MEMORY AND CPU EFFICIENT ITERATIVE SCHEMES FOR HIGHER ORDER DGM

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ABSTRACT

The discontinuous Galerkin method (DGM) has attracted quite some interest from the CFD community over the last few years, as people are looking for a high-resolution alternative to the finite volume method, that would provide high mesh convergence rates for steady RANS, and low dissipation and dispersion errors for unsteady LES and DES computations on unstructured meshes.

Of the many methods under investigation, the discontinuous Galerkin method seems very promising, not in the least due to its data locality allowing us to consider the method as a hybrid between a structured method, avoiding indirect addressing at the element level - and an unstructured method, providing geometrical flexibility. This feature may be used to obtain a very efficient Newton-Krylov-ILU iterative procedure, especially if single-precision preconditioners are used, as shown in [1].

Although the Newton-Krylov-ILU provides high CPU efficiency it remains impractical, since the memory consumption remains high, even when single precision preconditioners are used. In order to avoid the construction of the (fine-level) Jacobian matrix, we investigate the CPU performance of combinations of p-multigrid and Newton-Krylov iterations, either featuring parallel Newton-Krylov/Gauss iterations to provide high-quality coarse level updates for the p-multigrid cycles as in [2], or using p-multigrid as a preconditioner for the Newton-Krylov iterations.

REFERENCES

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[2] K. Hillewaert, N. Chevaugeon, P. Geuzaine and J.-F. Remacle, Hierarchic multigrid iteration strategy for the discontinuous Galerkin solution of the steady Euler equations, *International Journal for Numerical Methods in Fluids*, Vol. 51(9-10):1157-1176