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COMBUSTION IN AFTERBURNING BEHIND EXPLOSIVE BLASTS

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Our knowledge of condensed phase explosions is limited although explosives have existed since the gunpowder was discovered in China in the 9th century. The physical complexity of condensed phase explosions, involving extremely high pressures and temperatures, phase transitions, turbulence, shocks, mixing, instabilities, chemical reactions and shock-turbulence interactions puts very high demands on the physical modeling and the numerical simulation techniques. Performance evaluation of an explosive compound with respect to afterburning requires sufficient combustible properties of the explosive compound and a careful determination of most appropriate charge positioning to achieve the desired afterburning effect. Understanding the physical processes of afterburning and how these are affected by the surroundings and Height of Blast (HoB) facilitates the optimal utilization of an explosive compound. The usage of Coarse Grained Simulations (CGS) for these kinds of investigations is a cost effective approach to identify the most optimal conditions for the subsequent full scale experiments. In Enhanced Blast Explosives (EBX) metal particles, usually aluminum, are added to the explosive compound in order to increase the afterburning energy release by allowing the metal particles and detonation products combust with air. This presents another modeling challenge since the combustion becomes multi-phased.

In this paper we will present the work done by authors in the field of CGS of afterburning, which includes single and multi-phase afterburning of trinitrotoluene (TNT) w/o aluminium at different HoB [1, 2], (Fig. 1) as well as multi-phase afterburning of nitromethane (NM)/steel in a spherical sector domain [3, 4] (Fig. 2). The main objective of this work is to examine the use of combustion CGS to elucidate the physical processes involved in unconfined air and near-ground air blasts, demonstrate what affects the HoB has on the afterburning and how metal particles affect the combustion. The aim is to capture the most significant stages of turbulent mixing, involving the initial blast wave, secondary and reflected shocks, possible implosions and the constant mixing stage(s).

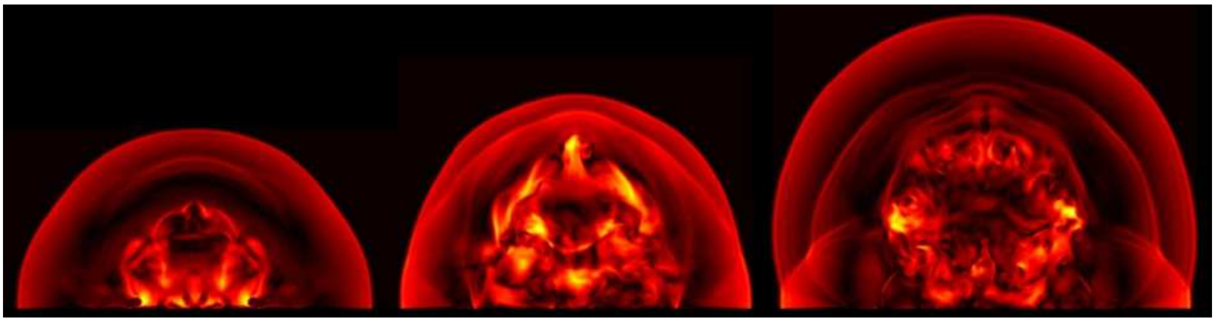
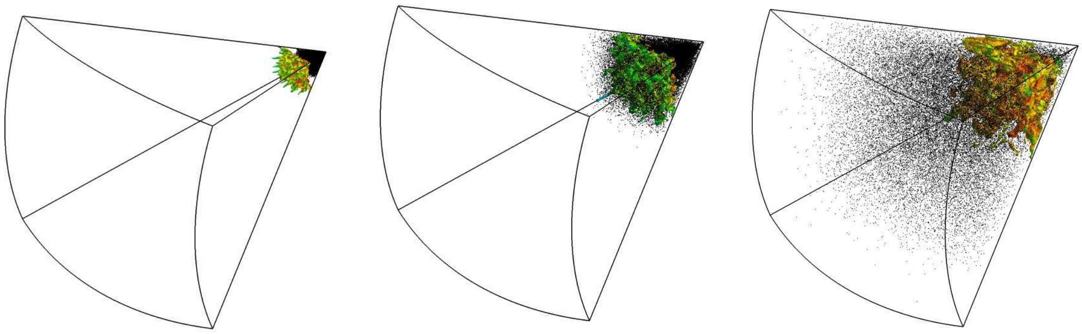


Figure 1: CGS of TNT afterburning: magnitude of velocity for HoB 0.15 m, HoB 0.5 m and HoB 1 m.



(a) (b) (c)

Figure 2: Mixing layer profiles for NM/steel charge shown at different times: (a) 0.13 ms, (b) 0.58 ms and (c) 1.52 ms.

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