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Dynamics of Wake-Vortices Deflection Over an Airfoil Using Active Morphing Flaps[1] YOSHIAKI ABE, TAKAYUKI KONISHI, TOMONAGA OKABE, Tohoku University — Dynamics of wake-vortices structures deflected by active morphing flaps were investigated around a NACA0012 airfoil at a low angle of attack. Two-dimensional direct numerical simulations were performed at the chord Reynolds number of 10,000, where the vortex patterns in controlled and noncontrolled wakes were investigated as well as the effect of an actuation frequency on the control ability. It was found that there is an optimum actuation-frequency regime at around $F^+ = 2.00$ which is normalized by the chord length and freestream velocity. Wake vortices of the well-controlled case is classified as the 2P mode according to the Williamsons categorization, where the forced frequency corresponds to the natural vortex shedding frequency without control. Meanwhile, the other synchronized modes do not maintain the wake deflection. We also performed a massive parametric study to construct the map of wake vortex structures with respect to actuation frequency and amplitude, which were systematically classified using a proper orthogonal decomposition. The present classification of wake vortex patterns and finding of the optimum frequency regime in the wake deflection control can lead to a more robust design suitable for vortex-induced-vibration (VIV) related engineering systems.

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