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Numerical investigation for design and critical performance evaluation of a horizontal axis hydrokinetic turbine SUCHI SUBHRA MUKHERJI, ARINDAM BANERJEE, Missouri S&T — We will discuss findings from our numerical investigation on the hydrodynamic performance of horizontal axis hydrokinetic turbines (HAHkT) under different turbine geometries and flow conditions. Hydrokinetic turbines are a class of zero-head hydropower systems which utilizes kinetic energy of flowing water to drive a generator. However, such turbines very often suffer from low efficiency which is primarily controlled by tip-speed ratio, solidity, angle of attack and number of blades. A detailed CFD study was performed using two-dimensional and three dimensional numerical models to examine the effect of each of these parameters on the performance of small HAHkTs having power capacities $\leq$ 10 kW. The two-dimensional numerical results provide an optimum angle of attack that maximizes the lift as well as lift to drag ratio yielding maximum power output. However three-dimensional numerical studies estimate optimum turbine solidity and blade numbers that produces maximum power coefficient at a given tip speed ratio. In addition, simulations were also performed to observe the axial velocity deficit at the turbine rotor downstream for different tip-speed ratios to obtain both qualitative and quantitative details about stall delay phenomena and the energy loss suffered by the turbine under ambient flow condition.

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