Analysis of explosion dynamics from buried explosive charges using thermal infrared imaging

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Thermography is a very evolving field in science and industry owning to the enormous progress made in the last decades in microsystem technologies of infrared detector design as well as in electronics, and computer science. The development of high speed infrared cameras with high temporal resolution have given rise to a wide variety of demanding thermal infrared imaging applications ranging from academics and research, industrial R&D, non-destructive testing and materials testing, aerospace and defense.

Detonics is among the fields of science that could benefit of the improvement of thermal infrared imagery technologies. More specifically for the investigations of explosion dynamics, high-speed thermal infrared imaging could allow a direct measurement of the total energy released and the active radius. These data correlated with visible digital high-speed video camera might facilitate the understanding of the thermodynamics of the explosion as well as the ignition and heat/particle propagation inside the active explosion area.

In the present work we report detonics experimental results conducted using our recently developed FAST M3K camera. The main objectives of the experiments were the evaluation of the repeatability of some buried charge test method, the ejecta characteristics of a new type of standard soil as well as the performance of some selected protectives items and fabrics when subjected to the soil ejecta of a buried explosive charge.

Developing efficient protection systems against buried explosive charges requires extensive experimental work and numerical simulations. Confined explosions may occur due to various reasons and the resulting ejecta, heat and shock waves may be extremely harmful and lead to major endangerment or casualties [1]. When an explosive charge is detonated in soil, the depth of burial and the type of soil have a significant effect on the energy directed on a target and causes more damage than a similar external free-air explosion. In general, the efficiency of the explosion is characterized by the quantity of the released energy, the velocity at which the thermally expanding gases are released and by the spatial and temporal evolution of the generated heat wave and released particles. Thanks to the high performances of the Telops FAST M3K camera with frame rate of about 15 000 frames per second, we successfully monitored explosions tests gaining important insights into the dynamics of explosions of buried explosive charges.

1- Wu, C., Lu, Y., Hao, H. Numerical prediction of blast-induced stress wave from large-scale underground explosion. Int. J. Numer. Anal. Meth. Geomech. 28, 93–109 (2004).