

УДК 519.6

**A MAXIMUM PRINCIPLE UNDER WEAK ASSUMPTIONS OF REGULARITY  
IN MIXED CONSTRAINED PROBLEMS****A.V. Arutyunov** (*RUDN, Moscow*), **D.Yu. Karamzin** (*CCAS, Moscow*),  
**F.L. Pereira** (*University of Porto, Portugal*)

Our research is devoted to study of the Pontryagin Maximum Principle (MP) [1] for optimal control problems with mixed constraints. There are many authors who addressed this class of problems (see book [2] and the bibliography cited therein). Here, we obtain

- a simple proof of MP for a problem with generalized mixed constraints  $R(x,u,t) \in C$ , where  $C$  is closed and convex set;
- a simple observation which allows us to considerably weak the assumptions of regularity used in the previous work on mixed constraints.

Regularity assumptions are mandatory for problems with mixed constraints whenever it is required that the necessary conditions of optimality remain informative. In earlier research on this class of problems, the authors endowed the mixed constraints function with a global regularity condition which has to hold for every feasible control and for all points in the considered time interval. Here, we allow constraints to be regular only in a  $\delta$ -tube along the optimal control.

In our paper, we provide a new simple proof of the MP for a problem with mixed constraints based on a smooth variational principle, [3].

The research was supported by FCT grant SFRH/BPD/26231/2006 (Portugal) and RFBR project № 08-01-00092 (Russia), and also by the Project U&D-13-147 of FCT – Fundação para a Ciência e a Tecnologia.

**Bibliography**

- [1] *L.S. Pontryagin, V.G. Boltyanskii, R.V. Gamkrelidze, and E.F. Mishchenko*, *Mathematical Theory of Optimal Processes* [in Russian], Nauka, Moscow (1983).
- [2] *A.V. Arutyunov*. *Optimality conditions: Abnormal and Degenerate Problems. Mathematics and Its Application*. Kluwer Academic Publisher, 2000.
- [3] *A.D. Ioffe, V.M. Tikhomirov*. Several remarks on variational principles. *Mat. Zametki*, 61, № 2, 305-311 (1997).