Does kinetic theory really contribute to shock-capturing schemes for compressible gas-dynamic equations?

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Shock-capturing schemes for the compressible Euler/Navier-Stokes equations have been earnestly studied by plenty of researchers. Nowadays a lot of people in various fields of science and technology benefit from the outcome. It sounds, nevertheless, a bit too exaggerative to say that the shock-capturing technology presently available is well-matured; even the most advanced schemes at present still exhibit anomalous behaviors, such as the carbuncle phenomenon and post-shock oscillations, which should not be overlooked. The robustness of the shock-capturing schemes based on kinetic theory, i.e. kinetic schemes, are well-known. Pullin's equilibrium flux method (EFM), which is also called1st order kinetic flux vector splitting scheme (KFVS), is carbuncle free. This 1st order kinetic scheme is not useful for practical purpose because of low accuracy and some improvements for the increase in the accuracy have been proposed. The resulting kinetic schemes, such as 2nd order KFVS and !

Xu's gas-kinetic BGK scheme, lose the resistance to shock anomalies, however. In the present talk, we will propose a very simple remedy against carbuncle phenomenon in 2nd order kinetic schemes. The performance of the modified kinetic scheme will be demonstrated in the problem of a hypersonic inviscid or viscous flow past a blunt body. Comparisons will be made with various advanced shock-capturing schemes at present. Lastly, we will discuss whether kinetic theory really contributes to the robustness or not.