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Axisymmetric Shock-Attached Frame Detonation Simulations
BRIAN TAYLOR, University of Illinois at Urbana-Champaign, ASLAN KASIMOV, Massachusetts Institute of Technology, D. SCOTT STEWART, University of Illinois at Urbana-Champaign — We present a method of simulating one-dimensional axisymmetric detonations governed by the reactive Euler equations in a reference frame moving with the shock surface. We use this methodology to verify relations between normal detonation speed, D_n, and curvature, (κ), as predicted by Detonation Shock Dynamics (DSD), an asymptotic theory derived in the limit of slowly varying, weakly curved detonations. Our simulations demonstrate the previously theorized instability of certain regions of D_n-κ solutions with multiple turning points, which result in rapid transition to strong detonation or failure of the reaction front. It is also shown that the shock-attached frame method can be used to obtain D_n-κ relations that satisfy the complete reactive Euler equations without restrictions to small curvature or near Chapman-Jouguet detonation speeds.

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