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**APPROACH TO NUMERICAL SIMULATION OF THE SPATIAL MOTIONS
OF A GAS/LIQUID MEDIUM IN A SPACE STAGE PROPELLANT TANK IN
MICROGRAVITY WITH ACCOUNT FOR THE HOT ZONE**

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Space propulsion systems ensure multiple startups and shutdowns of the main liquid-propellant rocket engines in microgravity conditions for spacecraft preset motions and reorientation control. During the passive flight of a space stage (after its main engine shutdown), the liquid propellant in the tanks continues moving by inertia in microgravity and moves as far away from the propellant management device as possible. In this case, the pressurization gas is displaced to the propellant management device, which creates the potential danger of the gas entering the engine inlet in quantities unacceptable for multiple reliable engine restarts. In this regard, the determination of the parameters of fluid movement in propellant tanks under microgravity conditions is a pertinent problem to be solved in the designing of liquid-propellant propulsion systems. This paper presents an approach to the theoretical calculation of the parameters of motion of the gas-liquid system in the propellant tanks of today's space stages in microgravity conditions. The approach is based on the use of the finite element method, the Volume of Fluid method, and up-to-date computer tools for finite-element analysis (Computer Aided Engineering - CAE systems). A mathematical simulation of the spatial motion of the liquid propellant and the formation of free gas inclusions in passive flight was performed, and the motion parameters and shape of the free liquid surface in the tank and the location of gas inclusions were determined. The liquid motion in a model spherical tank in microgravity conditions was simulated numerically with and without account for the hot zone near the tank head. The motion parameters of the gas-liquid interface in a model cylindrical tank found using the proposed approach are in satisfactory agreement with experimental data. The proposed approach will significantly reduce the extent of experimental testing of space stages under development.

Keywords: *space launch vehicle, microgravity, engine multiple startups, passive flight, space motion of liquid propellant, free gas inclusions, finite-element method, volume of fluid method, propellant management device.*

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