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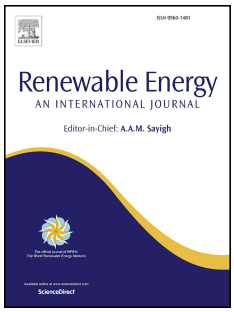


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# Performance Analysis of a Small Wind Turbine Equipped with Flexible Blades

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**Abstract**

Wind turbine efficiency can drop drastically away from design conditions, which is especially troublesome for small fixed-pitch, constant speed types of devices and those operating in highly variable winds. Recent advances in the design of adaptive structures gives rise to a new turbine concept, employing continuous shape morphing, allowing the turbine to adapt more effectively to variable conditions. Such morphing blades could increase energy capture, and help small wind turbines become more economically viable through increased efficiency over a wide range of wind speeds and tip-speed ratios. In this paper, we examine the practicality of a flexible or *morphing* bladed turbine through experimental and numerical analysis. Experiments are conducted comparing a prototype rigid bladed design to an identical flexible one, with a total of 18 data sets containing 230 data points. Experimental results show that the flexible design outperforms the rigid one, especially when experiencing unfavorable loading conditions. Maximal corrected power coefficients were increased in all cases, up to 32.6%. The operational range was also increased in most cases, to a maximum of 34.5% over the rigid bladed design. These results suggest that the flexible design could produce more power than a rigid one, especially when conditions are sub-optimal.

*Keywords:* wind, turbine, flexible, energy, morphing, FSI

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