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SIAM Journal on Numerical Analysis

Dear Editor,

Please find attached a manuscript that we would like to submit for publication in the SIAM Journal on Numerical Analysis.

In the paper we present spectral discretizations for transport and advection PDEs, which preserve many of the qualities of transport and advection. For example, the operation of multiplying functions on a manifold can be viewed as bilinear operator on $C(M)$. The evolution of the transport equation preserves this infinite dimensional operator. Our discretization manages to conserve a discrete analog of function multiplication, and this discrete-multiplication operator converges spectrally to the traditional notion of function multiplication. Standard spectral Galerkin and pseudo-spectral discretizations do not admit such a conservation law. This is merely one of many conservation laws addressed in the paper.

These preservation properties are tantamount to achieving stable numerical algorithms with robust behavior. In comparison to a standard spectral Galerkin discretizations, we observe superior behavior with respect to relevant norms (i.e. the sup-norm for functions and the L^1-norm for densities) across a range of resolutions. This discretization is of immediate relevance to a broad readership interested in discretizations for optimal control and imaging when a user requires particularly low resolutions without sacrificing robustness.

The paper is 23 pages in length, which we hope is acceptable. We have strived to reduce the page length without sacrificing too much content. A few theoretical results were discarded in this process. We have found further reductions to be difficult to accomplish without sacrificing the main theorems of the paper or throwing out the numerical validation section entirely.

Sincerely,
Henry O. Jacobs