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Principles of the theory of extremum and applications

The following principles would be discussed in the lecture : Lagrange principle for necessary condition, Hamilton and Jacobi ideas about perturbation of extremal problems and main principles on existence and algorithms. The final part of the lecture will be devoted to application of the theory of extremal problems to Natural Sciences, Economics, Technology and Mathematics.

The following four questions could be put about extremal problems:

- what are the conditions of extremum in an extremal problem (necessary, sufficient, necessary and sufficient)?
- how to describe the evolution of solutions if the problem is perturbed?
- weather the solution of the problem exists or not?
- how to find the solution numerically?

In the lecture some important general approaches to these questions will be discussed.

At the beginning of the lecture a survey of the basis of the theory together with a description of tools of investigation will be represented.

The honor of creation of general strategy for investigation of extremal problems with constraints relates to Lagrange.

The first paragraph is devoted to generalization of fundamental ideas of Lagrange.

In the second paragraph some abstract version of Hamilton–Jacobi theory would be represented.

In the next two paragraphs principles of existence, duality principles and some principles concerning algorithms are discussed.

The final paragraph is devoted to application of the theory to physics, problem of control in engineering, economics, etc and concrete extremal problems in mathematics.