MECHANICAL ENGINEERING

IMPROVED APPLICATIONS OF FILTERED RAYLEIGH SCATTERING

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Many optical diagnostic techniques are capable of measuring combusting flows. However, environmental factors can trouble most techniques such as reflections from metallic surfaces or flows containing solid particles or liquid droplets due to intense Mie scattering. Unfortunately, these conditions are synonymous with most practical combusting systems. Filtered Rayleigh scattering is an optical strategy for measuring gas flow properties such as temperature or velocity in those complicated environments. By use of the molecular iodine filter, filtered Rayleigh scattering can filter out Mie scattering prior to reaching the detector. Unfortunately, many difficulties exist in the technique and improvements are needed. Three investigations were conducted to improve the experimental design, strategy, and data processing of filtered Rayleigh scattering. Continuous wave filtered Rayleigh scattering has been implemented for the first time to increase the effectiveness of the molecular iodine filter and reduce the Mie scattering noise reaching the detector. The post-processing of filtered Rayleigh scattering images has been made more effective by reducing the presence of particles using a digital particle rejection filter. Finally, a theoretical analysis was conducted on the simultaneous presence of Rayleigh and Mie scatter in order to improve experimental design of filtered Rayleigh scattering.

Approved _____ Date _____

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