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Dynamic Stall for Wind Energy Generation[1] DAVID KEISAR[2], DAVID GREENBLATT[3], Technion - Israel Institute of Technology — Although insects fly by exploiting the phenomenon of dynamic stall, designers consider it to be both inefficient and potentially damaging. In a break with convention, we show that for a large chord-radius ratio (c/R) vertical axis wind turbine, dynamic stall can be exploited for efficient wind energy generation. Physically, the lift overshoot effects resulting from the dynamic stall vortex (DSV) generate positive torque when the blade dynamic pressure is high while shedding of the DSV occurs when the blade dynamic pressure is low. Blades also experience varying virtual camber and chordwise favorable pressure gradients. An analytical model was developed based on a momentum balance that included the effects of dynamic pitching and virtual cambering together with an empirical data set. Complimentary wind tunnel experiments were performed on a small-scale ($0.4m^2$) turbine. Both the analysis and the experiments illustrated the impact of c/R and the chordwise blade connection point on the effects of dynamic stall. Despite the small scales and low Reynolds numbers, power coefficients of up to 16% were measured and flow visualization confirmed that dynamic stall, with the associated DSV, is the mechanism driving the turbine to maximum power.

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