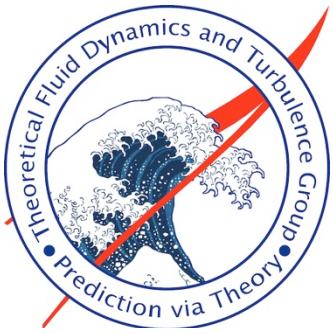
Aeroacoustic and Aerodynamic Interaction Effects Between eVTOL Rotors



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Electric vertical take-off and landing (eVTOL) aircraft are characterized by their unconventional wing and electric rotor configurations, which involve both side-by-side and tandem rotor configurations. These configurations create unique aerodynamic and acoustic flow-fields. We numerically investigate the interaction effects between rotor pairs as well as their individual and combined acoustic radiation. We examine horizontal and vertical spacing, rotor tilt angles, and forward flight effects. Performance is characterized by thrust coefficient, blade passage frequency (BPF) sound pressure level (SPL), and overall sound pressure level (OASPL). This study is performed with a mid-fidelity aerodynamic solver, Dust, which is used to predict the aerodynamic flow-field. The tonal acoustic pressure at observer positions is predicted via the Farassat F-1A solution of the Ffowcs Williams and Hawkings equation utilizing the aerodynamic flow-field. The configurations studied show strong aerodynamic interaction effects in thrust, as well as out-of-plane acoustic radiation from the aft rotor. Base predictions of thrust and noise are validated via experimental measurement. As rotor separation decreases, we observe that aft rotor thrust decreases and BPF SPL increases. The most forward rotor, however, is marginally impacted by the interactions. (This research is supported by Archer Aviation Inc.)