Vertical Axis Wind Turbine Farm Configuration Efficiency Based on Schools of Fish in Nature

Dieguez, Yenny

Expansive land resources are required to maintain traditional horizontal axis wind turbine farms due to disadvantages imposed by the interaction of adjacent turbine wakes. Horizontal wind turbines have long been recognized as more efficient machines; now however, vertical axis wind turbines (VAWTs) may claim supremacy, as they may actually benefit from such aerodynamic interactions. VAWT farms offer an efficient alternative that may be less costly and more practical. The purpose of this experiment was to design, build, and test a solution that could make this possible, thus increasing the amount of turbines that can work together advantageously within a VAWT Farm. It was investigated if staggering the positions of VAWTs along the z-axis in wave-like patterns could improve the voltage output of previously tested least efficient configurations. The hypothesis stated that if this alteration was applied, then the voltage produced would increase by atleast 10 percent. Wind farm arrangement layouts were designed based on knowledge that was gathered by observing how schooling fish swim. Seven turbine prototypes were engineered and tested in twenty-two different configurations according to previous investigations' best and worst performing configurations within a self-constructed wind tunnel. It was discovered that in a staggered array, the output of VAWTs can indeed increase if the turbines within a row are spinning in the same direction; hence, increasing the amount of turbines that can be arranged in a wind farm. On average, staggering the vertical altitudes of the VAWTs improved the three least efficient configurations by 37.84 percent; thus proving the hypothesis correct.

Awards Won: