SIAC Filtering for Boundary Filtering over Nonuniform Mesh Structures

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The Smoothness-Increasing and Accuracy-Conserving (SIAC) filtering technique is a post-processing technique that is used to improve numerical approximations. This technique enables improvement in the existing numerical results with both accuracy and smoothness with little computational cost. However, the traditional SIAC filter requires a uniform mesh and periodic boundary conditions that are usually not feasible in practical applications. We present a new boundary SIAC filter for Discontinuous Galerkin (DG) methods that can be applied to nonuniform meshes. The problem with filtering at the boundary problem is solved adding a special B-spline. The main idea for dealing the nonuniform mesh is the definition of the 'structuredness' of a nonuniform mesh that serves as a parameter of the SIAC filter to keeping the highest accuracy of the filtered solution. Numerical examples are shown to verify the accuracy of the filter for nonlinear problems containing shocks. This new technique allows us to overcome the requirements of having periodic boundary conditions and reveal a meaningful SIAC filtered solution for general mesh structures.

Keywords: Discontinuous Galerkin, SIAC Filtering, Boundary, Nonuniform Mesh, High Order Methods.