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An Enriched-Basis Discontinuous Galerkin Method for Wall-Modeled Large-Eddy Simulations[1] STEVEN R. BRILL, MATTHIAS IHME, Stanford University — We developed an enriched-basis discontinuous Galerkin (DG) method for wall-modeled large-eddy simulations (WMLES) of turbulent flows. Ordinarily, higher-order methods, such as DG-schemes, require significant mesh refinement near the wall in order to resolve the turbulent boundary layer without spurious oscillations due to large gradients in the boundary layer. To avoid this issue, we enrich the traditional polynomial basis with a problem-specific non-polynomial basis function in the near-wall elements in order to capture the inner boundary-layer structure while still using a coarse mesh. In this method, the enrichment function is not required to be active, but is chosen by the Galerkin procedure when it is optimal, such as near the wall. As a result, the enrichment basis functions capture the mean behavior near the wall, the polynomial basis functions resolve the large eddies, and a subgrid scale model represents the small scale behavior. We discuss the procedure for choosing the proper enrichment functions for a problem and integrating non-polynomial basis functions into the DG framework. The method is demonstrated in application to turbulent channel flows and other canonical wall-bounded turbulent flows.

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