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Advances in VISAR Interferogram Analysis: Speckle-Adaptive & Ghost Fringe Removal Techniques

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A VISAR (velocity interferometer) is an important diagnostic used at National Laboratories in shock physics experiments, measuring how a target moves in response to transient high pressure loading. Accurate measurement of velocity is needed to make precise equation of state determinations of a variety of materials. Spatial variations in laser illumination (speckle), irregularities in fringe phase and visibility can confuse conventional interferogram analysis. We have developed a new "SpeckleAdaptive" algorithm that solves this issue and have obtained good results using it on recent laser-driven equation of state measurements. We have also developed better analysis methods for removing the confusing effects of "ghost fringes" from the VISAR interferogram, which are due to unwanted reflection of illumination from target layer interfaces. A Lissajous presentation for interferogram data is advantageously used, which improves upon the conventional lowpass filtering approach. The accurate separation of strong ghost fringes from weakly reflecting good signal is often the most important factor for obtaining useful equation of state data. This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.