소형 풍력발전기 소음 저감을 위한 익형 설계 연구

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Design of Low Noise Airfoil for Use on Small Wind Turbines

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Abstract : Wind power is one of the most reliable renewable energy sources and the installed wind turbine capacities are increasing radically every year. Although wind power has been favored by the public in general, the problem with the impact of wind turbine noise on people living in the vicinity of the turbines has been increased. Low noise wind turbine design is becoming more important as noise is spreading more adverse effect of wind turbine to public. This paper demonstrates the design of 10 kW class wind turbines, each of three blades, a rotor diameter 6.4m, a rated rotating speed 200 rpm and a rated wind speed 10 m/s. The optimized airfoil is dedicated for the 75% spanwise position because the dominant source of a wind turbine blade has been known as trailing edge noise from the outer 25% of the blade. Numerical computations are performed for incompressible flow and for Mach number at 0.145 and for Reynolds numbers at 1.02×10^6 with a lift performance, which is resistant to surface contamination and turbulence intensity. The objective in the low design process is to reduce noise emission, while sustaining high aerodynamic efficiency. Dominant broadband noise sources are predicted by semi-empirical formulas composed of the groundwork by Brooks et al. and Lowson associated with typical wind turbine operation conditions. During the airfoil redesign process, the aerodynamic performance is analyzed to minimize the wind turbine power loss. The results obtained from the design process show that the design method is capable of designing airfoils with reduced noise using a commercial 10 kW class wind turbine blade airfoil as a basis. The new optimized airfoil clearly indicates reduction of total SPL about 3 dB and higher aerodynamic performance.

Key words : Wind turbine(풍력발전기), Airfoil self noise(익형자체소음), Airfoil design(익형설계)

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