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Velocity Pattern Analysis of Multiple Savonius Wind Turbines Arrays

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Abstract:
The right location of an individual wind turbine within a wind farm is important in order to gain its optimal power output. Due to the large area involved, an experimental study can be difficult and non-economical. This paper presents a methodology by which the location of downstream turbines can be estimated by using velocity pattern analysis. A wake structure of an isolated helical Savonius turbine with 90º twist angle is first evaluated by a Sliding mesh method incorporating Reynold Average (RANS) turbulence model Spalart Allmaras. The formation of vortices outside the wake is then observed. It was found that by placing a downstream turbine at the location of the strongest vortex occurrence, in this case within the area between 20º to 90º with respect to the advancing blade of the upstream turbine, produces an enhancement of power coefficient to the later. Repeating the same procedure for another downstream turbine also yields the same result. The last turbine of the line array always experiences the highest power coefficient of all. An application of the concept to a 9 turbine array in a V formation reveals an overall power improvement of 11%. However, placing the downstream turbine in other areas of weaker vortex shows insignificant improvement.