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High Order Discontinuous Galerkin Positivity-Preserving Numerical Simulation of Condensed Explosives Detonation

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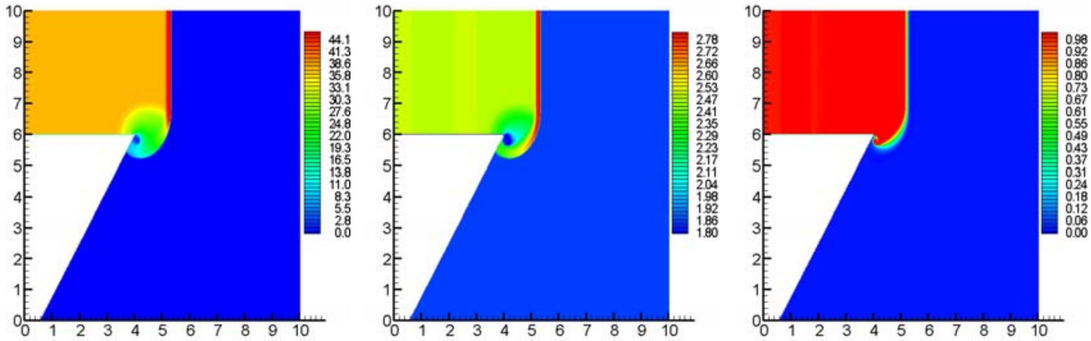
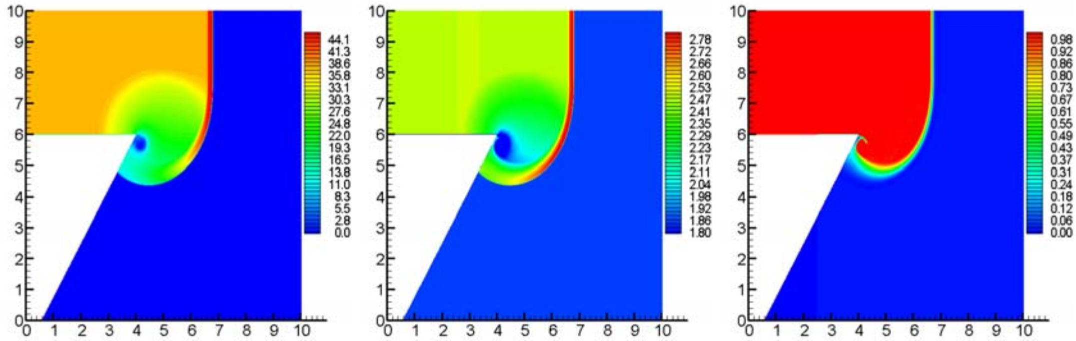
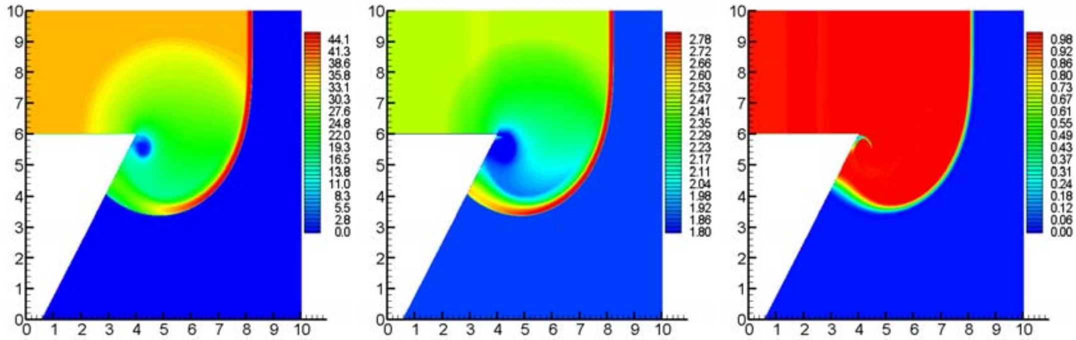
The detonation wave diffraction phenomena is an important issue for condense explosives detonation. When the wave propagates forward and encounters a corner, the corner will lead the detonation wave to curve and spread downward. Affected by wave expansion, low pressure and low density form. As a result of the numerical scheme error, the density, pressure and chemical reaction progress in these areas may be negative. Compared with gas detonation, the condensed explosive detonation has higher detonation velocity and pressure, which is more likely to lead to this kind of circumstance. It always runs counter to the actual physical process and causes blow-ups, so it should be urgently dealt with. High order discontinuous Galerkin positivity-preserving scheme for two-dimensional Euler equations is proposed, and the enforcement of positivity-preserving scheme in rectangular and triangular meshes is discussed. As shown in Fig 1, after the detonation wave expansion at the corner, the low pressure cause only a little of explosive reaction. At 0.37 μs in Fig 2, the reaction progress maximum 0.2 appears near the corner point, which then decline to 0.08 rapidly along the inner wall downwards. Afterwards, it experience remaining the same value from 0.2mm to 0.4mm distance and then decline to 0 gradually. It contributed minimally to pressure increasing, but with high particle speed, the vetex may be easily formed. During the computing process, the density, pressure and chemical reaction progress probably appear negative value in the centre of vetex without the positivity-preserving limiter. When the positivity-preserving limiter is added, negative density, pressure or chemical reaction progress in the center can not occur in simulation. The method is verified by numerical simulation examples, and can be applied in numerical simulation of condensed explosives detonation.



(a) t=0.57μs



(b) t=0.77μs



(c) t=0.97μs

Figure 1. Contours of pressure, density and the reaction rate (from left to right) of detonation diffraction around 120°corner at different time

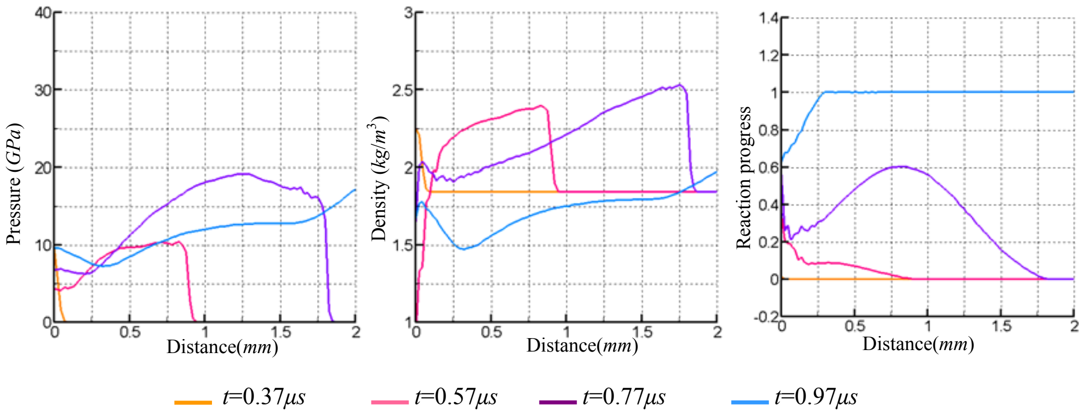


Figure 2. Plots of pressure, density and the reaction progress of detonation diffraction around 120°corner along the inner wall 2*mm* distance at different time

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