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Unsteady spectra of velocity field for a canonical dynamic stall process[1] ROHIT GUPTA, University of Illinois at Urbana-Champaign, SABRINA HENNE, KAREN MULLENERS, cole Polytechnique Fdrale de Lausanne, PHILLIP ANSELL, University of Illinois at Urbana-Champaign — Dynamic stall is a multi-scale phenomenon that is commonly associated with airfoils undergoing rapid maneuvers. The knowledge of the dominant modes of instability in the flow field is critical for the design of effective actuation strategies for the control of dynamic stall. The objective of the present investigation was to extract the time-dependent spectral content of the velocity field about a NACA 0012 airfoil model subjected to a linear pitch-up maneuver in a water tunnel at a chord-based Reynolds number of 10^4. This objective was achieved through a novel strategy involving a combination of empirical mode decomposition and the Riesz transformations. The velocity field was acquired using high-fidelity, time-resolved particle image velocimetry. The acquired velocity measurements were processed through the empirical mode decomposition algorithm to obtain a set of oscillatory modes, known as the intrinsic mode functions, and an underlying trend, termed as the residue. The dominant amplitudes and frequencies were extracted through a direct application of the Riesz transform. The resulting velocity field spectra were then analyzed at several critical stages of the dynamic stall process.

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Rohit Gupta
University of Illinois at Urbana-Champaign

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