Hydrodynamic model of fish orientation in a channel flow

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For over a century, scientists have sought to understand how fish orient against an incoming flow, even without visual and flow cues. In a study published in *eLife*, researchers explore a potential hydrodynamic

mechanism of fish rheotaxis—movement away or toward water currents—through the study of the bidirectional coupling between fish and the surrounding fluid.

The researchers point out that a major contribution of the proposed model is the treatment of the fish as an invasive sensor that both reacts to and influences the background flow, thereby establishing a coupled interaction between the fish and the surrounding environment.

By modeling a fish as a vortex dipole, a jet flow with a system of two vortices, in an infinite channel with an imposed background flow, they established a dynamical system that captures the existence of a critical flow speed for fish to successfully orient while performing cross-stream, periodic sweeping movements.

The researchers juxtaposed their models with experimental observations in the literature on the rheotactic behavior of fish deprived of visual and lateral line cues. The crucial role of bidirectional hydrodynamic interactions unveiled by this model points at an overlooked limitation of existing experimental paradigms to study rheotaxis in the laboratory.

More information: Maurizio Porfiri et al, Hydrodynamic model of fish orientation in a channel flow, *eLife* (2022). DOI: 10.7554/eLife.75225

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