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Stability transitions and directional flipping in a microswimmer with superparamagnetic links YUVAL HARDUF, YIZHAR OR, Technion, Israel Institue of Technology — The famous work of Dreyfus et al (2005) introduced a microswimmer composed of a chain of superparamagnetic beads and actuated by a planar oscillating magnetic field. Further numerical simulations of the swimmer model by Gauger Stark (2006) revealed that for large enough oscillation amplitude of the magnetic field's direction, the swimmer's mean orientation and net swimming direction both flip from the mean direction of the magnetic field to a direction perpendicular to it. This observation has been confirmed experimentally in Roper et al (2008). In our work, we analyze this phenomenon theoretically by studying the simplest possible microswimmer model: two slender links connected by an elastic joint, while one link is superparamagnetic. The dynamic equations of motion are formulated explicitly, and approximated by a second-order system which resembles the well-known Kapitza pendulum with an oscillating pivot. Conditions for stability transitions induced by the system's parametric excitation are obtained numerically and analytically by using Hill's equation and infinite determinant. Remarkably, it is also found that there exist intermediate parameter regions of dynamic bistability where the aligned and perpendicular directions are both stable under different initial conditions.

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