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Kinematics of Fish Midline Models

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In the study of the kinematics of aquatic propulsion of undulatory swimmers, the propagation of extrema of curvature and various surrogates for curvature such as deflection from centerline are used to analyze the mechanical power. Several expressions are in use to approximate the wave shape of the fish as the wave passes down the body of the fish. The majority of these expressions – for example, trigonometric or polynomial functions - derive from ease of expression rather than from fish kinematics. Some of the inconsistencies that result from the use of these expressions include small angle restrictions, inconsistencies in propagation speed of extrema of curvature and deflection, and inconsistencies with Newton's second law of motion. In this investigation, we study the more widely used wave shape equations and examine the physical consequences of each. We then attempt to reconcile these inconsistencies with the biological literature and make recommendation of alternative midline models.

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