QUANTITATIVE VISUALIZATION OF OPEN-AIR EXPLOSIONS BY BACKGROUND-ORIENTED SCHLIEREN

T. MIZUKAKI[1C], K. WAKABAYASHI[2], T. MATSUMURA[2], and N. NAKAYAMA

[1]Dept. of Aeronautics and Astronautics, Tokai University, Hiratsuka, 259-1292, Japan
[2]Department of Physics, Advanced Institute of Science and Technologies, Tsukuba, 305-8565, Japan

[c]**Corresponding** author: Tel.: +81463581211; Fax: +81463582060; Email: mizukaki@keyaki.cc.u-tokai.ac.jp

KEYWORDS:
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Fluid: Air, High speed flows, Flows with shocks
Visualization method(s): Background-oriented schlieren with natural background, High-speed video camera
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ABSTRACT: This paper describes quantitative flow visualization of large-scale shock waves generated by open-air experiment such as safety examination of explosives. Overpressure prediction, density distribution behind shock front, and the x-t diagram of shock waves generated by explosion are shown. The visualization method used here was background-oriented Schlieren method combined with a high-speed camera (Hi-BOS). The experiment was piggyback one on the explosive safety examination held by Japan government. A high-speed video camera, Phantom V730, with 100,000 frames per second, 480 pixels by 680.pixels of images size, and 33 microseconds of exposure time, was used as an image-recording device. The cross-correlation function was used to determine background image shift with eight by eight of interrogation window. Numerical analysis using hydro-code, AUTODYN, was made to theoretically estimate both overpressure history and profile of density behind the shock front. Our experimental results showed that overpressure profile, shock propagation diagram, and density profile behind shock wave, was successfully extracted from the images obtained with Hi-BOS. The comparison of those values with numerically obtained ones showed good agreement except the density profile behind shock wave. Based on these findings, we proposed three-dimensional shock wave visualization in open-air experiment.

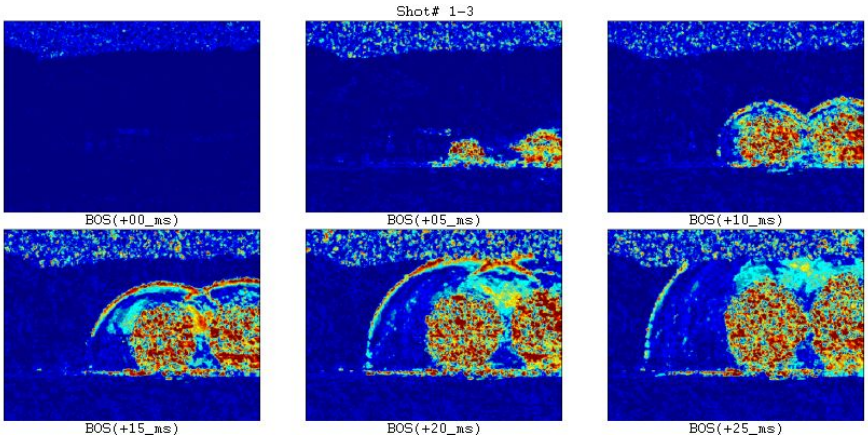

Fig. 1 Background displacement map of spherical shock waves by explosion generated by 10-kg TNT explosive; every five millisecond from ignition.

References

1. Mizukaki, T., et al., *Quantitative visualization of open-air explosions by using background-oriented schlieren with natural background*, in *28th International Symposium on Shock Waves*. 2011: Manchester, UK. Paper#2564.