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Investigation of the rotational flow effects in a pitching airfoil genetically optimized for vertical axis wind turbines DANIELE RAGNI, TUDelft, LAURA VITALE, ANDREA IANIRO, Universita' Federico II, BEN GEURTS, CARLOS FERREIRA, TUDelft — In the present study, an airfoil optimized for vertical axis wind turbines applications has been developed with a genetic algorithm, selecting the geometry with maximum $(dc_l/d\alpha)/c_d$ among airfoils generated with 16 shape functions. The airfoil, operating in the curved trajectory of a vertical axis wind turbine, is usually optimized adopting conformal mappings in the straight path. Recent experimental results have shown disagreement with this approach, due to the forces determined in the curved flow path. To investigate the effects of flow rotation, an aluminum model (c=0.25m) has been manufactured from the optimized shape and further tested in the LST tunnel of the TUDelft at Reynolds number 10^6. Planar PIV experiments in combination with the PIV based load determination technique have been performed to simultaneously obtain velocity fields and loads. Results including velocity, pressure distributions, lift and drag are initially discussed in a steady airfoil configuration and compared with numerical results. Successively, the model has been unsteadily pitched using a magnetic linear actuator (up to 3 Hz frequency), with a free stream $V_\infty = 40$ m/s corresponding to Re = 0.7×10^6. Phase locked PIV vector fields have been acquired and compared to the steadily obtained results.

Daniele Ragni
TUDelft

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