Abstract Submitted
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Hydrodynamic optimality of ribbon fin shapes[1] RAHUL BALE, MALCOLM MACIVER, NEELESH PATANKAR, Department of Mechanical Engineering, Northwestern University — The primary mode of propulsion in gymnotiform and balistiform swimmers is via the undulation of anal and/or dorsal fins, commonly referred to as ribbon fins, attached to a more or less rigid body. Ribbon fins usually have a convex shape as opposed to a rectangular or concave profile. In this work we investigate if there is a hydrodynamic basis underlying this observation. Fully resolved fluid dynamics computations are performed to calculate the mechanical cost of transport (COT) as a measure of swimming efficiency of the fin. We find that the ribbon fin of a black ghost knifefish has lower COT compared to a hypothetical rectangular ribbon fin. In order to quantify this difference in COT between the two fin shapes, we obtain scaling for COT in terms of various parameters which affect the swimming performance of the fin. Using scaling arguments we address the question of how a convex profile, commonly observed in gymnotiform and balistiform swimmers, is optimal compared to rectangular or concave shapes.

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