

Retrofit Winglets for Wind Turbines

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Wind energy has demonstrated its potential as a renewable energy source. Much research has been devoted to technologies that improve wind turbine efficiency, winglets being among them. Blade tip vortices increase induced drag and affect wind turbine lift generated. This affects power generated and efficiency of turbines. In aircraft, winglets have proven to reduce induced drag. However, winglets tend to increase aircraft bending moments, requiring structural reinforcement and making winglets an expensive proposition. The primary objective of this study is to design a retrofit winglet for a baseline Wind Turbine, and determine economic feasibility. Traditional methods to determine power output of a wind turbine, such as the Blade Element Momentum theory, are insufficient to model a wind turbine with winglets. A Vortex Lattice Method for rotor applications has been developed. Economic feasibility is a key issue in the wind industry today. Accordingly, a cost function that compares design, manufacture and labor costs against increment in power has been developed. These tools, along with researched winglet design philosophy, will be used to determine a beneficial winglet configuration. Lightweight material and careful configuration design will minimize root bending moments, thus mitigating a need for structural reinforcement of the blade. The net result will be a retrofit winglet configuration that, with minimum installation cost, provides improved performance and economic benefit.