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CFD-Informed Reduced-Order Modeling of Extreme-Speed Turbochargers[1] DAVID FELLOWS, DANIEL BODONY, University of Illinois at Urbana-Champaign, Champaign, IL, RYAN MCGOWAN, CCDC Army Research Laboratory, Aberdeen Proving Ground, MD — In order to improve their efficiency and performance, aircraft compression-ignition engines often incorporate turbochargers originally designed for ground-based applications. To sufficiently power the aircraft, these turbochargers must operate outside of their standard operating envelopes and consequently encounter high-cycle fatigue brought on by aerodynamically-induced blade resonances. The onset of fluid-structural interactions in turbochargers at these conditions has not been extensively studied. In this talk, we investigate the behavior of the turbine-side of the turbocharger utilizing computational fluid dynamics (CFD) and computational structural dynamics (CSD) methods to understand the mechanisms responsible for turbine blade resonance. A reduced-order model is constructed utilizing the Euler-Lagrange equation. The structural response is described utilizing a method of assumed modes approach, informed by CSD, and the unsteady fluid response is informed by CFD. We specifically investigate the unsteady fluid dynamics model that links blade deformations to the induced surface pressure fluctuations.

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