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A mass-conserving sparse grid combination technique with biorthogonal hierarchical basis functions

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Grid-based solvers for the simulation of kinetic equations suffer from the curse of dimensionality. The sparse grid combination technique is a means to reduce the number of degrees of freedom in high dimensions, however, the hierarchical representation for the combination step with the state-of-the-art hat functions suffers from poor conservation properties and numerical instability.
We introduce two new variants of hierarchical multiscale basis functions for use with the combination technique: the biorthogonal and full weighting bases. The new basis functions conserve the total mass and are shown to significantly increase accuracy for a finite-volume solution of constant advection. Further numerical experiments based on the combination technique applied to a semi-Lagrangian Vlasov–Poisson solver show a stabilizing effect of the new bases on the simulations.

This is joint work with Theresa Pollinger, Johannes Rentrop und Dirk Pflüger.

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