Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Analysis of the self-starting capability of a new hybrid vertical axis wind turbine with a fluid-structure interaction approach[1] MEILIN YU, KAN LIU, WEIDONG ZHU, University of Maryland, Baltimore County — Vertical axis wind turbines (VAWTs) provide promising solutions for distributed wind energy harvesting in both urban and rural areas. However, it is challenging to guarantee satisfactory self-starting capability and high power efficiency simultaneously in a VAWT design. We have recently designed a new hybrid Darrieus-Modifed-Savonius (HDMS) VAWT to address this challenge. The aerodynamics of the new hybrid design is analyzed using a fluid-structure interaction approach based on high fidelity computational fluid dynamics. We find that compared to the Darrieus VAWT, the HDMS design has better self-starting capability due to the torque provided by the inner MS rotor at small tip speed ratios (TSRs); the HDMS design can maintain high power efficiency at large TSRs with an appropriately sized MS rotor. The key flow physics is that the HDMS design can keep accelerating at small TSRs due to the inner MS rotor, and can suppress dynamic stall on the Darrieus blades at large TSRs. The effects of the turbine configuration, inertia and loading on the self-starting capability and power efficiency are further studied.

[1]The authors gratefully acknowledge the support of the Maryland Higher Education Commission through the Maryland Offshore Wind Energy Research Challenge Grant Program.

Meilin Yu
University of Maryland, Baltimore County

Date submitted: 02 Aug 2019 Electronic form version 1.4