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FLOW COMPUTATIONS OF INDUSTRIAL CASES WITH HIGH-ORDER DISCONTINUOUS GALERKIN SCHEME

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This work addresses the application and development of high-order Discontinuous Galerkin method (DGM) to achieve an accurate flow prediction in complex industrial cases.

The current objectives of aerodynamic design require more accurate calculations of aerodynamic characteristics of different aircraft elements, as well as for the full aircraft. The standard computational schemes based on second order finite-volume approach require extremely fine meshes and consequently involve considerable computational resources. It is expected that high-order methods could significantly reduce the required computing resources: memory and computation times.

Still a big effort needs to be undertaken in order to improve the efficiency of these high-order methods, and make them competitive to their low-order counterpart. Vincent and Jameson [1] give a detailed review of the main issues that prevent nowadays the adoption of high-order techniques in industry.

Within European project IDIHOM the applicability of high-order methods for industrial cases, characterized by complex geometries, has been investigated as well as existing high-order techniques to address real flow problems have been improved.

The part of TsAGI and NUMECA International was to develop high order DGM for full Reynolds system of equations closed by a EARSM class turbulence model. High-order spatial discretizations up to order 4 (K = 1, 2, 3) are used for the solution of aerodynamic problems. The method is realized on unstructured hexahedral grids, automatically generated by HEXPRESS™ (NUMECA).

The cases revised in current paper are: NASA Rotor37, MTU T106 Cascade, FALCON representative aircraft, 2D high-lift airfoil and Onera M6 wing. All cases, except FALCON, are widely performed in industry for CFD validation, and for which a large experimental database is available. These cases will exploit the capabilities of a CFD code to handle different flow regimes (subsonic and transonic), rotating periodic geometries, etc, with high-order methods. This paper also tries to analyze the required computer resources in comparison with the widely used second order finite-volume methods.

REFERENCES

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