SOME RESULTS OF COHERENT STRUCTURES IDENTIFICATION IN PLASMA JETS

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In the experiment, plasma jet image is projected by objective lens onto ends of optical fibres coupled to the photodiodes, which converts the light into the electrical current. Attached electronic amplify the current, digitalize it and record. The total 128 fibres are divided into four independent directions of observation indexed by angle of 45 degrees. Each of the observation direction subsystem consists of two rows with sixteen fibres. Cross section perpendicular to the axis of the plasma jet can be reconstructed from these records. For scheme of the experiment see Figure 1 [1].

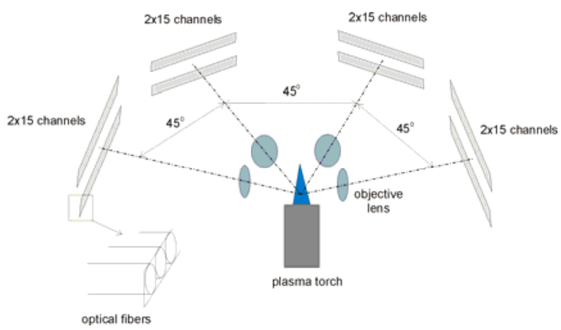

Figure 1. Experimental layout schematic.

The time development of radiation intensity in the cross sections perpendicular to the axis of a plasma jet yields basic information on dynamics of structures propagation along the flow axis. These diagnostic cross sections can be constructed along the flow axis and perpendicular to axis of plasma jet. An important influence on the resultant plasma jet dynamics rests also with impact of dynamic effects of the surroundings, that cooperate in installing un-equilibrium dynamic system of the plasma jet core with surrounding medium. The balance relations of un-equilibrium open thermodynamics make it possible to study the time evolution of such arrangement, using experimental data of the radiation intensity variations scanned in several planes adjusted perpendicularly to the plasma jet axis. Each of these planes contains information on the time evolution of radiation intensity for plasma jet in both its spatial and time disposal.

Hence, the problem rests with identifying the structures that iterate in the plasma jet core, using as the basis the information scanned from four separate directions that are dislocated inside two parallel planes. To determine the time intervals of the recurrences, the maximum of radiation intensity will be scanned, obtaining four components of the vector. The time evolution within two selected time intervals is compared using the correlation analysis for determining the correlation coefficients. The sequence of the values of the correlation coefficients yields information concerning the mutual orientation of such structures.

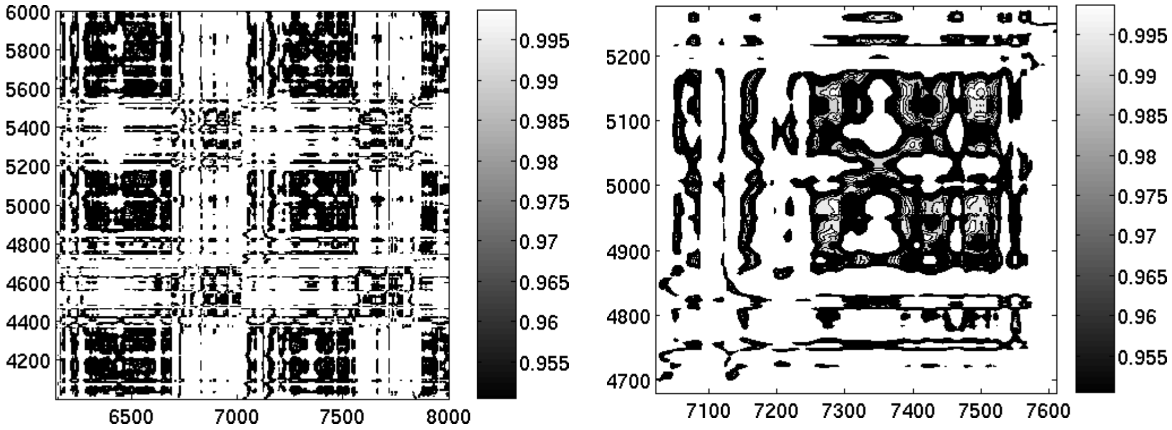

Figure 2. Graphic representation of correlation coefficients matrices.

Within time intervals of significant mutual resemblance, the correlation coefficients are approaching to the value one. Such approach allows constructing rectangular matrices. The rows and columns of these matrices correspond to the monitored time intervals, see figure 2 left. If there exists a significant resemblance of the monitored signals, the values of the elements in the matrices are approaching to one, see Figure 2 right. As we can assume relatively equal relaxation intervals of heat energy transfers in radial direction for the two monitored configurations in free plasma flow, the resemblance of the monitored structures suggests the possibility of their coherence see Figure 3. The recurrence in the regions whose values approaching to one represents an important characteristic of the structures in plasma jet. In this way the monitored record represents structures with features of coherent behaviour in the plasma jet.

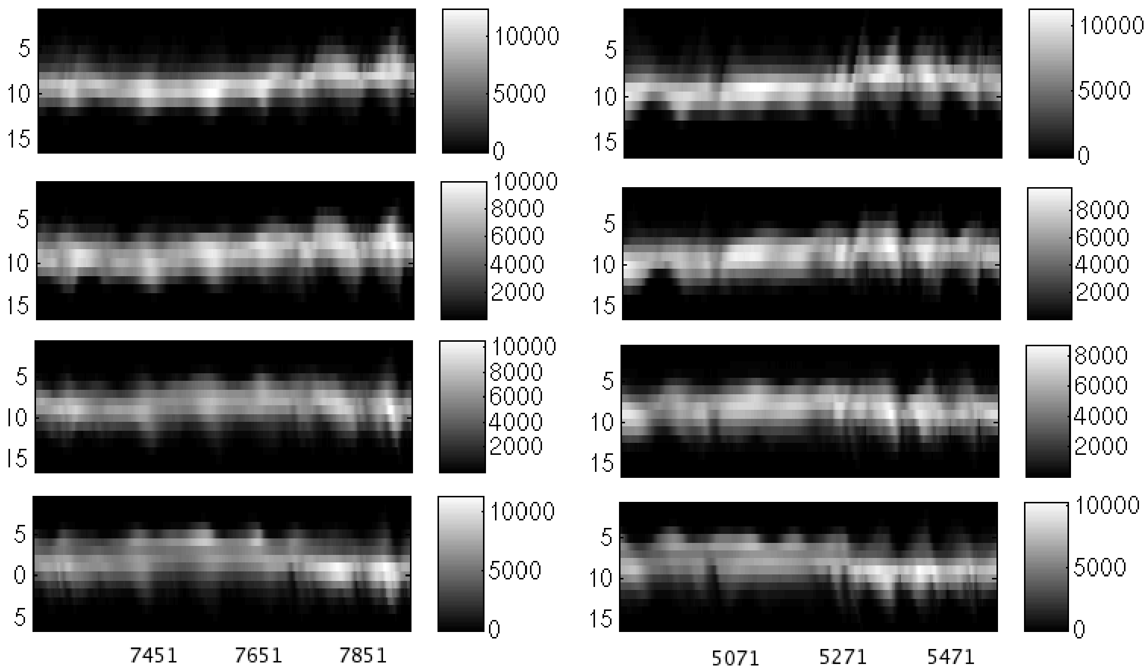

Figure 3. Time evolution of source signal corresponding to right matrix in figure 2.

[1] Jiří Šonský, *Applying of fibre optics to plasma jet diagnostics*, Acta Technica CSAV 52 (2007), 15-31

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