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Title

Aerodynamic and aero-acoustic effects of applying bio-inspired rotors to a multi- rotorcraft: a numerical study.

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Abstract

With the growing exploration of active and passive noise control systems within the aerospace industry, bio-inspiration has been an ever-prevalent solution [1,2,3]. Additionally, small-unmanned aerial vehicles (UAV's) have become essential to the future optimization of societal and business operations, with their root noise mechanisms studied intensively [4,5], though solutions rarely numerically and experimentally backed on multi- rotor applications. This study therefore intends to capture both issues, presenting numerical test data for a multi-rotorcraft, employing previously tested Neuroptera insect-inspired-, noise-reducing rotors [6]. The aerodynamics and aero-acoustics were resolved through Unsteady Reynolds- Averaged Navier- Stokes (URANS) simulations, within ANSYS Fluent, in addition to near-field and far-field acoustic predictions through direct URANS coupling, and Ffowcs-Williams-Hawkings formulation (FW-H), respectively. Baseline aerodynamic and aero-acoustic validation for a hovering case was achieved using the DJI-9450 rotor, with good agreement generally shown between experimental and numerical data. By examining the near- and far- field noise spectra, changes to observed tonal and broadband noise could be identified on the novel design, compared with the baseline DJI-9450 case.

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