

Advantages of Multispectral Imaging for Accurate Gas Temperature Profile Retrieval from Fire Combustion Reactions

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Abstract : Infrared thermal imaging is used for a wide range of applications, especially in the combustion domain. However, it is well known that most combustion gases such as carbon dioxide (CO₂), water vapor (H₂O), and carbon monoxide (CO) selectively absorb/emit infrared radiation at discrete energies, i.e., over a very narrow spectral range. Therefore, temperature profiles of most combustion processes derived from conventional broadband imaging are inaccurate without prior knowledge or assumptions about the spectral emissivity properties of the combustion gases. Using spectral filters allows estimating these critical emissivity parameters in addition to providing selectivity regarding the chemical nature of the combustion gases. However, due to the turbulent nature of most flames, it is crucial that such information be obtained without sacrificing temporal resolution. For this reason, Telops has developed a time-resolved multispectral imaging system which combines a high-performance broadband camera synchronized with a rotating spectral filter wheel. In order to illustrate the benefits of using this system to characterize combustion experiments, measurements were carried out using a Telops MS-IR MW on a very simple combustion system: a wood fire. The temperature profiles calculated using the spectral information from the different channels were compared with corresponding temperature profiles obtained with conventional broadband imaging. The results illustrate the benefits of the Telops MS-IR cameras for the characterization of laminar and turbulent combustion systems at a high temporal resolution.

Keywords : infrared, multispectral, fire, broadband, gas temperature, IR camera

Conference Title : ICWFMP 2022 : International Conference on Wildland Fire Management and Prevention

Conference Location : Toronto, Canada

Conference Dates : September 20-21, 2022