High-speed video and digital image analysis of solid propellant gas generator's jet exhaust

© D.A. Yagodnikov[1], I.I. Khomyakov[1], A.S. Burkov[1], A.V. Samorodov[1], O.A. Artyuhova[1], L.S. Yanovsky[2], Ye.V. Surikov[2]

[1] Bauman Moscow State Technical University, Moscow, 105005, Russia
[2] Baranov Central Institute of Aviation Motor Development, Moscow, 111116, Russia

The paper specifies the issues of high-speed video techniques and digital image processing of some fire tests of a modeling solid-fuel gas generator. It becomes possible to use the digital processing of the large video information flow for diagnosing the high-temperature combustion and the course of two-phase flows. The authors introduce a procedure for calibrating the photometric lamp of back-illuminated CCD cameras according to the brightness temperature. They designed software programs for processing, storage, and presentation of the obtained results. Some tests of solid propellant gas generator were conducted, where a high-speed video filming was used to shoot how the combustion products flow from the two-nozzle block. This paper presents some examples of halftone image processing of temperature fields as well as gas-dynamic flow patterns, which illustrate the full-cycle application of the optical non-contact method of diagnosis from experimental tests to receiving quantitative characteristics of the studied temperature fields.

Keywords: *high-speed video; solid fuel; combustion products; digital image analysis.*

Yagodnikov D.A. (b. 1961) graduated from Bauman Moscow Higher Technical School in 1984. Dr. Sci. (Eng.), Professor, Head of the Rocket Engines Department of Bauman Moscow State Technical University. An author of more than 180 scientific papers on processes and development of non-contact methods of diagnosing rocket and jet engines.

Khomyakov I.I. graduated from Bauman Moscow State Technical University in 2005. Assistant of the Rocket Engines Department. A specialist in design and testing of jet engines.

Burkov A.S. graduated from Moscow Aviation Institute in 2010. An engineer of the Scientific Research Institute for Power Engineering at Bauman Moscow State Technical University, a Postgraduate of the Rocket Engines Department, a specialist in the field of mining bench rocket and jet engines.

Samorodov A.V. (b. 1975) graduated from Bauman Moscow State Technical University in 1999. Ph.D., Head of the Research and Testing Center for Biometric Technology Department, Assoc. Professor of the Biomedical Technical Systems Department of Bauman Moscow State Technical University. Author of more than 100 scientific papers on image recognition and decision making, optical-digital systems of automated processing of medical-biological images. e-mail: avs@bmstu.ru

Artyukhova O.A. (b. 1986) graduated from Bauman Moscow State Technical University in 2009. Assistant of the Biomedical Technical Systems Department, a Researcher in the Research and Testing Center for Biometric Technology of Bauman Moscow State Technical University. An author of more than 30 scientific papers on automation of medical and biological preparations analysis and image processing. e-mail: artyukhova@bmstu.ru

Yanovsky L.S. (b. 1948), Dr. Sci. (Eng.), Professor, Honored Worker of Science, Head of a Department of Baranov Central Institute of Aviation Motor Development. A leading scientist in the field of thermal physics, chemmotology, aviation fuels, lubricants, and special liquids. An author of more than 300 scientific papers.

Surikov Ye.V. , Ph.D., Head of a Division of Baranov Central Institute of Aviation Motor Development. A specialist in the field of mining bench rocket and jet engines.