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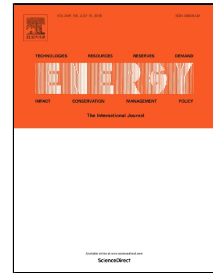
LES simulation and experimental validation of the unsteady aerodynamics of blunt wind turbine airfoils

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1 LES simulation and experimental validation of the 2 unsteady aerodynamics of blunt wind turbine airfoils

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8 **Abstract:**

9 In order to investigate the unsteady performance of blunt wind turbine airfoils caused by
10 boundary layer separation and wake eddies, this paper studies the aerodynamic performance by
11 large eddy simulation (LES) and wind tunnel experiment at a Reynolds number of 2.62×10^5 . The
12 blunt airfoils are obtained by enlarging the trailing edge of the DU 91-W2-250 airfoil to 6% and
13 10% chords symmetrically on both pressure and suction sides of the airfoil. The simulation was
14 carried out with the incompressible finite-volume Navier-Stokes code EllipSys3D; and, the
15 experiment was done in a wind tunnel with a cross-section of $0.5\text{m} \times 0.5\text{m}$ by measuring the
16 surface pressure and wake velocities using ESP-64HD pressure scanner and TSI hot-wire
17 anemometer. The unsteady wake was captured by hot-wire in the wind tunnel, and LES with
18 EllipSys3D. Both experiment and LES show that the spectrum of aerodynamic forces has a
19 broadband nature which is in coincidence with the wake eddies, implying that the unsteady
20 Kármán vortex sheet is the driving mechanism of the force fluctuation. Moreover, the trailing edge
21 size affects the separation bubbles and transition process in the boundary layer. It shows that the
22 boundary layer near the leading edge is unstable in the spanwise direction, which is characterized
23 by low frequency waves.

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