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Comparing the resolution power of standard finite difference and spectral difference schemes

Julien Vanharen[1], Guillaume Puigt[1], Xavier Vasseur[2],
Jean-François Boussuge[1], Pierre Sagaut[3]

[1] Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique (CERFACS), CFD Team, 42 avenue Gaspard Coriolis, 31057 Toulouse Cedex 1, France

[2] ISAE-SUPAERO, 10 avenue Edouard Belin, BP 54032, 31055 Toulouse Cedex 4, France

[3] Aix-Marseille Univ, CNRS, Centrale Marseille, M2P2 UMR 7340, 13451 Marseille, France

Abstract: The spectral analysis is a basic tool to characterise the behaviour of any convection scheme. By nature, the solution projected onto the Fourier basis enables to estimate the dissipation and the dispersion associated with the spatial discretisation of the hyperbolic linear problem. Such an approach is the prerequisite to define the associated Points Per Wavelength -PPW- for capturing the solution wavelength with a given mesh refinement.

This presentation follows the one entitled *Revisiting the spectral analysis for high-order spectral discontinuous methods*. In the first presentation, a new theoretical framework was introduced to explain the spectral behaviour of the spectral difference scheme. Here, we wish to compare the accuracy of the spectral difference scheme and the one for standard finite difference schemes applied to aeroacoustics. Such an analysis is a prerequisite to show that the spectral resolution of the spectral difference method is in strong agreement with the spectral resolution of well-established schemes for aeroacoustics.

In practice, the two standard finite difference schemes (applied to aeroacoustics) are the 6th order compact scheme of Lele [1] and a 4th order DRP scheme developed by Bogey and Bailly [2]. They are coupled with their relative filters and with a low-dissipation low-dispersion time integration procedure.

It is finally shown that the Spectral Difference method is as accurate as (or even more accurate) than the considered Finite Difference schemes. As a consequence, the Spectral Difference approach is a good candidate to perform accurate unsteady Large Eddy Simulations.

Keywords: space-time spectral analysis, spectral discontinuous, finite difference, aeroacoustics.

References

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