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Statistical Hotspot Model for Explosive Detonation

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The presence and need for energy localization in the ignition and detonation of high explosives is a corner stone in our understanding of explosive behavior. This energy localization, known as hot spots, provides the match that starts the energetic response that is integral to the detonation. In our model, we use the life cycle of a hot spot to predict explosive response. This life cycle begins with a random distribution of inhomogeneities in the explosive that we describe as a potential hot spot. A shock wave can transform these into hot spots that can then grow by consuming the explosive around them. The fact that the shock wave can collapse a potential hot spot without causing ignition is required in order to model phenomena like dead pressing. The burn rate of the hot spot is taken directly from experimental data. In our approach we do not assume that every hot spot is burning in an identical environment, but rather we take a statistical approach to the burning process. We also do not make a uniform temperature assumption in order to close the mixture equation of state, but track the flow of energy from reactant to product. Finally, we include both the hot spot burn model and a thermal decomposition path, required to explain certain long time behaviors. Building on work performed by Reaugh et. al., we have developed a set of reaction parameters for an HMX based heterogeneous explosive. These parameters have been determined from computer models on the micron scale, and experimental data. This model will be compared to experimental rate stick data. This work was performed under the auspices of the U.S. Department of Energy by University of California, Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.