High accurate monotonicity-preserving Semi-Lagrangian scheme for Vlasov-Poisson Simulations

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We study a high accurate monotonicity-preserving (MP) Semi-Lagrangian scheme for Vlasov-Poisson simulations. The classical Semi-Lagrangian scheme with Lagrange interpolation of degree $2d+1$ is known to be high accurate and free from CFL condition, but it does not satisfy local maximum principle. To remedy this drawback, using the conservative form of the Semi-Lagrangian scheme, we recast existing MP schemes for the numerical flux in a common framework, and then substitute the local minimum/maximum by some "better" guess, in order to avoid as much as possible loss of accuracy and clipping near extrema, while keeping the monotonicity on monotone portions. With the limiter, on the one hand, the scheme keeps the good properties of the unlimited scheme: it is conservative, free from CFL condition and high accurate. On the other hand, for locally monotonic data, the monotonicity of the solution is preserved. Numerical tests are made on free transport equation and Vlasov-Poisson system.

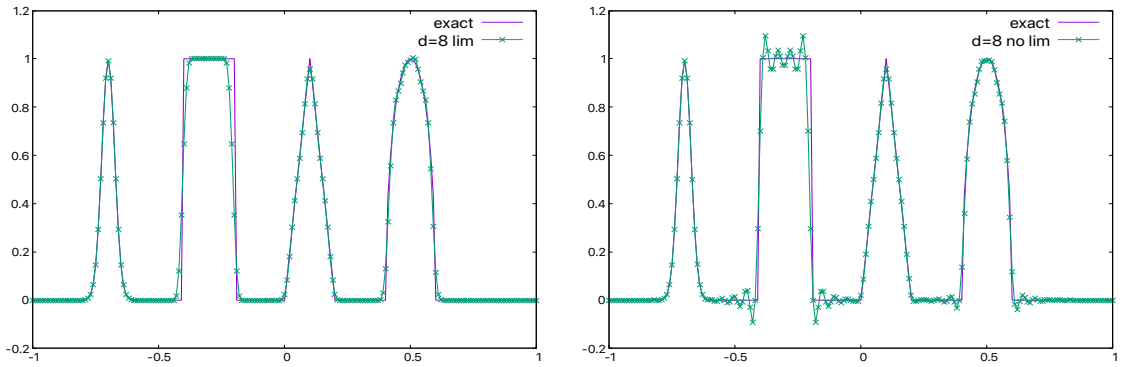

Figure 1: Free transport equation. Left: with limiter; right: without limiter

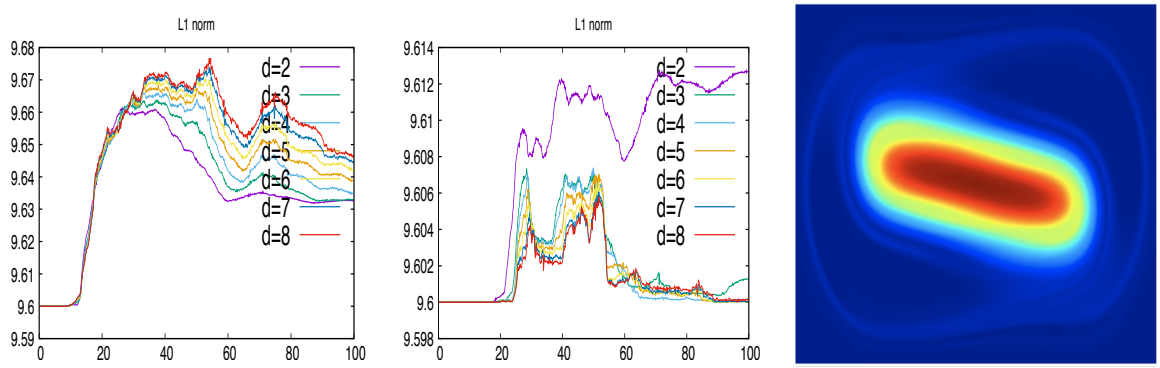

Figure 2: Vlasov-Poisson system. L^1-norm with/without limiter (left/middle); $f(T=100)$ (right)

References

[1] Chang Yang, Michel Mehrenberger, *High accurate monotonicity-preserving Semi-Lagrangian scheme for Vlasov-Poisson Simulations*, in clearance procedure, before submission.

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