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Analysis of unsteady strong shocks[1] MICHAEL WADAS, ERIC JOHNSEN, University of Michigan — From supernovae to inertial confinement fusion, strong, unsteady shock waves occur in a variety of flows encountered in high-energy-density (HED) science. The unique feature of such flows that inhibits their analytical treatment is the development of entropy gradients behind the shock front that result from a variable shock strength, significantly complicating the analysis of HED experiments involving laser-driven shocks. Our objective is to develop a semi-analytical theory for solving these flows that accounts for the effect of this variable-entropy region and apply it to the analysis of HED experiments. The theory extends the method of characteristics by imposing a unique boundary condition on entropy discontinuities in a framework that prevents the unbounded generation of additional characteristics that would otherwise lead to an intractable problem. It is found that the method correctly calculates key flow features present in laser-driven compression experiments including the shape of the entropy profile and the variable strength of the shock. The solutions obtained using our theory are compared to simulations performed using an in-house, high-order accurate discontinuous-Galerkin code.

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