EXACT SOLUTIONS FOR RADIATION TRANSPORT

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Exact solutions for the differential equations of mathematical physics are of interest to mathematicians all over the world because analytical formulas allow not only the fast and demonstrative study different physical phenomena but also the construction of test problems that help evaluate the accuracy of numerical algorithms. The most striking example is the exact solution for the strong point explosion problem obtained by Leonid. I. Sedov in 1946 [1]. The solution exerted a strong influence on the development of hypersonic flows theory and helped study a wide range of interesting and practically important problems in explosion theory.

At RFNC – VNIITF search for analytical solutions was started just after the institute was established by the to-be academicians Nickolay N. Yanenko and Anatoly F. Sidorov. In 1958 they found exact solutions for two-dimensional unsteady flows in a polytropic gas [2]. Their work was supported by Eugene I. Zababakhin, who later became RFNC – VNIITF Scientific Director. Zababakhin's focus was on cumulative processes and in 1960 he derived a self-similar solution for the Rayleigh problem on the collapse of bubbles in incompressible viscous fluid [3]. These accomplishments triggered a burst of efforts aimed to find exact solutions in different areas of hydrodynamics. In 1961 and 1962, V. E. Neuvazhayev solved gas outflow into vacuum for exponential energy release [4] and spherical shock propagation in a heat-conducting gas [5]. In 1963, V. A. Suchkov found a solution for shock-free compression of a 2D prism and gas outflow into vacuum from an oblique wall [6]. In 1964-1968, A.F. Sidorov found solutions for shock-free compression of a 3D polyhedron and gas outflow into vacuum from a 3D polyhedron [7–9]. In 1965, V. A. Simonenko derived a solution for a convergent shock in a heat-conducting gas [10]. In 1979–1986, M. Y. Kozmanov with coauthors found exact solutions for a system of energy and radiative transfer equations in different approximations [11–15]. In 1985, V. F. Kuropatenko and O. V. Buryakov obtained hydrodynamics solutions for a mixture of two gases [16]. In 1986, M. Y. Kozmanov and A. S. Nurbakov found exact solutions for radiative hydrodynamic [17]. RFNC – VNIITF scientists go on searching for new exact solutions and some of them are discussed in the paper.

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