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Simulations of High Speed Fragment Trajectories PETER YEH, STEPHEN ATTAWAY, SRINIVASAN ARUNAJATESAN, TRAVIS FISHER, Sandia Natl Labs — Flying shrapnel from an explosion are capable of traveling at supersonic speeds and distances much farther than expected due to aerodynamic interactions. Predicting the trajectories and stable tumbling modes of arbitrary shaped fragments is a fundamental problem applicable to range safety calculations, damage assessment, and military technology. Traditional approaches rely on characterizing fragment flight using a single drag coefficient, which may be inaccurate for fragments with large aspect ratios. In our work we develop a procedure to simulate trajectories of arbitrary shaped fragments with higher fidelity using high performance computing. We employ a two-step approach in which the force and moment coefficients are first computed as a function of orientation using compressible computational fluid dynamics. The force and moment data are then input into a six-degree-of-freedom rigid body dynamics solver to integrate trajectories in time. Results of these high fidelity simulations allow us to further understand the flight dynamics and tumbling modes of a single fragment. Furthermore, we use these results to determine the validity and uncertainty of inexpensive methods such as the single drag coefficient model.

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