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A numerical investigation of polygonal converging shock waves

VERONICA ELIASSON, Department of Mechanical Engineering, University of California, Berkeley, CA 94720, USA, WILLIAM D. HENSHAW, Lawrence Livermore National Laboratory, Livermore, CA 94551 USA — Numerical simulations of cylindrically converging shock waves were performed. The converging shocks impinged upon a set of zero to sixteen regularly spaced cylindrical obstacles. For more than two obstacles, the resulting diffracted shock fronts formed polygonal-shaped patterns near the point of focus. For three obstacles, a triangular-shaped shock was observed during the last stages of the focusing process. The triangle was subjected to regular reflection, and thus the shape remained unchanged until it had focused. Guderley's self-similar solution for the radius, R, as a function of time, t, can be expressed as $R = \varepsilon_0 \, (t_c - t)^{\alpha}$. The self similar exponent, α, was close to the expected value of unity for the triangular case. For the square-shaped shock undergoing Mach reflection, the self-similar exponent was found to be α=0.844, which agrees well with Guderley's solution for cylindrical shocks (α=0.834). Also, the maximum pressure and temperature as a function of number of obstacles were studied. The highest maximum pressure and temperature occurred with no obstacles. This should be expected, since in all other cases, part of the flow is reflected by the obstacles and never reaches the focal point.

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