Mathematical modeling of interaction of high-speed flows of gases and liquids with solids

Klinacheva N L[@], Zharylkanova M S, Shestakovskaya E S and Yalovec A P

South Ural State University, Lenin Avenue 76, Chelyabinsk 454080, Russia

[@] klinacheva_76@mail.ru

This paper presents the results of mathematical modeling of the interaction of high-speed gas flows with a solid. The developed software package is based on an algorithm that allows to jointly simulate the region of a gas flow, the motion of which is described by Eulerian variables and a solid body, which is described by Lagrangian variables. The system of equations of continuum mechanics in cylindrical coordinates is solved by the method [1], both for Eulerian and Lagrangian variables. Verification of the numerical algorithm was carried out on the following tasks: the piston problem, the outflow of gas from the Laval nozzle, the spread of detonation products (cylinder test). A comparison of the results obtained with the analytical solution [2,3] (the problem of the piston and the outflow of gas from the nozzle) and with experimental data on the expansion of the cylindrical shell under the action of detonation products [4] showed their good agreement. The presented software package makes it possible to calculate the thermodynamic parameters of media in problems of interaction of high-speed flows of gases and liquids with solids.

[1] Yalovec A P 1997 *Journal of Applied Mechanica and Technical Physics* **38** 137–150

[2] Loboiko B G, Dikov O Y and Smirnov E B 2007 *Collection of problems on gas dynamics of explosion* (Snezhinsk: VNIITF)

[3] Landau L D and Lifshic E M 1987 *Theoretical physics. Elasticity theory* (Moscow: Nauka)

[4] Lee C L, Hornig H C and Kury J W 1968 *Lawrence Radiation Laboratory,* 1–38