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Low-*Re* swimming across viscosity gradients, II: Theory[1] CHRISTIAN EPARZA LOPEZ, ERIC LAUGA, University of Cambridge, JORGE GONZALEZ-GUTIERREZ, Universidad Nacional Autonoma de Mexico, Universidad Autonoma de Chiapas, ROBERTO ZENIT, Universidad Nacional Autonoma de Mexico, Brown University — To understand the experiments presented in "Low-*Re* swimming across viscosity gradients, I: Experiments", we develop a hydrodynamic model to describe the motion of a helical swimmer across a viscosity gradient formed by two miscible fluids. We assume that the resistive force theory of slender filaments is locally valid on the helical propeller and we calculate the swimming speed as a function of the position of the swimmer, relative to the fluid-fluid interface. Comparing with macro-scale experiments, our model accurately predicts the motion of the swimmer when it crosses from low to high viscosity. When crossing in the opposite direction, gravitational forces become important and we modify our model to include buoyancy. In general we find that it is harder for a pusher swimmer to cross from low to high viscosity, whereas for a puller swimmer it is the opposite. Our model is also extended to the case of a continuous viscosity gradient.

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