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ON THE CHOICE OF METHODS USED IN THE OPTIMIZATION OF ROCKET DESIGN PARAMETERS AND CONTROL PROGRAMS

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The aim of this work is to choose rational methods for solving the combined problem of the optimization of the design parameters, trajectory parameters, control programs, and basic characteristics of single-stage controlled rockets with solid-propellant sustainer engines at the initial design stage. The optimization parameters include rocket design parameters and trajectory parameters that allow one to form flight control programs in different flight segments. The parameters were optimized in such a way as to maximize the flight range objective function, i. e. the distance for which the rocket head is to be delivered with the required values of the kinematic parameters at the end of the flight. Algorithms and programs were developed to assess the efficiency of deterministic optimization methods, such as the Hooke–Jeeves zero-order pattern search, the Nelder–Mead zero-order polytope method, and first- and second-order coordinate gradient descent methods, in the solution of the combined problem. The use of the Hooke–Jeeves zero-order pattern search, which gives the optimization parameter vector closest to the global optimum of the objective function, was shown to be expedient. As shown by calculations, first- and second-order coordinate gradient descent methods and the zero-order polytope method require a comparatively larger number of iterations to find the optimal value of the optimization parameter vector. The flight range depends essentially on the values of the chosen optimization parameters. Because of this, the optimization of the chosen parameters (and, perhaps, other parameters too) in the solution of specific target problems seems to be an indispensable stage of controlled-rocket design. The optimization algorithms considered may be used without any significant modifications by design organizations at the initial design stage of space hardware of different purposes.

Keywords: *controlled object, solid-propellant sustainer rocket engine, initial design stage, design parameters, trajectory parameters, objective functional, deterministic optimization methods.*

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