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Aerodynamic Design of Wing based on Humpback Whale Flipper SAIF AKRAM, FAISAL BAIG, Aligarh Muslim University — The tubercles provide a bio-inspired design that has commercial viability for wing-like structures. Wind tunnel tests at low speeds of model humpback flippers with leading-edge tubercles have demonstrated improvements tubercles make, such as a staggering 32% reduction in drag, 8% improvement in lift, and a 40% increase in angle of attack over smooth flippers before stalling. The tubercles on the leading edge act as a passive-flow control device that improves the performance and maneuverability of the flipper. Possible fluid-dynamic mechanisms for improved performance include delay of stall through generation of a vortex and modification of the boundary layer, and increase in effective span by reduction of both spanwise flow and strength of the tip vortex. In the present work, numerical investigation of a 3D wing with scalloped leading edge inspired by the humpback whale flipper is carried out at high subsonic speeds with variation in angle of attack from 0 to 25 degrees. The effect of using different turbulence models is also investigated in order to attain a better understanding of mechanism(s) responsible for improved aerodynamic performance. This new understanding of humpback whale flipper aerodynamics has strong implications for wing design.

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