

## Mathematical Modelling of a Low Tip Speed Ratio Wind Turbine for System Design Evaluation

**Authors :** Amir Jalalian-Khakshour, T. N. Croft

**Abstract :** Vertical Axis Wind Turbine (VAWT) systems are becoming increasingly popular as they have a number of advantages over traditional wind turbines. The advantages are reliability, ease of transportation and manufacturing. These attributes could make these technologies useful in developing economies. The performance characteristics of a VAWT are different from a horizontal axis wind turbine, which can be attributed to the low tip speed ratio operation. To unlock the potential of these VAWT systems, the operational behaviour in a number of system topologies and environmental conditions needs to be understood. In this study, a non-linear dynamic simulation method was developed in Matlab and validated against in field data of a large scale, 8-meter rotor diameter prototype. This simulation method has been utilised to determine the performance characteristics of a number of control methods and system topologies. The motivation for this research was to develop a simulation method which accurately captures the operating behaviour and is computationally inexpensive. The model was used to evaluate the performance through parametric studies and optimisation techniques. The study gave useful insights into the applications and energy generation potential of this technology.

**Keywords :** power generation, renewable energy, rotordynamics, wind energy

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