Modern numerical methods for the simulation of laser-induced shock waves

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In this work a comparative analysis of several modern high-order numerical methods is conducted with a view to solving continuum mechanics problems with laser-induced shock waves. Such problems are characterised with high-intensity shocks and non-ideal equations of state (EOS) [1]. We confirm that for our problems with a Mie–Grüneisen-type EOS the spurious oscillations naturally occurring with the usage of the high-order methods still reduce their amplitude to manageable levels with characteristic-wise decomposition for up to 5th-order WENO, but remain high for higher-order methods and smooth out enough only with the MPWENO family of schemes [2]. We observe that the high dissipation of the numerical flux becomes less and less noticeable as the order of the WENO reconstruction is increased. We also show that a new combination of recently suggested WENO-S weights [3] with the FM-mapping [4] coupled with MP-limiting works reasonably well on our test cases (though not without some unphysical kinks). We follow a method-of-lines approach with high-order SSP two-step explicit Runge–Kutta methods for integration in time [5].

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