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Transport and Mixing Phenomena Developed by Vortex Formation in Flow around Airfoil Using Lagrangian Coherent Structures

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Abstract : In this study, mass transport between separation bubbles and the flow around a two-dimensional airfoil are numerically investigated using Lagrangian Coherent Structures (LCSs). Finite Time Lyapunov Exponent (FTLE) technique is used for the computation to identify invariant manifolds and LCSs. Moreover, the Characteristic Base Split (CBS) scheme combined with dual time stepping technique is applied to simulate such transient flow at low Reynolds number. We then investigate the evolution of vortex structures during the transport process with the aid of LCSs. To explore the vortex formation at the surface of the airfoil, the dynamics of separatrix is also taken into account which is formed by the combination of stable-unstable manifolds. The Lagrangian analysis gives a detailed understanding of vortex dynamics and separation bubbles which plays a significant role to explore the performance of the unsteady flow generated by the airfoil. Transport process and flow separation phenomena are studied extensively to analyze the flow pattern by Lagrangian point of view.

Keywords : transport phenomena, CBS Method, vortex formation, Lagrangian Coherent Structures
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