**A Modular Sensor Suite for Propulsion Testing**

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Abstract

Industrial process tomography is widely used for the characterization of a wide variety of physical processes. One of the drawbacks of process tomography equipment is that they are specific to a particular application and process. Therefore, different instruments are required for characterizing turbulent sprays and flames. A modular sensor suite is developed to characterize flames and sprays used in the propulsion industry. The sensor suite enables the user to select from a range of plug and play emitter and sensor modules to estimate several physical characteristics of the system under study. The sensor suite developed in this study is capable of measuring planar temperatures, radical species concentrations (such as OH, AlO, CH, C+), and particulate volume fractions in flames and planar surface area densities and drop sizes in sprays. The modular suite also has a configurable algorithm with an embedded database that includes many of the radiative properties, such as wavelength and line width, gas species, and particulate volume fractions. The sensor suite is a monolithic structure that can be mounted in any orientation around the physical process. Sample soot and temperature data from ethylene and propulsion diffusion flames ,and OH concentrations from a hydrogen flame are presented to highlight the capabilities of the sensor suite in characterizing turbulent diffusion flames. In addition, sample surface area densities and drop sizes from a water spray are presented to highlight the capability of the sensor suite to characterize sprays. The data obtained from the sensor suite is validated using data from published literature for flames and using Phase Doppler Interferometry in sprays. The current sensor suite can accommodate flames and sprays that are up to 250 mm in diameter, making it a valuable diagnostic for the propulsion industry.