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Recent advances in high order numerical methods for fluid dynamics

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SUMMARY

We present the latest developments of our **H**igh-**O**rder **S**pectral **E**lement **S**olver (HORSES3D), [1], an open source high-order discontinuous Galerkin framework, capable of solving a variety of flow applications, including compressible flows (with or without shocks), incompressible flows, various RANS and LES turbulence models, particle dynamics, multiphase flows, and aeroacoustics.

Recent developments allow us to simulate challenging multiphysics including turbulent flows, multiphase and moving bodies, using local p-adaption and fast multigrid time advancement. In addition, we also present recent work that couples Machine Learning techniques and high order simulations [2, 3, 4].

Keywords: high order discontinuous Galerkin, machine learning

AMS Classification: 35 (pdes), 65 (num analysis), 76 (fluids)

References

[1] E Ferrer, G Rubio, G Ntoukas, W Laskowski, O Mario, S Colombo, A. Mateo-Gabn, F Manrique de Lara, D Huergo, J Manzanero, AM Rueda-Ramrez, DA Kopriva, E Valero. HORSES3D: a high order discontinuous Galerkin solver for flow simulations and multi-physic applications. *arXiv:2206.09733*, 2022.

[2] F Manrique de Lara, E Ferrer. Accelerating High Order Discontinuous Galerkin solvers using Neural Networks: 1D Burgers' equation. *Computers & Fluids* **235**(), 2022.

[3] F Manrique de Lara, E Ferrer. Accelerating High Order Discontinuous Galerkin solvers using Neural Networks: 3D Navier-Stokes equations. *Under review*, 2022.

[4] KE Otmani, G Ntoukas, E Ferrer. Towards a robust detection of flow regions using unsupervised Machine Learning. *Under review*, 2022.

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