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Advances on the application of the FV-MLS method for the compressible Euler and Navier-Stokes equations to high accuracy demanding applications.

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ABSTRACT

Nowadays, in CFD there is a need of high accuracy methods for problems in which is essential to capture the fine features of the flow. Pseudospectral methods and finite differences schemes are commonly used in such high-accuracy demanding applications, as computational aeroacoustics or the simulation of turbulent flows. These methods are unbeatable, both in terms of accuracy and efficiency, by unstructured-grid approaches. For rather complex geometries, however, even though the use of multiblock grids allows the use of structured grid procedures, unstructured-grids methods are a reasonable option. But this kind of methods presents several problems for its application to real problems, some of them suffer a great increase of the computational resources and many others have difficulties for the evaluation of high order derivatives of the variables.

A high order method (FV-MLS) well-suited for the application in unstructured grids has recently been presented in [1]. This method is based on the application of a meshfree technique (Moving Least Squares) in a Finite Volume framework. One of the advantages of this method is the increase of the order of accuracy without raising the number of degrees of freedom. Another interesting feature is the treatment of viscous terms in the Navier-Stokes equations. The use of Moving Least Squares allows to compute these terms directly at integration points. This procedure leads to a very clear and accurate approximation of the viscous flux. In fact, with this technique it is possible to obtain the same order of accuracy for this terms than for the convective ones. Moreover, since the FV-MLS method is a finite-volume solver, it is possible to use any of the shock capturing techniques developed for the finite volume method, being very good its behavior in presence of discontinuities.

Regardless of these very promising features of the FV-MLS method and its very good results on our test computations [1, 2], there still remains the question about its suitability for more difficult and demanding problems such as the application to turbulent flows and to aeroacoustics applications.

In this contribution, we try to answer to this question. We present some numerical examples of the application of the FV-MLS method to high accuracy demanding problems, both in the field of aeroacoustics and turbulent flows.

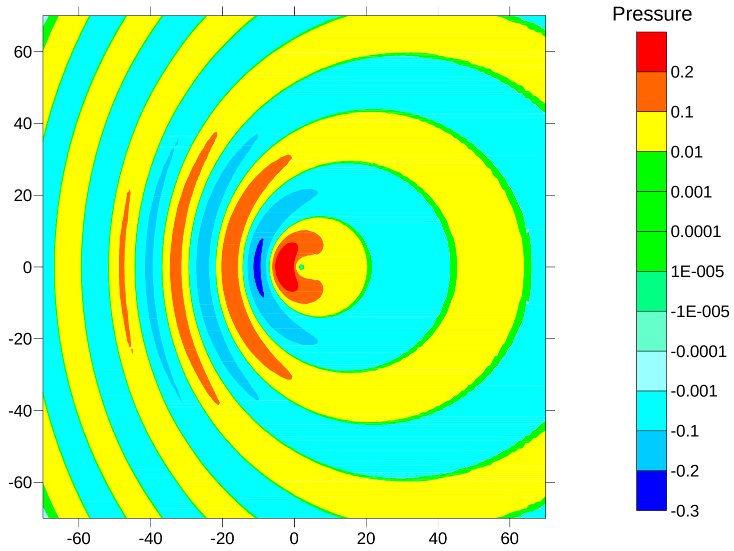

Figure 1: Periodic acoustic source in uniform mean subsonic flow, with Mach number 0.5. Instantaneous pressure contours at t=192.

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