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Computational investigation of feedback loop as a potential source of neuromechanical wave speed discrepancy in swimming animals.[1]
NAMU PATEL, NEELESH A. PATANKAR, Northwestern University — Aquatic locomotion relies on feedback loops to generate the flexural muscle moment needed to attain the reference shape. Experimentalists have consistently reported a difference between the electromyogram (EMG) and curvature wave speeds. The EMG wave speed has been found to correlate with the cross-sectional moment wave. The correlation, however, remains unexplained. Using feedback dependent controller models, we demonstrate two scenarios – one at higher passive elastic stiffness and another at lower passive elastic stiffness of the body. The former case becomes equivalent to the penalty type mathematical model for swimming used in prior literature and it does not reproduce neuromechanical wave speed discrepancy. The latter case at lower elastic stiffness does reproduce the wave speed discrepancy and appears to be biologically most relevant. These findings are applied to develop testable hypotheses about control mechanisms that animals might be using at during low and high Reynolds number swimming.

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