

Fully automated, robust, high-fidelity large-eddy simulation of aircraft flows

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Abstract

In recent years, high-fidelity large-eddy simulation (LES) has shown great success and attracted a lot of attention in investigating high Reynolds number flows, not only in academia but also in industry. This talk discusses our recent studies on fully automated, robust, high-fidelity numerical methodologies based on hierarchical Cartesian meshes for compressible flows. Fully automated grid generation coupled with a robust and non-dissipative numerical scheme that can handle realistic high Reynolds number flows is essential for extending the high-fidelity LES to industrial problems. One of the key elements is our proposed physics-compatible secondary conservation numerical scheme that satisfies the kinetic energy and entropy preservation (KEEP) by discretely satisfying the analytical relations of the governing equations. The KEEP scheme is highly robust without introducing numerical dissipation, something that existing numerical schemes fail to do. The superior robustness stems from the significant improvement of entropy preservation in the KEEP scheme. We also discuss illustrative applications of near-stall and transonic buffeting flows at high Reynolds numbers around complex full aircraft configurations to show the recent capability of high-fidelity simulations and our numerical framework.

Keywords: Large-eddy simulation, Kinetic energy and entropy preserving scheme, Cartesian mesh, Compressible flows, Aircraft flows

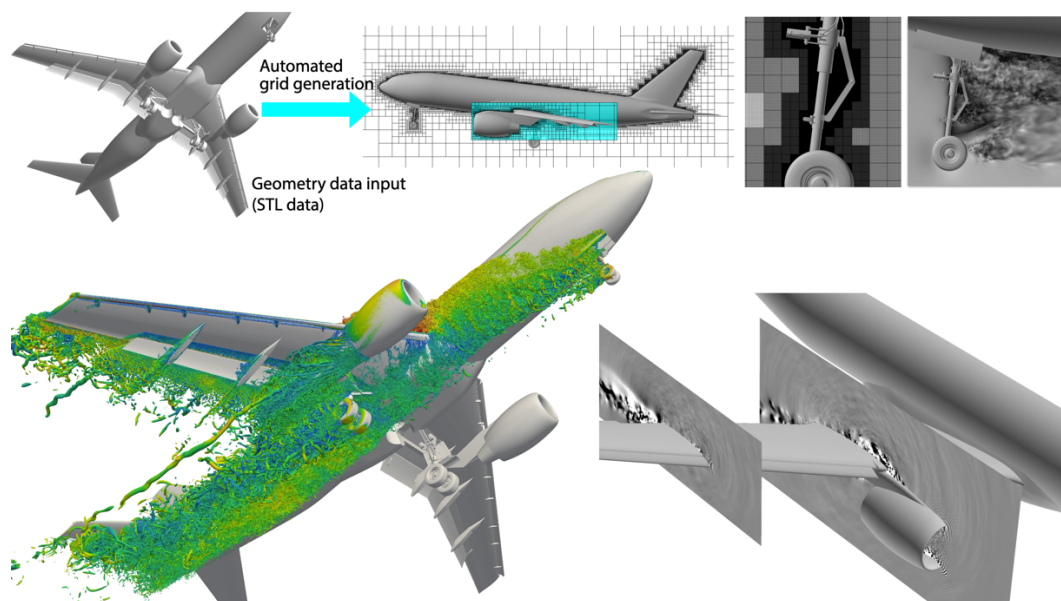


Figure 1. Fully automated high-fidelity large-eddy simulation of aircraft flows at high Reynolds numbers.

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