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WALL MODELLED LES APPROACH FOR SIMULATION OF TURBULENT FLOWS ON UNSTRUCTURED MESHES

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Accurate simulation of complex attached turbulent flows or flows with shallow separation for reasonable time is a challenging issue when industry-oriented aviation configurations are considered. The popular rapidly developing hybrid RANS-LES approaches are widely recognized as a compromise for solving similar problems nowadays and in the near future. A complexity of the industry-oriented configurations demands a usage of unstructured meshes and corresponding higher accuracy robust numerical algorithms. In order to reduce overall computational cost, well developed supporting numerical technologies (such as wall functions, synthetic turbulence generators, etc.) are needed.

We present the numerical algorithm for scale resolving simulation of complex near-wall turbulent flows on unstructured meshes. It is based on the original higher accuracy Edge-Based Reconstruction (EBR) [1] numerical scheme. We use hybrid RANS-LES IDDES method [2] as a wall-modelled LES (WMLES) approach to simulate attached and mildly separated turbulent flows. We develop the method and corresponding techniques to provide unsteady turbulence at the income of WMLES simulation domain. The method for turbulent content generation is built basing on the 3D extension of the Randomized Spectral Method proposed in [3] for aeroacoustics applications. In order to diminish requirements to mesh resolution in boundary layers, the approach based on wall functions is elaborated. The numerical algorithm and corresponding computational techniques are implemented in the in-house code NOISEtte.

Results of simulations of canonical near-wall turbulent flows and more complex configurations will be presented to demonstrate performance of the developed algorithm.

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REFERENCES

[1] P. Bakhvalov, I. Abalakin, T. Kozubskaya, Edge-based reconstruction schemes for unstructured tetrahedral meshes. *Int. J. Numer. Methods Fluids*, Vol. **81**(6), pp. 331–356, 2016.
[2] M.L Shur, P.R. Spalart, M.Kh. Strelets, A.K. Travin, A hybrid RANS-LES approach with delayed-DES and wall-modelled LES capabilities. *Int. J. Heat Fluid Fl.*, Vol. **29**(6), pp. 1638-1649, 2008.
[3] I.A. Borovskaya, T.K. Kozubskaya, O. Kurbanmuradov, K.K. Sabelfeld, On modelling of homogeneous random fields and signals and their applications in aeroacoustics problems, *Math. Model.*, Vol. **19**(10), pp. 76–88, 2007.