深圳北理莫斯科大学
УНИВЕРСИТЕТ МГУ-ППИ В ШЭНЬЧЖЭНЕ
SHENZHEN MSU-BIT UNIVERSITY

应用数学讲座

Научный Семинар по Прикладной Математике

Research Seminar on Applied Mathematics

应用数学报告（72）

报告人 / Докладчик / Speaker: Cherkasov 副教授(深圳北理莫斯科大学)

题目 / Название / Title: Brachistochrone problem and two-dimensional Goddard problem

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摘要 / Аннотация / Abstract:
The motion of a point mass in a vertical plane under the action of gravity, linear viscous friction, support reaction of the curve, and the thrust is considered. The angle of inclination and the thrust are considered as control variables. The amount of fuel is indicated. The goal of the control is to maximize the horizontal coordinate of a point in a given time. The novelty of the paper lies in the fact that the structure of the optimal thrust is determined and the optimal synthesis is constructed in the three-dimensional space ‘‘slope angle-velocity-mass’’. For the case of a motion without friction, it is shown that the optimal thrust control takes boundary values, and the trajectory consists of two arcs, at the beginning with maximum thrust, and ending with zero thrust. The optimal synthesis in the three-dimensional space ‘‘slope anglevelocity-mass’’ is constructed for a specific area of the variables. For the case of linear viscous friction, an arc with an intermediate thrust can be included in an extreme trajectory. Assuming that the intermediate (singular) thrust satisfies the constraints, it is shown that the optimal thrust program consists of two arcs, maximum thrust at the beginning and zero thrust at the end, or three arcs: maximum thrust at the beginning, then intermediate thrust and zero thrust at the end. The following combination of arcs is also possible: zero thrust at the beginning, then an intermediate thrust and again zero thrust at the end. The logic of thrust control is similar to the well-known solution of the Goddard problem. The results of numerical simulation illustrating the theoretical conclusions are presented. The results are also valid for the Brachistochrone problem, which is interrelated to the range maximization problem. The results of numerical simulation illustrating the theoretical conclusions are presented.

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