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Morping blade design for vertical axis wind turbines DAVID MACPHEE, University of Alabama, Tuscaloosa, ASFAW BEYENE, San Diego State University — Wind turbines operate at peak efficiency at a certain set of operational conditions. Away from these conditions, conversion efficiency drops significantly, requiring pitch and yaw control schemes to mitigate these losses. These efforts are an example of geometric variability, allowing for increased power production but with an unfortunate increase in investment cost to the energy conversion system. In Vertical-Axis Wind Turbines (VAWTs), the concept of pitch control is especially complicated due to a dependence of attack angle on armature azimuth. As a result, VAWT pitch control schemes, both active and passive, are as of yet unfeasible. This study investigates a low-cost, passive pitch control system, in which VAWT blades are constructed of a flexible material, allowing for continuous shape-morphing in response to local aerodynamic loading. This design is analyzed computationally using a finite-volume fluid-structure interaction routine and compared to a geometrically identical rigid rotor. The results indicate that the flexible blade increases conversion efficiency by reducing the severity of vortex shedding, allowing for greater average torque over a complete revolution.

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