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Proprioceptive gait and speed selection in a slender inertial swimmer MEDERIC ARGENTINA, University Nice Sophia Antipolis, MATTIA GAZZOLA, L. MAHADEVAN, Harvard University — We study the dynamics of a slender inertial swimmer accounting for hydrodynamics, mechanics, muscle activity and sensory feedbacks. Our theory elucidates how elastic properties and proprioception contribute to selecting swimming speed and locomotion gait. Swimmers are shown to take advantage of resonance phenomena to enhance speed and efficiency. Furthermore, we demonstrate how a minimal proprioceptive model, in which the local muscle activation is function of body curvature, is sufficient to exploit hydromechanic properties and drive elastic instabilities associated with thrust production. Our results quantitatively agree with live fish experiments and provide a mechanistic basis for the relation U/L $\sim$ f between the swimmer's speed U, length L and tail beat frequency f determined empirically by Bainbridge more than half a century ago.

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