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Accelerating High Order Discontinuous Galerkin solvers using neural networks

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High order discontinuous Galerkin methods, e.g. [1,2] allow accurate solutions by high order polynomials inside each mesh element. Increasing the polynomial order leads to high accuracy, but increases the cost. On the one hand, high order polynomials require more restrictive time steps when using explicit temporal schemes, and on the other hand, the quadrature rules lead to more costly evaluations per iteration.

We propose to accelerate high order discontinuous Galerkin methods using Neural Networks. To this aim, we train a Neural Networks using a high order discretisation to extract a corrective forcing that can be applied to a low order solution to recover high order accuracy. With this corrective forcing term, we can run a low order solution (low cost) and correct the solution to obtain high order accuracy. We provide examples and discuss the accelerations obtained for 1D Burger's [3] and 3D Navier-Stokes simulations.

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