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The phylogeny of swimming kinematics: The environment controls flagellar waveforms in sperm motility JEFFREY GUASTO, Tufts University, LISA BURTON, MIT, RICHARD ZIMMER, UCLA, ANETTE HOSOI, ROMAN STOCKER, MIT — In recent years, phylogenetic and molecular analyses have dominated the study of ecology and evolution. However, physical interactions between organisms and their environment, a fundamental determinant of organism ecology and evolution, are mediated by organism form and function, highlighting the need to understand the mechanics of basic survival strategies, including locomotion. Focusing on spermatozoa, we combined high-speed video microscopy and singular value decomposition analysis to quantitatively compare the flagellar waveforms of eight species, ranging from marine invertebrates to humans. We found striking similarities in sperm swimming kinematics between genetically dissimilar organisms, which could not be uncovered by phylogenetic analysis. The emergence of dominant waveform patterns across species are suggestive of biological optimization for flagellar locomotion and point toward environmental cues as drivers of this convergence. These results reinforce the power of quantitative kinematic analysis to understand the physical drivers of evolution and as an approach to uncover new solutions for engineering applications, such as micro-robotics.

Jeffrey Guasto
Tufts University

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