The paper is concerning the experimental analysis made using both an atmospheric pressure burner and a liquid fuel burner. The main focus is the definition of a procedure for the flame instability regimes identification in industrial and aeronautical burners. Instability, in fact, is an unpleasant aspect of combustive system that negatively impacts on combustion efficiency. The online monitoring of the onset of instability conditions, permits to control combustion parameters (as fuel or air mass flow, temperature, pressure, etc.) and to stabilize again the flame. The analysis has been performed by a High Speed Digital Camera, an Intensified ICCD and an Infrared camera with the use of optical filters (OH*, CH*, CO2 and soot).

Using the High Speed Digital Camera Flame, high speed images can be analysed and instability can be detected as sudden variations of amplitude of the output signal. Spectral analysis and Wavelet transform of pixel intensities of flame images were used as an investigative instrument. Moreover the images were also analysed in term of RGB (Red Green Blue) contents. Finally, an RMS (root mean square) analysis was performed to individuate the most unstable regions in the flame. ICCD was used to acquire OH and CH chemiluminescence signal acquisition that was also shown to be a good approach for monitoring flame stability. With the aim to characterize the chemical species also a system monochromator/photomultiplier was used. Since the PMT has a very fast time response (kHz) it can be used to monitor temporal variability of chemiluminescence in the flames and it is possible to apply the wavelet tool already described for the high rate image analysis. The Artificial Neural Network and the Least Squares Support Vector Machine were used to identify the flame regime, using as inputs the power spectral characteristics of the flame image pixel intensities time series and of the PMT signals. Results show that the flow regime predictions from the LS-SVM model are generally more accurate than predictions based on the ANN.

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