SIMULTANEOUS SOOT VOLUME FRACTION AND SOOT TEMPERATURE FIELDS IN AXIS-SYMMETRIC FLAMES BY MODULATED ABSORPTION/EMISSION TECHNIQUE

Q. Wang[1], J. Bonnety[1], C. Morin[2], G. Legros[1]
qianlong.wang@etu.upmc.fr
[1] Sorbonne Universités, UPMC Univ Paris 06, CNRS, UMR 7190 Institut Jean le Rond d'Alembert, F-75005 Paris, France
[2] UVHC, TEMPO, Le Mont Houy, F-59313 Valenciennes cedex 9, France

Based on light extinction and flame emission measurements at two wavelengths (645 and 785 nm), an extension of the modulated absorption/emission technique has been developed to simultaneously map soot volume fraction and temperature in an axis-symmetric flame. The temperature is deduced from soot emission in a classical way. However, the soot emission coefficient and self-absorption along the line-of-sight are the main sources of uncertainties. Typically, the soot refractive index varies with particle lifetime, spectral wavelength, etc. For this reason, the soot absorption coefficient fields are mapped at both mentioned wavelengths. A Tikhonov regularization complements the onion-peeling method applied to the measurements of the absorption of the collimated laser beams. This provides the local absorption coefficient fields, therefore, the soot volume fraction field, assuming that the soot refractive indices are those delivered by Chang and Charalampopoulos. Independently, an original deconvolution method based on the onion peeling and accounting for soot self-absorption is proposed to map soot emission fields. According to Planck law, the knowledge of soot emission fields at both wavelengths leads to a self-calibrated technique delivering 2D temperature fields with a fair accuracy. The results delivered by the methodology are first contrasted with fields provided by numerical Santoro flame simulations available in the literature. This allows a systematic analysis of the noise influence. Then a comparison with experimental data enables the assessment of the methodology's relevance.

10.4405/profic2014.C30