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Investigating the Noise Reduction techniques for Rotor Drones

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Abstract

Noise pollution has increased because of the surge in popularity of micro-air vehicles. The propulsive system and its interface with the airframe must be optimized in terms of aerodynamics and aeroacoustics to solve this problem. The present study reviews noise source mechanisms and control strategies available in the literature for noise suppression, with a focus on the fluid-dynamic aspects of low Reynolds numbers of the propulsive system and the interaction of the propulsive system flow with the airframe. One strategy is the use of trailing edge serrations on multi-copter rotors for noise reduction. Aerodynamic and acoustic performance of isolated multi-copter rotors with different parameters of serrations are compared, and results show that serrated models have lower overall sound pressure level than the baseline model for most cases, contributed by both broadband and tonal noise reductions. Another strategy involves optimizing micro-air vehicle rotor blade geometry through low-cost numerical methods, resulting in an 8 dB(A) reduction in acoustic power according to the literature [1]. Turbulence interaction noise is shown to be a major source of noise in low Reynolds number rotor configurations. Literature provides parametric study on geometric optimization of serrated blades[2]. But there a limited study on the fluid-structure interactions of the serrated blades. Although serrated rotor blades have the potential to enhance aerodynamic and acoustic performance, they may also induce alterations in the flow field surrounding the rotor blades, which could result in instabilities such as flutter. This study aims to examine the optimized geometry of serrated blades and the flutter experienced by the structure. A total of 3 blade designs i.e., sinusoidal, saw-tooth and a half-span are selected for the study. The flow behavior and the loads experienced by the blade is also discussed.

References

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