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**Modelling of the fluid structure interaction of the horizontal axis bio-Inspired
wind turbine blade and effect on annual energy production**

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Renewable energy is needed to solve South Africa's energy problem. This paper presents an investigation on the performance of a Horizontal Axis Wind Turbine (HAWT) with bio-inspired blade design. The corrugated albatross-inspired airfoil, GOE174, was generated by modifying the baseline coordinates with amplitude functions. The 2D profile was recreated in 3D blade using Solid Edge and examined in Ansys Fluent 2025R1 CFD simulations for the angles of attack from -60° to 60° . The results showed that lift increased with increasing angle of attack and maximum performance was obtained at about AoA of 50° . Flow separation beyond this critical angle resulted in stall and a drop in lift coefficient. The airfoil was placed in the wind tunnel and held in place by a force gauge rig where lift and drag forces were measured. The amount of lift that an airfoil creates has to do with the angle of attack, speed, and other conditions. The error analysis of CFD and wind tunnel findings was quantified using variance and standard deviation for three test velocities which are 2.08 m/s, 3.47 m/s and 5.36 m/s. The models showed good agreement at low velocity with little inaccuracy $\sigma = 0.156$. Variability increased at moderate velocity $\sigma = 0.322$ and discrepancies rose substantially at high velocity, $\sigma = 0.908$, indicative of turbulence and experimental sensitivity. The comparison with smooth profiles will be done in future research, the study is limited to revealing improved lift stability, delayed stall and increased aerodynamic efficiency. The practical implication is that such designs might be used in real world turbine blades allowing for increased energy capture and operational robustness under changeable wind conditions.