

Reconstructing Fluid Velocity Fields from Whisker-Inspired Sensors

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Hydrodynamic signals provide critical information for aquatic animals allowing for the detection and tracking of complex wake structures. Harbor seals use their undulated whiskers to discern wake disturbances from upstream objects from self-induced vibrations. This study uses an array of biologically inspired whisker sensors that consist of a resin-printed whisker mounted onto a polydimethylsiloxane (PDMS) base embedded with two strain gauges to measure streamwise and transverse strain. To map mechanical strain measurements to fluid velocity, we use a linearized second-order dynamic model of the vortex-induced vibration of the whisker. Parameters including inertia, damping, and stiffness were determined via experimental pluck tests. Sectional lift and drag coefficients of the whisker as functions of angle of attack were obtained via computational fluid dynamics (CFD) simulations of a single-wavelength whisker segment. Preliminary results demonstrate that the second-order model can reconstruct the mean and fluctuating velocity components incident on the whisker from strain measurements in the canonical case of a cylinder wake.