LLNL-ABS-728610

Toward Sub-wavelength Spatial Resolution in VISAR Interferogram Analysis

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A VISAR is a Doppler velocity interferometer commonly used to diagnose the response of shock physics targets in equation of state experiments at the National Ignition Facility (NIF), Omega Laboratory for Laser Energetics (Univ. of Rochester), and other shock physics facilities around the world. Typically a line across the target is imaged to the slit of a streak camera while passing through an interferometer. The latter produces thirty or so bias fringes along the slit versus a time axis. These shift vertically in response to a target velocity change. Using a conventional Fourier transform column-by-column algorithm, a spatial resolution smaller than one period of the bias fringe sinusoid is not practical. However, if detector pixel noise is not too great, a sub-wavelength spatial resolution can be obtained using a row-by-row algorithm having small phase steps (along the spatial dimension). The smaller spatial "footprint" on the detector is useful for reducing systematic errors caused by sample granularity, edge release waves, detector blemishes, streak camera warp irregularity, and spatial nonuniformity in the drive laser intensity (speckle). We show preliminary data analysis of NIF VISAR data using about a quarter wave of spatial extent using a modified push-pull technique in a row-by-row style.

Prepared by LLNL under Contract DE-AC52-07NA27344.