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INFLUENCE OF THE WIND TURBULENCE ON THE STANDARD AND COUNTER-ROTATING VAWT PERFORMANCES

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In urban or offshore areas the wind is fluctuating and unstable with fast changes in direction and intensity. In these environments the use of small vertical axis wind turbines (VAWT) is preferred due to several advantages over horizontal axis wind turbines (HAWT), at least after more thorough studies on the possibility of self-start at relatively low speeds or low Reynolds numbers.

This research is focused on computational investigation on unsteady flow around of a three-blade H-rotor, with various airfoils, at high angles of attack (the standard VAWT configuration). The study is also dedicated to investigating the causes that lead to the inability of the VAWT turbines with fixed pitch and low solidity to self-start with the aim of identifying solutions to overcome them. The consideration of starting behavior, therefore, offers a supplementary solution to improve the overall performance.

In this work a two counter rotating rotors configuration is numerically investigated to determine the efficiency and to fully understand the flow physics structure around it. For this analysis, URANS and LES CFD methods are used, with the proper choice of the turbulence model. Based on the preliminary numerical results, it is estimated that this new unconventional configuration will have greater efficiency, approximately 8% more, compared to a standard VAWT configuration.

Numerical simulations take into account the wind regime at various turbulence intensities to determine possible influences on the self-starting phase and turbine performance. Finally, a proper combination of geometric and flow parameters is determined, suitable for both a self-starting regime at low speeds and for a good efficiency at average wind speeds.

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