

Lattice-Boltzmann Simulations of a Rotor-Beam Configuration

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In small-size UAVs configurations, rotor-beam interaction noise is an important contributor to the tonal noise. The emergence of harmonics is enhanced by the presence of the beam in the very near wake downstream of the rotor. Distinct and coupled noise source mechanisms occur. Both the rotor blades and the beam radiate sound as both experience unsteady loading due to the presence of each other (see Fig. 1). High-fidelity Lattice-Boltzmann (LBM) simulations are performed, enabling to capture both the aerodynamic and acoustic features involved in this configuration. Results from the performed simulations are compared to previous Navier-Stokes simulation, analytical modeling and experiments carried out on the exact same configuration. Fig. 1 presents similar results for both numerical methods, and a good comparison with two-dimensional potential interaction models for the rotor and the beam. Solid and porous formulations of the Ffowcs Williams and Hawkins acoustic analogy will be compared in the presentation. This acoustic comparison aims at evaluating the importance of the scattered noise contribution in this compact configuration.

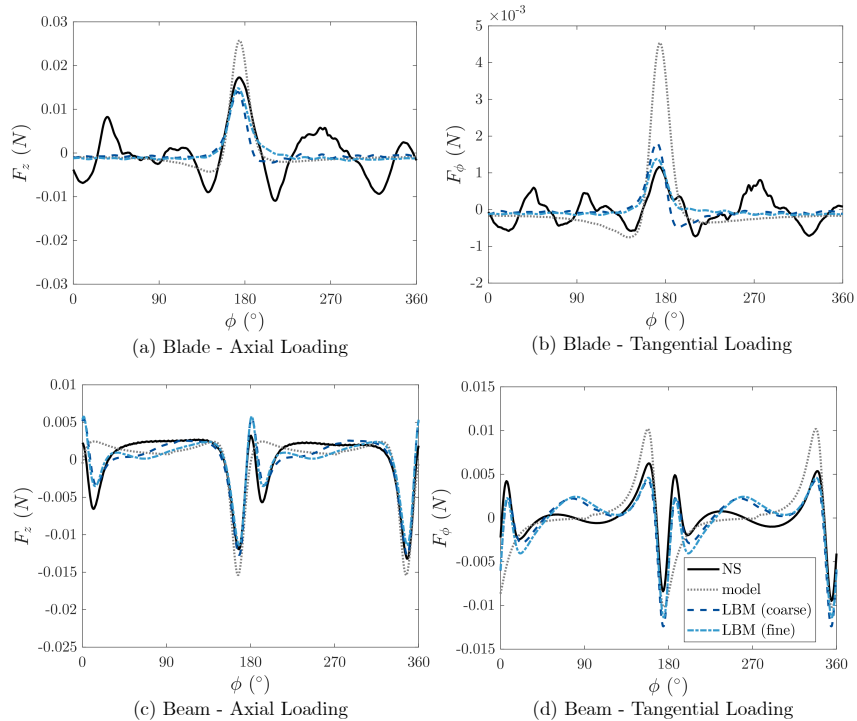


Figure 1: Axial and tangential unsteady loadings on the blade and the beam at 80% of the span.