

**DEVELOPMENT OF AN APPROACH TO MATHEMATICAL SIMULATION OF DYNAMIC PROCESSES IN A SOLID-PROPELLANT ROCKET ENGINE**

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Working processes in the combustion chamber of a solid-propellant rocket engine (SPRE) are accompanied by a number of physical phenomena and effects, which are extremely complex and varied. In certain conditions, a complex SPRE working medium flow may be represented as a 1D axial flow, which is described by 1D ordinary differential equations of motion, momentum, and energy. To solve them, difference schemes are usually used. The goal of this work is to develop an approach to mathematical simulation of SPRE dynamic without recourse to traditional difference schemes. This paper presents a nonlinear mathematical model of SPRE working processes in the approximation of a 1D working medium flow and with account for its interaction with the SPRE structure. To solve the system of partial differential equations, the following methodological approach was proposed. The SPRE charge was divided into  $n$  sections, whose number was chosen to describe given acoustic modes of gas oscillations in the longitudinal direction. By replacing the spatial derivatives with difference quotients, the system of partial differential equations was reduced to a system of ordinary differential equations. The proposed approach was verified using a model SPRE. The simulation results showed the workability of the proposed approach and the stability of the numerical integration process at the adopted integration steps. The calculated time dependence of the pressure and the working medium discharge rate is in satisfactory agreement with the static characteristics. In this rocket model, accounting for the interaction of the SPRE working processes with the SPRE structure did not result in any significant change in the former because the acoustic frequencies of the working medium differ significantly from the longitudinal vibration frequencies of the rocket structure.

**Keywords:** *solid-propellant rocket engine, mathematical simulation, partial differential equation, difference scheme, ordinary differential equation.*

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