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HIGHER ACCURACY ADJUSTABLE METHOD FOR SCALE RESOLVING SIMULATION OF TURBULENT FLOWS ON UNSTRUCTURED MESHES

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Scale resolving approaches are becoming increasingly involved in solving industry-oriented problems of complex configurations. Hybrid RANS-LES methods have been recognized as a good compromise from the accuracy – computational costs point of view for nowadays and the near future. The recent investigations show that their efficiency can be improved by using numerical algorithms better adjusted to the solution and mesh peculiarities.

We develop a adjustable numerical method for scale-resolving simulation of turbulent flows on unstructured meshes. It is built on the higher-accuracy and lower-cost Edge-Based Reconstruction (EBR) [1] numerical scheme and its WENO extension [2] for shock capturing treatments. The EBR scheme is a second-order FV scheme on arbitrary unstructured meshes and reduces to a high-order FD method on translationally invariant meshes. A construction of the adjustable method we develop is based on three basic points: hybridisation, anisotropy and adaptivity. Hybridization assumes an optimal combination of different approximation types (central-difference, upwind, shock-capturing). Anisotropy implies a possibility to vary the methods of calculating numerical fluxes including types of Rieman solvers, stencil widths, weight coefficietnts, etc. at different faces of the control volume. Adaptivity means a possibility of changing the numerical methods' parameters dynamically depending on special analyzers. The development of these "smart" properties of the numerical algorithm is aimed at the reduction of overall computational costs along with gaining maximum possible accuracy and could finally provide the numerical results on unstructured meshes comparable with those obtained by high-order schemes like DG for shorter comutational times.

An efficiency of the numerical algorithm is demonstrated on computations of canonical turbulent flows and more complex problems including hot underexpanded turbulent jet.

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