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Computational Study of Reynolds Number Effect on Owl-like Wing Aerodynamics at Low Reynolds Numbers

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Aerodynamic performance and flow fields around an owl-like airfoil at the Reynolds number of 23,000 and 46,000 are numerically investigated using three-dimensional large-eddy simulations. Especially, the Reynolds number effects on flow fields and aerodynamic characteristics are discussed in this study. Flow separations, transitions and reattachments are observed in both suction and pressure sides for all the conditions we investigated, and those points move to a leading edge direction with increasing the Reynolds number. The movement of those points affects a nonlinearity of C_L-α curve, a magnitude of drag, and the angle of attack for the maximum lift-to-drag ratio. The maximum lift-to-drag ratio at the Reynolds number of 46,000 is found to be approximately 32 at the angle of attack of 3.0 degrees, while that of 23,000 is approximately 23 at the angle of attack of 6.0 degrees.

Keywords: Low Reynolds number flow, Aerodynamics, Reynolds number effect, Large eddy simulations