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HIGHER-ORDER METHODS FOR AEROSPACE APPLICATIONS

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ABSTRACT

Computational Fluid Dynamics is a key enabler for meeting the strategic goals of future air transportation. However, the majority of the aerodynamic simulation tools used in the aeronautical industry for routine applications are based on second-order finite volume methods. In order to produce sufficiently accurate results, very fine meshes with a large number of grid points are required, which in the case of complex applications, lead to enormous computing times. These limitations reduce the scope of innovation in aircraft development, keeping aircraft design at a conservative level.

High-order methods offer the possibility to achieve a fast reduction of approximation errors with only a moderate increase in the number of degrees of freedom. Over the last years the development of efficient higher-order methods for Euler and Navier-Stokes equations has been a hot research topic in academia all over the world. For example, on European level the research project ADIGMA (2006-2009) [1] demonstrated the applicability and high potential of high-order discretization methods to CFD problems encountered in aerospace applications. However, in order to fully exploit this potential, further research effort is required concerning the industrialization of higher-order methods with respect to efficient solvers as well as robust meshing and solution approaches for turbulent high Reynolds number flows around complex 3D configurations. Furthermore, the impact of higher-order discretization methods on advanced approaches to modelling of unsteady turbulent flows needs to be investigated in view of new design concepts. These research areas are addressed in the 7th European Research framework programme project IDIHOM (2010-2013).

This mini-symposium will give on overview of the achievements of the European initiative IDIHOM. Among others the following topics will be addressed:

- Development of higher-order methods for the solution of Reynolds Averaged Navier Stokes equations;
- Development of memory-lean iterative solution techniques for higher-order discretization methods for large-scale high Reynolds number computations;
- Enhancements concerning generation of higher-order grids for complex 3D geometries;
- Development of innovative grid adaptation techniques and error estimators;
- Higher-order discretization methods applied to unsteady turbulent flow simulation with focus on scale resolving properties;
- Assessment of advanced higher-order methods with state-of-the-art industrial CFD solvers for external and internal aerodynamic test cases.

Participation is open not only to participants of the project, but to any researcher in the above mentioned fields.

REFERENCES

[1] N. Kroll, H. Bieler, H. Deconinck, V. Couaillier, H. van der Ven, K. Sorensen (Eds.) "ADIGMA – A European Initiative on the Development of Adaptive Higher-Order Variational Methods for Aerospace Applications", *Notes on Numerical Fluid Mechanics and Multidisciplinary Design*, Vol. 113, Springer, (2010).