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Sparse Grids for Spectral Elements Using L-Galerkin Methods.

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Abstract:

The Continuous Spectral Element approach (CG) is generalized in two ways: Rather than using the full grid, a reduced grid is used. The reduced grid consists of grid-points at corners and edges of cells. Points in the interior of a cell are unused. The numerical treatment is dependent on local (L-Galerkin) operators. which map discontinuous functions to a continuous field representation. The second generalization consists of defining a number of L-Galerkin operators. The usual quadrature approximation is one example, equivalent to averaging at discontinuities, One example for another L-Galerkin operator is pre-regularisation. The pre-regularisation method can be based on any high order finite difference scheme for corner points. The time derivatives for points at edges can then be defined such that the whole scheme is conserving. A regular choice of points is possible and gives the same result as GL points with pre-regularisation. Linear analysis and a convergence test on the sphere are presented. The reduced grid is based on serendipity basis function interpolation, which is available for triangular and quadrilateral cells. By using diagnostic points, other cell shapes, such as hexagons, are possible.