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**Numerical Simulation of Tethered Underwater Kites for Power Generation** AMIRMAHDI GHASEMI, DAVID OLINGER, Worcester Polytech Inst., GRETAR TRYGGVASON, University of Notre Dame — An emerging renewable energy technology, tethered undersea kites (TUSK), which is used to extract hydrokinetic energy from ocean and tidal currents, is studied. TUSK systems consist of a rigid-winged "kite," or glider, moving in an ocean current which is connected by tethers to a floating buoy on the ocean surface. The TUSK kite is a current speed enhancement device since the kite can move in high-speed, cross-current motion at 4-6 times the current velocity, thus producing more power than conventional marine turbines. A computational simulation is developed to simulate the dynamic motion of an underwater kite and extendable tether. A two-step projection method within a finite volume formulation, along with an Open MP acceleration method, is employed to solve the Navier-Stokes equations. An immersed boundary method is incorporated to model the fluid-structure interaction of the rigid kite (with NACA 0012 airfoil shape in 2D and NACA 0021 airfoil shape in 3D simulations) and the fluid flow. PID control methods are used to adjust the kite angle of attack during power (tether reel-out) and retraction (reel-in) phases. Two baseline simulations (for kite motions in two and three dimensions) are studied, and system power output, flow field vorticity, tether tension, and hydrodynamic coefficients (lift and drag) for the kite are determined. The simulated power output shows good agreement with established theoretical results for a kite moving in two-dimensions.

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