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Design and Validation of a Darrieus Type Hydrokinetic Turbine for South African Irrigation Canals Experimentally and Computationally

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Abstract : Utilizing all available renewable energy sources is an ever-growing necessity, this includes a newfound interest into hydrokinetic energy systems, which open the door to installations where conventional hydropower shows no potential. Optimization and obtaining high efficiencies are key in these installations. In this study a vertical axis Darrieus hydrokinetic turbine is designed and constructed to address certain drawbacks experience by axial flow horizontal axis turbines in an irrigation channel. Many horizontal axis turbines have been well developed and optimized to have high efficiencies but depending on the conditions experienced in an open channel, the performance of these turbines may be adversely affected. The study analyses how the designed vertical axis turbine addresses the problems experienced by a horizontal axis turbine while still achieving a satisfactory efficiency. To be able to optimize the vertical axis turbine, a computational fluid dynamics model was validated to the experimental results obtained from the power generated from a test turbine installation operating at various rotational speeds. It was found that an accurate validated model can be obtained through validation of generated power output.

Keywords : hydrokinetic, Darrieus, computational fluid dynamics, vertical axis turbine
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