Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Investigation of tip-vortex instability in the near-wake region of a rotor PRABAKARAN RAJAMANICKAM, LOKESH SILWAL, VRISHANK RAGHAV, Auburn University — Most studies of stability of tip vortices generated from rotors have been focused in the far-field wake, where the vortices are usually modeled as interlaced, helical vortices. In the near wake, due to blade-vortex interactions and a reduction in the cross-sectional area of the slipstream, the tip-vortex configuration deviates from the circular, helical structures found in the far-field wake. These near-wake effects are well captured by the Landgrebe's empricial model for the vortex trajectories. The dependence of near-wake characteristics on the stability of tip vortices becomes significant especially in hovering rotors, where the vortices are convected away from the blade slowly when compared with rotors in forward or, axial flight. The dependence of near-wake characteristics also increases with decreasing thrust coefficients. A linear stability analysis is carried out for the Landgrebe's vortices to predict the growth rate and the instability modes, following closely the classical work of Gupta and Loewy (1974). The predictable quantities from the linear theory are functions of the wake age, with its values approaching the far-field values for very large wake ages. The theoretical results are then compared with the experimental observations conducted in our experimental setup.

Prabakaran Rajamanickam
Auburn University

Date submitted: 10 Aug 2020 Electronic form version 1.4