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Towards a Coupled Vortex Particle and Acoustic Boundary Element Solver to Predict the Noise Production of Bio-Inspired Propulsion NATHAN WAGENHOFFER, KEITH MOORED, JUSTIN JAWORSKI, Lehigh Univ — The design of quiet and efficient bio-inspired propulsive concepts requires a rapid, unified computational framework that integrates the coupled fluid dynamics with the noise generation. Such a framework is developed where the fluid motion is modeled with a two-dimensional unsteady boundary element method that includes a vortex-particle wake. The unsteady surface forces from the potential flow solver are then passed to an acoustic boundary element solver to predict the radiated sound in low-Mach-number flows. The use of the boundary element method for both the hydrodynamic and acoustic solvers permits dramatic computational acceleration by application of the fast multiple method. The reduced order of calculations due to the fast multipole method allows for greater spatial resolution of the vortical wake per unit of computational time. The coupled flow-acoustic solver is validated against canonical vortex-sound problems. The capability of the coupled solver is demonstrated by analyzing the performance and noise production of an isolated bio-inspired swimmer and of tandem swimmers.

Nathan Wagenhoffer
Lehigh Univ

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