Tomography of thermal plasma flows by mean of single CCD camera

Yacine Babou[1], Félix Cannat[2] and Damien Lequang[1]

1) *von Karman Institute for Fluid Dynamics, Rhode-St-Genèse, Belgium*
2) *ONERA, Département Mesures Physiques, BP 80100, Palaiseau Cedex, 91123, France*

Thermal plasma jets produced are extensively used in a wide range of industrial domain necessitating high energy density medium or elevated thermal fluxes, such as heat protective material testing for atmospheric re-entry applications. Characterization of plasma jet features such as temporal behavior or homogeneity is an important step to identify ways of thermal processing improvement. A simple tomography system will be proposed to document on the plasma flow dynamic taking place in the whole plasma jet volume. The optical arrangement combines a single CCD High Speed Camera with a set of mirrors properly arranged to mimic an equivalent optical setup including multiple CCD cameras.

The optical arrangement has been applied to characterize air plasma jet produced at atmospheric pressure with a small-scale Microwave Plasma Torch (MPT). Various operating conditions have been investigated and tomography measurements were performed at 5 kHz rate acquisition. The three-dimensional distribution of the local optical emission rebuilt by means of tomography technique will be presented and discussed for typical situations. In particular, the situation corresponding to a common plasma jet (see Figure 1) and the situation corresponding to a cyclone jet characterized (by a depletion of plasma at the center) will be examined to assess the performance of the proposed optical technique and to demonstrate the significant benefits for actual thermal plasma jet characterization improvement.
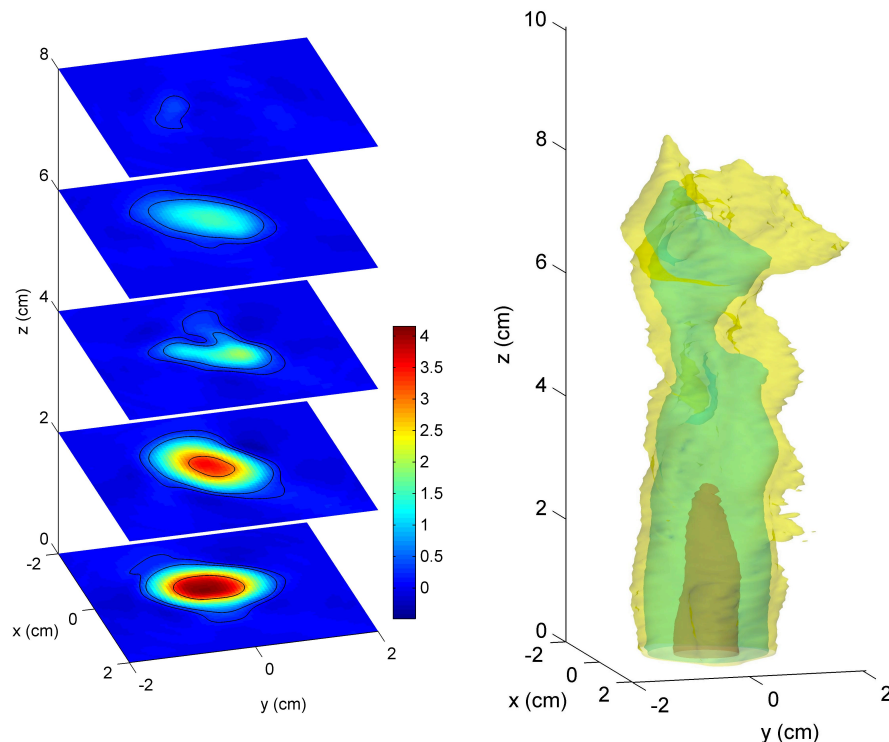

Figure 1: Three-dimensional distribution of the instantaneous emission for the common plasma jet case (jet sections on the left and iso-emission layers on the right).

Relevant topic: plasma diagnostics, tomography
Corresponding author: yacine.babou@vki.ac.be