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Control of Flow Structure on Non-Slender Delta Wing: Bio-inspired Edge Modifications, Passive Bleeding, and Pulsed Blowing
MEHMET METIN YAVUZ, ALPER CELIK, CENK CETIN, Middle East Technical University — In the present study, different flow control approaches including bio-inspired edge modifications, passive bleeding, and pulsed blowing are introduced and applied for the flow over non-slender delta wing. Experiments are conducted in a low speed wind tunnel for a 45 degree swept delta wing using qualitative and quantitative measurement techniques including laser illuminated smoke visualization, particle image velocimety (PIV), and surface pressure measurements. For the bio-inspired edge modifications, the edges of the wing are modified to dolphin fluke geometry. In addition, the concept of flexion ratio, a ratio depending on the flexible length of animal propulsors such as wings, is introduced. For passive bleeding, directing the free stream air from the pressure side of the planform to the suction side of the wing is applied. For pulsed blowing, periodic air injection through the leading edge of the wing is performed in a square waveform with 25% duty cycle at different excitation frequencies and compared with the steady and no blowing cases. The results indicate that each control approach is quite effective in terms of altering the overall flow structure on the planform. However, the success level, considering the elimination of stall or delaying the vortex breakdown, depends on the parameters in each method.

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