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Reynolds number effect on airfoil wake structures under pitching and heaving motion.[1] KYUNG CHUN KIM[2], HAMIDREZA KARBASIAN[3], School of Mechanical Engineering, Pusan National University, EXPTENSYS TEAM[4] — Detached Eddy Simulation (DES) and particle image velocimetry (PIV) measurements were performed to investigate the wake flow characteristics of an airfoil under pitching and heaving motion. A NACA0012 airfoil was selected for the numerical simulation and experiments were carried out in a wind tunnel and a water tunnel at Reynolds number of 15,000 and 90,000, respectively. The airfoil oscillated around an axis located distance from the leading edge chord. Two different angles of attack, 20 and 30, were selected with 10 maximum amplitude of oscillation. In order to extract the coherent flow structures from time-resolved PIV data, proper orthogonal decomposition (POD) analysis was performed on 1,000 instantaneous realisations for each condition using the method of snapshots. Vorticity contour and velocity profiles for both PIV and DES results are in good agreement for pitching and heaving motion. At high Reynolds number, 3D stream-wise vortices appeared after generating span-wise vortices. The higher maximum angle of attack allows the leading edge vortex to grow stronger and that the angle of attack appears to be more important in influencing the growth of the leading edge vortex structure than the reduced frequency.

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