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High fidelity turbulence simulations with adaptive mesh refinement in Nek5000[1] NICOLAS OFFERMANS, ADAM PEPLINSKI, PHILIPP SCHLATTER, Department of Mechanics, KTH Royal Institute of Technology, Sweden — The design of an adequate mesh is a complex and time-consuming task for users of computational fluid dynamics codes, which typically requires some a priori knowledge of the developing physics. We use adaptive mesh refinement, which combines error estimators and grid adaptation, as a tool for automatic mesh optimization. This strategy allows for better error control and easier mesh generation. Our framework is Nek5000, a highly-scalable code based on the spectral element method. The h-refinement technique is chosen for mesh adaptation, where selected elements are split via an octree structure, and two types of error estimators are considered. The first estimate relies on the local spectral properties of the solution. The second one is goal-oriented and based on the dual-weighted residual method, which requires the computation of an adjoint problem. Applications include direct numerical simulations of 3D turbulent cases such as the flow in a periodically constricted channel, also called periodic hill, and the flow around a NACA4412 wing profile at $Re_c = 850,000$. We ensure that the adaptive simulations are reliable and stable, and we compare the choice of error estimators on the refinement patterns and other relevant flow quantities.

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