

Optimal Conditions for Energy Extraction from VAWTs

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INTRO

Motivations of this work build upon previous research in controlled autorotation of small particles in a flow tank [1-2]. This research explores the introductory capabilities of a new VAWT design, the S-WIND, by first testing the performance of its small-scale prototype. Future research aims to explore the efficiency of densely-packed arrays of the S-WIND through CFD analysis as a potential scalable alternative.

METHODS

Researchers created a 16' long wind tunnel to view the S-WIND prototype's performance in ideal conditions. Researchers also utilized an anemometer, tachometer, and multimeter capable of continuous data collection to measure model performance.

DISCUSSION

The difference in power output between staggered vs. spiral configuration for 10, 8-blades is marginal. The spiral configuration contributes to aesthetics of the design when coupled with the blades' support frame. Future research plans are to create a digital model capable of CFD analysis to gather precise data, and to study densely-packed arrays of S-WIND VAWTs. This future research will build upon previous research suggesting counter-rotating arrangements have potential to improve power densities up to an order of magnitude greater than HAWTs [3].

RESULTS

10-Blade Spiral Avg. RPM vs.

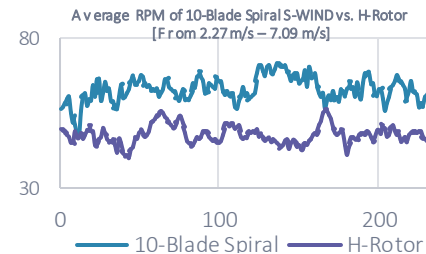
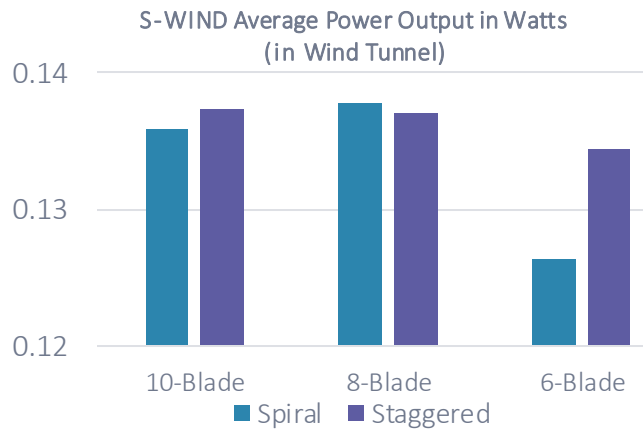
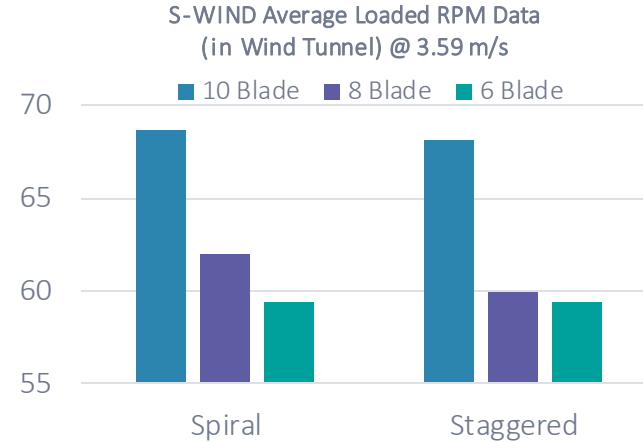
Config.	% Diff.
8-B Spiral	+10.80%
8-B Stgrd.	+14.50%
10-B Stgrd.	+0.78%
6-B Spiral	+15.61%
6-B Stgrd.	+15.57%

8-Blade Spiral Avg. Power Output vs.

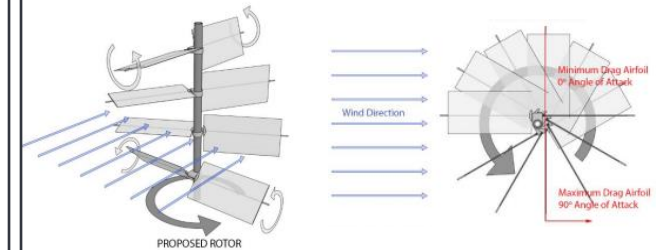
Config.	% Diff.
10-B Spiral	+1.30%
10-B Stgrd.	+0.30%
8-B Stgrd.	+0.50%
6-B Stgrd.	+2.50%
6-B Spiral	+9.03%

10-Blade Spiral Avg. RPM vs.

Config.	% Diff.
H-Rotor	+31.7%



ADDITIONAL FIGURES



Minimized Upwind Angle of Attack Concept



Spiral and Staggered S-WIND Prototype Configurations



Wind Tunnel Setup



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