MECHANICAL ENGINEERING STUDENT SEMINAR

Thursday, March 28, 2024, at 12:30, D. Dan and Betty Kahn Building, Room 217.

Conformally Decambered UAV Wings for Vertical Axis Wind Turbine Applications

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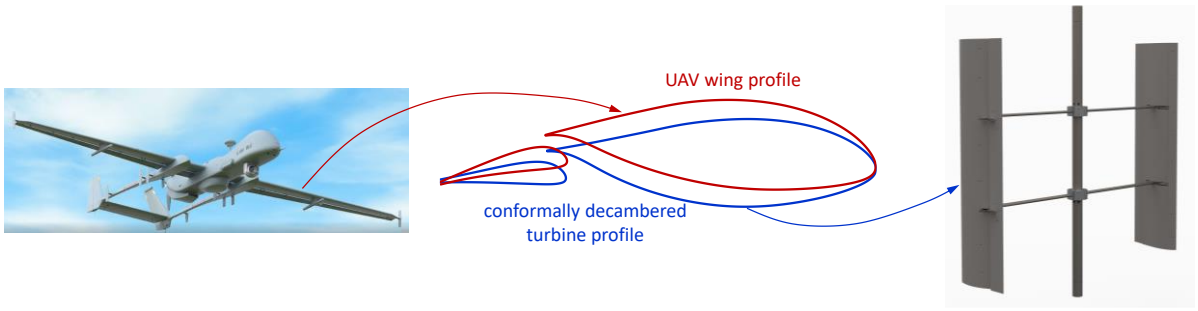
A two-bladed, H-rotor, vertical axis wind turbine with two-element natural laminar flow (NLF) blade profiles – commonly used on subsonic long endurance unmanned air vehicles – was wind-tunnel tested. The NLF selection was based on its high maximum lift coefficient, high aerodynamic efficiency, large positive-lift angle-of-attack range, and gentle stalling characteristics. Turbine blade kinematics were used to establish a "virtual camber-line," which was then used to conformally map the original profile onto the chord-line. Decambered blades showed substantially greater power and torque coefficients than the original NLF profile blades – up to 60% and 27% respectively – which represents the first experimental validation of conformal decambering. Relatively large peak power coefficients of 28% were attained, despite maximum chord-based Reynolds numbers being less than 2×10^5. Depending upon the chord-radius ratio, light or deep dynamic stall occurred in the second upstream quadrant, and the flap flow remained attached virtually throughout. In contrast, on the original profiles, massive separation was observed on the blades, and the flap flow remained separated due to outer surface flow separation. High chord-based Reynolds number ($>10^6$) experiments are presently being planned in Princeton University's High Reynolds number Test Facility.



Note: the seminar will be given in Hebrew