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AN OSCILLATION LIMITING AND FLUX CONSERVING MESHFREE FORMULATION FOR SHOCK MODELING

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High rate impulsive loading can generate hydrodynamic processes where shocks give rise to state and field variable discontinuities. The essential shock physics include the Rankine-Hugoniot (R-H) jump condition and the second law of thermodynamics for entropy production. Oscillatory instabilities in the form of Gibbs phenomenon occur at the jump when higher-order methods are used to approximate the discontinuous solution. In this work a stable (oscillation limiting) and flux conserved formulation under the reproducing kernel particle method framework is developed for shock modeling. The Rankine-Hugoniot condition is naturally satisfied and correct shock speed is obtained under the appropriate weak form. A Riemann-embedded flux divergence operator, formulated under the framework of stabilized conforming nodal integration, guarantees correct entropy production and flux conservation and thus produces the correct shock propagation, while a Godunov-type flux-corrected velocity limits shock oscillation. The Godunov velocity correction for oscillation limiting is constrained to the shock region using a detection algorithm based on the reproducing kernel spectral decomposition property, so that higher-order accuracy is maintained elsewhere in the domain.