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Enhancing wind turbines efficiency with passive reconfiguration of flexible blades VINCENT P A COGNET, BENJAMIN THIRIA, PMMH (UMR 7636 CNRS - ESPCI - UPMC Paris 6 - UPD Paris 7 - PSL), SYLVAIN COURRECH DU PONT, MSC (UMR 7057 CNRS - UPD Paris 7), MSC TEAM[1], PMMH TEAM[2]
— Nature provides excellent examples where flexible materials are advantageous in a fluid stream. By folding, leaves decrease the drag caused by air stream; and birds' flapping is much more efficient with flexible wings. Motivated by this, we investigate the effect of flexible blades on the performance of a wind turbine. The effect of chordwise flexible blades is studied both experimentally and theoretically on a small wind turbine in steady state. Four parameters are varied: the wind velocity, the resisting torque, the pitch angle, and the blades bending modulus. We find an optimum efficiency with respect to the bending modulus. By tuning our four parameters, the wind turbine with flexible blades has a high-efficiency range significantly larger than rigid blades', and, furthermore enhances the operating range. These results are all the more important as one of the current issues concerning wind turbines is the enlargement of their operating range. To explain these results, we propose a simple two-dimensional model by discretising the blade along the radius. We take into account the variation of drag and lift coefficients with the bending ability. This model matches experimental observations and demonstrates the contribution of the reconfiguration of the blade.

[1]Matiere et Systemes Complexes
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