

3rd International Conference and Exhibition on **Mechanical & Aerospace Engineering**

October 05-07, 2015 San Francisco, USA



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Efficient patterned vertical axis wind turbine farms

A patterned wind turbine farm is a new concept for development of power generation using Vertical Axis Wind Turbines (VAWTs). In this study, we developed efficient patterned vertical axis wind turbine farms that consist of multiples of three VAWT clusters having the same topology with scaled geometrical ratios of the cluster. The farms have high efficiency compared to conventional aligned and staggered farm-layouts. The developed cluster is based on the numerical study of the efficiency of clusters of two VAWTs in parallel and oblique layouts. The numerical model is validated by solving two and three-dimensional turbulent flows through single Savonius and Darrieus VAWTs at different tip speed ratios and the results for the power coefficient show good agreements with the available experimental data. The developed triangular cluster has an enhanced average power coefficient up to 26% higher than that of an isolated turbine. The cluster generates 3.2 times the power generated by an isolated turbine with a power ratio 1:1.2:1 between its individual turbines. The developed farms have the same power scaling factor and power coefficient enhancement ratios of the three turbine cluster. Numerical solutions of farms that consist of nine and twenty-seven turbines confirm the pattern and the enhanced power coefficient. The scaling factor of 3.2 can be used to predict the performance of larger farms with the same topology to save processing time and man power.

Biography

Shaaban Abdallah, a Professor of Aerospace Engineering, has been at the University of Cincinnati since 1989. He obtained his PhD in Aerospace Engineering at the University of Cincinnati in 1980. He joined Penn State University from 1981 to 1988. His research interests include Computational Fluid Dynamics, nano fluids, Turbo-machines, Unmanned Aerial Vehicles and Medical devices. He has two US patents on centrifugal compressors and three disclosures with university of Cincinnati on medical devices.

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