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ALGEBRAIC LINEARITY PRESERVING LIMITERS FOR COMPRESSIBLE FLOW PROBLEMS*

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This talk presents an extension to the algebraic flux correction (AFC) linearity preserving flux limiter (LPFL) developed for scalar conservation laws to compressible flow problems. The ultimate goal of our approach is to develop a high-resolution method that can be easily and robustly applied to a variety of coupled partial differential equations (PDE). In this regard the appeal of the AFC framework is that stabilizing diffusion is constructed in a parameter free algebraic way by simple manipulation of the discrete linear operators derived from a Galerkin discretization of the PDE. To facilitate an initial implementation with broad applicability we explore the use of scalar dissipation (e.g. Rusanov). Methods from the AFC framework use the artificial diffusion operator to construct nodal anti-diffusive fluxes defined on the matrix graph. Effective limiting of these fluxes requires the satisfaction of bounds that enforce a local extremum diminishing property. Based on the LPFL for scalar diffusion from [1] we develop a new limiter for the compressible flow equations that does not have the time step constraints as the Zalasak limiter for compressible flow [2]. We will present results demonstrating the performance of the new method, both in terms of accuracy but also in the context of the performance of an algebraic multigrid preconditioner.

REFERENCES

[1] D. Kuzmin, Algebraic Flux Correction I: Scalar Conservation Laws, In *Flux-Corrected Transport*, Scientific Computation, pages 145–192. Springer, 2012.

[2] D. Kuzmin, M. Möller, and M. Gurris, Algebraic Flux Correction II: Compressible Flow Problems, In *Flux-Corrected Transport*, Scientific Computation, pages 193–238. Springer, 2012.

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