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Vertical Axis Wind Turbine Design Using Design-by-Morphing and Bayesian Optimization HARIS MOAZAM SHEIKH, PHILIP S MARCUS, University of California, Berkeley — Vertical Axis Wind Turbines (VAWTs) have not been commercialized due to their low Coefficients of Performance (Cp) compared to Horizontal Axis Wind Turbines (HAWTs). However, their low Cp's are likely due to the historical lack of systematic optimization. Recent studies, however, have shown that VAWTs can outperform HAWTs in closely packed arrays in terms of energy produced/area. This observation, combined with their low manufacturing and maintenance costs, and versatility, have sparked renewed interest in VAWTs. In this work, we optimize a VAWT and its concentrator with two techniques: Design by Morphing (DbM), which is a novel design method, and Bayesian optimization. With DbM, the shapes of the VAWT blades and concentrators are determined by morphing baseline shapes together, and the weights of the shapes used in the morph are part of a large Degree of Freedom (DoF) design space. Searching for the optimal design in the high DoF space is not possible using conventional optimization techniques due to the high cost of data for this problem, (i.e., computing or experimentally measuring the Cp of a VAWT). Using Bayesian optimization however, a 6-DoF space is optimized with only 1000 CFD-computed data points and produces an optimized VAWT along with its concentrator.

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