Line-VISAR Diagnostic in the Gas-gun Community

Used by the Los Alamos National Lab

Type of experiment: Shock and Detonation Physics

Keywords: Line VISAR, Gas guns, Shock-to-Detonation initiation, velocity heterogeneity

Summary of Application:

Short form: A ROSS 5100 was used on a line-VISAR system on a single stage gas gun to investigate spatial heterogeneity of mechanical response, chemical reaction and initiation during shock-to-detonation experiments and reactive wave evolution in energetic materials. The initial line-VISAR was built with a competitor's system and has since been replaced with a ROSS 5100.

Long form: To advance the understanding of detonation initiation from the macroscopic level to the material microstructure scale, spatially resolved diagnostics are a necessity such as line imaging and two dimensional imaging diagnostics like VISAR (velocity interferometer system for any reflector). VISAR records the time evolution of the Doppler shift of a probe laser from an advancing, reflective, shock wave onto a streak camera, providing the user a temporally resolved record of the fringe shifts and shock wave velocity. For a VISAR system, high contrast between the fringes is needed so a streak camera with high spatial resolution and high dynamic range is needed.

The ROSS5100 was used on a line-VISAR system (same system that is used at facilities like NIF and LLE that perform laser-driven shock and plasma physics experiments) using a Mach-Zender (M-Z) interferometer rather than a wide-angle Michelson interferometer (WAMI) that had been previously implemented on line-imaging VISAR systems for gas-guns. The benefits of implementing of line-imaging VISAR as a routine diagnostic for gas-guns are that gas guns can offer different strain rate and loading conditions than lasers and can sustain pressures for much longer times than laser drives. This allows for the study of different phenomena such as granular compaction an increase of the bulk density of a granular medium submitted to mechanical perturbation) or the slow build-up to detonation in plastic bonded explosives (PBX).

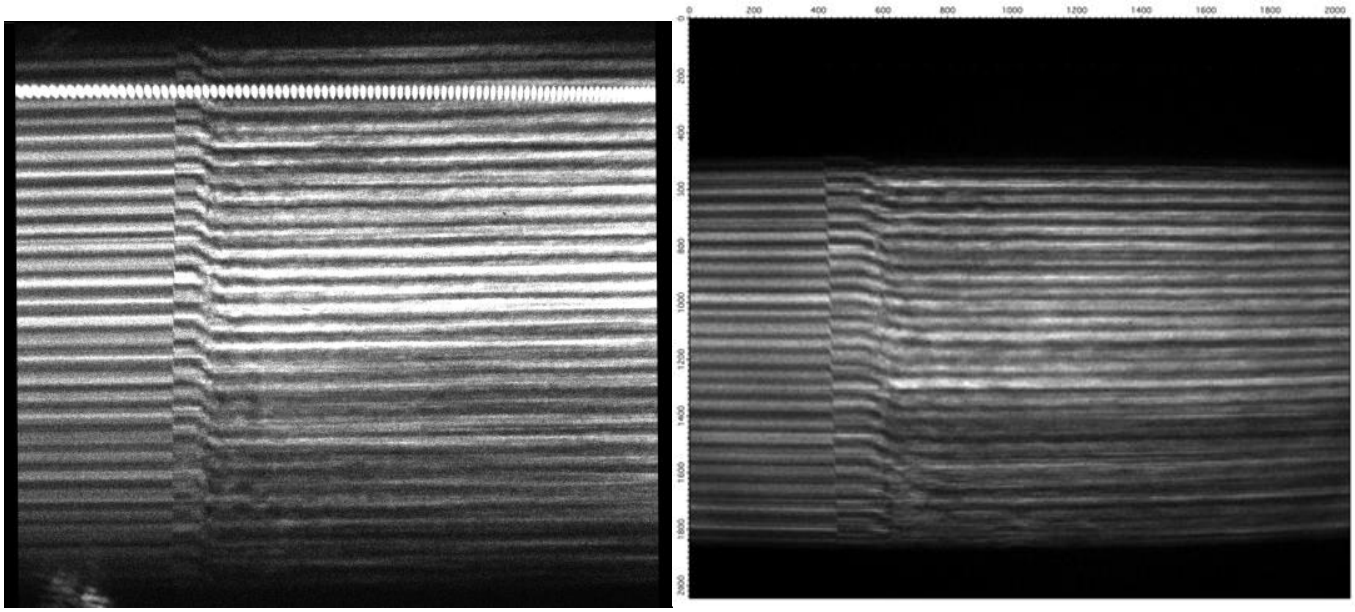
The line-VISAR system was specifically designed so it could be efficiently fielded on gas guns and other facilities for remote firing of explosives, and to be insensitive to damaging light intensity variations inherently associated with velocity heterogeneity exhibited by PBX. The single stage gas gun is set-up within close proximity to a two-stage gas gun, indoor firing chamber and other shock/detonation diagnostics. In this area, line-VISAR is able to be used simultaneously with the other diagnostics to complement continuum measurements with those on the microscopic level.

Since the original publication in Review of Scientific Instruments, the streak camera diagnostic was upgraded to a Sydor ROSS5100 streak camera system with OCM. The ROSS5100's direct-coupled high end scientific grade camera and high resolution streak tube provided the high contrast between the fringes needed when imaged. A side by side comparison of the two systems can be seen below.

Publications Regarding the Experiment:

Bolme, C. J. and Ramos, K. J., 2013, Line-imaging velocimetry for observing spatially heterogeneous mechanical and chemical responses in plastic bonded explosives during impact, *Review of Scientific Instruments*, **84**, 083903

Data Sample: An interferometric imaging velocimetry measurement was recorded on two different streak cameras to compare the camera performance. The data was recorded on an oriented single crystal of the explosive RDX, and the two velocity waves recorded are showing the elastic and the plastic waves. Images provide courtesy of C. Bolme at LANL.



Left: ROSS 5100 Streak Camera Data

Right: Previous Streak Camera System used