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Bioinspired sensory systems for local flow characterization BRENDAN COLVERT, KEVIN CHEN, EVA KANSO, Univ of Southern California — Empirical evidence suggests that many aquatic organisms sense differential hydrodynamic signals.This sensory information is decoded to extract relevant flow properties. This task is challenging because it relies on local and partial measurements, whereas classical flow characterization methods depend on an external observer to reconstruct global flow fields. Here, we introduce a mathematical model in which a bioinspired sensory array measuring differences in local flow velocities characterizes the flow type and intensity. We linearize the flow field around the sensory array and express the velocity gradient tensor in terms of frame-independent parameters. We develop decoding algorithms that allow the sensory system to characterize the local flow and discuss the conditions under which this is possible. We apply this framework to the canonical problem of a circular cylinder in uniform flow, finding excellent agreement between sensed and actual properties. Our results imply that combining suitable velocity sensors with physics-based methods for decoding sensory measurements leads to a powerful approach for understanding and developing underwater sensory systems.

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