

Rapid Modeling And Analysis Of Composite Wind Turbine Blades

Haotian DU

Wind turbine blades are the key component for wind turbines to capture wind energy directly, which are usually made of composite materials and have complex aerodynamic shapes. In the design process of composite blades, it is very important to analyze the structure dynamics of blades accurately and quickly. In this paper, the finite element method, material homogenization method and extended Bredt-Batho shear flow theory are combined to establish a mathematical model for rapid modeling and analysis of composite blades. The Python program is developed, and the NREL 5MW fan blade is taken as the research object to verify the accuracy of the mathematical model, and on this basis, the leading edge cracking of the blade is simulated. The results show that the calculation results of the mathematical model are in good agreement with the finite element analysis data. The beam cap layering angle is an important factor affecting the natural frequency of the blade, and its influence on the natural frequency of the blade is related to the blade vibration mode, which has a great influence on the vibration mainly in the waving direction, and with the increase of the beam cap layering Angle, the natural frequency of the blade gradually decreases. Layer stiffness degradation can be used to simulate blade leading edge cracking damage. The blade leading edge cracking has little effect on the natural frequency, and the modal curvature difference calculated by the mode displacement in the flapping direction can be used as the damage identification index to identify blade leading edge cracking damage effectively.