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Compressive sensing for spatial and spectral flame diagnostics
DAVID STARLING, JOSEPH RANALLI, Penn State University-Hazleton — Compressive sensing has been a valuable resource for use in quantum imaging, low light level depth mapping of natural scenes, object tracking and even for the improvement of miniature spectrometers via post processing. Experimentally, many optical compressive sensing techniques utilize a single pixel camera composed of a digital micromirror device or spatial light modulator coupled to one shot-noise limited detector. This method has the advantages of fast acquisition time and high signal to noise ratio. One currently unexplored area of study is the use of these techniques in the context of flame diagnostics. Optical diagnostics are employed for a variety of purposes in flames, including imaging of the heat release region (via chemiluminescence) and spatially resolved species and temperature measurement (via spontaneous Raman scattering). Compressive sensing has a dual role in this field, where the signals of interest are generally sparse and the mean photon flux is very low at the appropriate wavelengths. We show here that compressive sensing is beneficial in particular for the study of laminar, steady flames using Raman spectroscopy and flame chemiluminescence imaging, without the use of intensified CCDs, commercial spectrometers or high intensity pulse lasers. We present results from a theoretical study with experimental data to follow.

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