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Title:

Spherical harmonics-based numerical quadrature over a sphere

Abstract:

PDE solutions over a sphere usually need to be supplemented by evaluations of various globally integrated quantities, such as total mass, energy, or average temperature. Different PDE techniques, such as discontinuous Galerkin, double Fourier, Spherical transform, RBF-generated finite differences (RBF-FD), etc. are based on different types of node sets, ranging from highly structured (e.g. lat-long and cubed sphere) to fully unstructured (e.g. ME: minimal energy, as derived from electrostatic repulsion).

The intrinsic 'mismatch' between spherical harmonics and lat-long grids is well known. Previous literature has concluded that a similar mismatch will adversely affect the ability for accurate quadrature when using scattered node sets. We make a simple observation which entirely reverses this picture, showing that such nodes, and in particular ME sets, in fact are extremely well suited for highly accurate quadrature.