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Optimization of the wavelength range and number of bands used for the multi-spectral temperature measurement of surfaces exhibiting non uniform emissivity

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Abstract

Generally, when we want to characterize materials at high temperature [1], the optical temperature measurement can be affected by spatial emissivity variations of the surface that can vary versus many parameters. As the thermal characterization of materials through optical facilities can be strongly affected by the variations of their emissivity maps, it is of particular of interest to develop multi-spectral techniques to overcome this difficulty [2, 3]. In this paper, we present the work of our laboratory for optimizing the wavelength range and number of bands used for the multi-spectral temperature measurement of surfaces exhibiting non uniform emissivity, variable with temperature [4-6]. In particular, wavelengths different selection criteria are presented. These allow us not only to avoid the amplification of measurement error, but also to get rid of as best as possible of the emissivity and its spectral, spatial and temporal variations as well as wavelength variations of the transfer function of the detector and of optical components. Once the problem of minimum distance required between two selected wavelengths solved, the number of wavelengths which seems to be optimal for the temperature estimation taking into account variations with magnitudes of order two on the emissivity and overall transfer function of the measurement chain is discussed. These points are treated in theoretical, numerical and experimental points of view.

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