Advanced Interferometric Technique and Automatic Data Processing of Optical Image for Fluid Mechanics and Combustion Research

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TITLE OF THE SESSION: Scalar Diagnostics

In [1] are shown wide and often unique possibilities of interferometry for investigation of the Fluid Mechanics and Combustion. Interferometric methods can be used now for the measurement of very various characteristics: total mechanical impulse and reactive force of non-stationary flow, velocity and pressure fields in non-stationary potential flow, flame temperature and density field, burning rate and heat release power during laser ignition of propellant, heat release rate for gas explosion, heat release rate profile in the propellant burning wave.

Practical realization of the broad possibilities of interferometric methods require to automation of the process of measurement, first of all, for a stage of interferogram decryption (getting data about phases difference distribution in interferogram plane, eikonal value, etc).

Authors of this work have created some automation procedures, which permits to realize practically all possibilities of interferometric techniques discussed in [1]. This work generalizes some previous results of authors and presents a new not known earlier procedure to automations of the interferogram decryption. It uses belief about interferogram as on collections of black and white pixels and allows defining:
- the coordinates of interference bands borders and medium,
- the discrete kit of values of the function of phases difference distribution on interferogram (about 2000-3000 values),
- the eikonal (the double integral of the function of phases difference distribution on interferogram),
- the volume and surface of the object (if it possesses a cylindrical symmetry), as well as length of image border of object.

Authors believe that using of TV-registration and this procedure can make interferometric tools increasingly viable for use in the fluid mechanics and combustion research. Its algorithm is sufficiently simple and quick. It can be used to develop real-time diagnostic and control systems for fluid and combustion processes.

Authors suppose also that this procedure can be used for many other optical methods of combustion diagnostics. At present we develop a new automatic procedure of determination of the histogram - sharing the particles of two-phase flow on sizes by means of flow shadow image.

Now this approach to automation is used for monochrome images of interferogram and other optical images. In the future we are planning to use it for analysis of the images with 256 gradation of gray, as well as for analysis of color images.

The automatic system "Interferometry" (user-friendly software complex as a whole) and the results of the experimental investigation of various combustion systems during some non-stationary and stationary regimes will be presented in this paper, in particular, an animation cine film of temperature fields and heat release rate profiles in the burning wave during laser ignition of solid will be presented.

As a whole, this paper generalizes recent results and work in progress in the area of the using of interferometry in the study of combustion in the Department of Thermophysics of the Chuvash State University, which is a leader in this area of science in Russia.

Reference

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