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Application of FTLE analysis on unsteady flow around pitching airfoils of different amplitude[1] YOUWEI LIU, Syracuse University, DOUGLAS BOHL, Clarkson University, MELISSA GREEN, Syracuse University — The finite-time Lyapunov exponent (FTLE) was used to analyze the unsteady flow around a pitching NACA 0012 airfoil. A total of 15 different cases with fixed $Re_c = 12000$, various amplitudes ($\pm 20°$, $\pm 30°$, $\pm 40°$) and reduced frequencies ($k = 0.2 - 0.6$) were investigated. Phase-averaged particle image velocimetry (PIV) was used to obtain 14 windows of the two-component velocity field, which then were stitched together to obtain a window that was approximately $2.37c$ by $1.65c$. Due to the temporal and spatial resolution of the data set, FTLE results were able to resolve the structure and interaction of leading edge vortices (LEVs) and trailing edge vortices (TEVs), as well as the influences of amplitude and reduced frequency on the formation, shedding and merging of vortices. For the same amplitude, as frequency increases vortices start shedding later, their trajectories stays closer to airfoil surface, and TEVs become weaker. For the same reduced frequency, as the amplitude decreases primary and secondary LEVs form later. The formation of TEVs is highly dependent the combined influence of frequency and amplitude. With a higher frequency and lower amplitude, the area near the TE is dominated by the main LEV, as it remains attached for longer.

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