actuation profile in order to induce time-periodic solution for the shape kinematics which is asymptotically stable under perturbations. In particular, a swimmer with large drag resistance at its front enjoys a strongly stable shape kinematics. The results may explain why most of the flagellated eukaryotes swim with their head forward.

Yizhar Or
Dept. of Mechanical Engineering, Technion, Israel

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