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Spectrally Encoded Imaging for Fast Dynamic Surface Breakout Events

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Abstract: (250-word text abstract)

A diagnostic based on spectrally encoded imaging (SEI) has been developed for fast dynamic, single-shot, shock and detonation physics experiments. By spectrally encoding the interrogation pulses from a supercontinuum laser source with spatial target information, a target surface may be imaged through a single mode fiber by monitoring the varying return spectra of the collected pulses. At the heart of the system is optical time stretching via the dispersive Fourier transform technique that allows real-time measurements of the target return spectra. The interrogation pulse times are on the picosecond time scale, the interrogation repetition rates are on the nanosecond time scale, and the sensitivity of the system can be tailored via multiple amplification methods. The diagnostic also exhibits several key features that enable measurements beyond those of traditional imaging systems. For instance, the surface breakout data collected from the shot is transmitted entirely through a single optical fiber. This eliminates the requirement for full optical access to a dynamic surface event. As a result, the system can be fielded in remotely accessible facilities and enclosed experimental assemblies. Additionally, the system is non-imaging in the geometrical optics sense. Surface breakout information can be collected from non-planar target surfaces where traditional optical systems may struggle with depth-of-field issues. Lastly, it may be possible to extend the capability of the system to allow continuous velocimetry across the target surface as well. As a result of these unique features, the potential applications of the SEI diagnostic are promising and diverse.