A Moving Discontinuous Galerkin Method with Interface Condition Enforcement: Overview and a Least-Squares/DPG Formulation

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The Moving Discontinuous Galerkin Method with Interface Condition Enforcement (MDG-ICE), introduced by the present authors [1, 2], can accurately and stably compute flows with interfaces, without relying on interface or shock capturing. In order to detect a priori unknown interfaces, MDG-ICE uses a weak formulation that enforces the conservation law and its interface condition separately, while treating the discrete domain geometry as a variable. Thus, in contrast to the standard discontinuous Galerkin (DG) method, MDG-ICE has both the means to detect via interface condition enforcement and satisfy via grid movement the conservation law and its associated interface condition. As a result, optimal high-order convergence upon grid refinement, as well as exponential convergence using polynomial refinement, is possible in the presence of discontinuous interfaces. We review prior formulations based on a minimum residual nonlinear solver at the discrete level, and describe recently developed FOSLS/DPG-type formulations, in which optimal test functions corresponding to the linearization of the residual with respect to both the flow state variable as well as the grid are systematically generated. Results of applying this method to compute non-trivial flow problems will be presented.

[1] A. Corrigan, and A. Kercher, and D. Kessler, A Moving Discontinuous Galerkin Finite Element Method for Flows with Interfaces. Technical Report NRL/MR/604017-9765, U.S. Naval Research Laboratory, December 2017.

[2] A. Corrigan, and A. Kercher, and D. Kessler, A Moving Discontinuous Galerkin Finite Element Method for Flows with Interfaces. *International Journal for Numerical Methods in Fluids*, 89(9):362406, 2019.