Positivity-preserving time discretizations for production-destruction equations with applications to non-equilibrium flows.

In this talk, we will present a family of second-order and third-order modified Patankar Runge-Kutta (MPRK) methods, which are conservative and unconditionally positivity-preserving, for production-destruction equations. We derive necessary and sufficient conditions to obtain the designed order of accuracy. This ordinary differential equation solver is then extended to solve a class of semi-discrete schemes for PDEs. Combining this time integration method with the positivity-preserving finite difference weighted essentially non-oscillatory (WENO) schemes, we successfully obtain a positivity-preserving WENO scheme for non-equilibrium flows. Various numerical tests are reported to demonstrate the effectiveness of the methods. (Received February 03, 2020)