Aerodynamic characteristics of trough incident LEP wind turbine blades at various TI

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ABSTRACT:
An assessment of the aerodynamic characteristics of novel bio-inspired Leading-Edge Protuberanced (LEP) wings featuring varying trough incident angles were experimentally evaluated in this paper for different turbulence intensities. A self-developed passive grid was used to generate turbulence intensities ranging from 5% to 10% in the Low-speed subsonic wind tunnel for this present study. NACA 63(4)-021 airfoil model is chosen as the base model as it closely resembles flippers of the humpback whales. All the models were tested for a wide range of angle of attack from $0° \leq \alpha \leq 90°$ at four different Reynolds number in the order of 10_4 to 10_5. To identify the influence of the peak and the trough incident angles, LEP models featuring trough oriented at 4° is evaluated in this study. Results reveal that the peak and the trough incident LEP models are sensitive to turbulence intensities. Aerodynamic force coefficients like lift and drag coefficient both decreases with the increase in the TI while offering a stall delay benefit. Surface pressure distributions uncover the underlying physics behind them explaining the flow characteristics prevalent over the model.

Keywords: Leading-Edge Protuberances (LEP), Surface pressure, time-series, Pressure measurement, Pressure Integration technique, Lift & drag coefficient, stall delay, flow separation.