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Effect of Aspect Ratio on Cross-Flow Turbine Performance[1]
AIDAN HUNT, CARL STRINGER, BRIAN POLAGYE, University of Washington Mechanical Engineering — Cross-flow turbines convert kinetic power in wind or water currents to mechanical power. Unlike axial-flow turbines, the influence of geometric parameters on turbine performance is not well-understood, in part because there are neither generalized analytical formulations nor inexpensive, accurate numerical models that describe their fluid dynamics. Here, we experimentally investigate the effect of aspect ratio the ratio of the blade span to rotor diameter on the performance of a straight-bladed cross-flow turbine in a water channel. To isolate the effect of aspect ratio, all other non-dimensional parameters are held constant, including the relative confinement, Froude number, and Reynolds number. The efficiency is found to be invariant for the range of aspect ratios tested (0.95 1.63), which we ascribe to minimal blade-support interactions characteristic of the particular turbine investigated. Finally, a subset of experiments is repeated without controlling for the Froude number and the efficiency is found to increase, a consequence of Froude number variation that could mistakenly be ascribed to aspect ratio. This highlights the importance of rigorous experimental design when exploring the effect of geometric parameters on cross-flow turbine performance.

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