INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: **Aerodynamic Design and Wind Tunnel Testing of Small Horizontal-axis Wind Turbine for Multirotor Configurations**

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SHORT ABSTRACT

The present investigation explores the applicability of small horizontal-axis wind turbines (SHAWTs) to be employed as a power-generating source in places where energy demand is minimal or as a potential off-grid power source. The design and testing of SHAWT have been carried out at low λ ($0.5 < \lambda < 6$) and low Re ($0.3\times10^5 \leq Re \leq 3\times10^5$) conditions. The rotor blades were designed using the blade element momentum theory and fabricated using the 3D printer. The rotors' performance was tested in the wind tunnel using the rotary torque sensor (RTS). Based on the literature review, airfoil E216 (M1), SG6043 (M2), NACA63415(M3), and NACA0012 (M0) have been chosen for developing the model rotors. From BEMT analysis and experimental investigation, the M1 rotor shows maximum power coefficient of 0.37 and 0.34, respectively. The complexity of the BEMT rotor necessitates the development of a non-BEMT rotor, which in the present study are straight and linear tapered (SLT rotors). The SLT rotors with the root-to-tip chord (C_r/C_t) of 1:1 show favourable results. Furthermore, an in-depth investigation of wake propagation using particle image velocity (PIV) has been carried out. The near wake ($x/R < 6$) study shows the formation of a W-shape. The time-resolve and time-averaged stream wise PIV assessment reveal Gaussian-like (skew) distribution and the presence of two opposite crests, marking the flow movement. The high-fidelity PIV data were then used to develop an ANN-based wake model. It is observed that experimental and ANN-based models can produce much better and more reliable results than their analytical counterparts.