About Research in Sverdlovsk-Ekaterinburg on Optimal Control Problems

NIKOLAY KRASOVSKII

Institute of Mathematics and Mechanics UrB RAS
Ekaterinburg, Russia
e-mail: nnkras@imm.uran.ru

Abstract

In the fifties of the last century, a group of scientific workers was formed in Sverdlovsk under supervision of two maîtres I.G. Malkin (1907-1958) and E.A. Barbashin (1916-1969) for implementing research in the theory of differential equations and its applications. The main direction of the research was the investigation of problems on stability including problems with high initial perturbations for ordinary dynamic systems, systems with aftereffect and stochastic systems. Due to appearance of works on the theory of optimal control the studies on problems of formation sustainable processes of optimal control were settled to the main stream of the research. These studies were connected, to a considerable degree, with the dynamic programming method of R. Bellman and the maximum principle of L.S. Pontryagin.

It is planned to give a retrospective review of the Sverdlovsk-Ekaterinburg research with the accent on some problem approaches and results which can be related, to some extent, to a class of the "seminal" results. The content is presented in a short and popular form. The stuff of the lecture is generated by research of authors who worked in Ural: E.G. Albrekht, A.V. Kryazhimskiy, A.B. Kurzhanskii, Yu.S. Osipov, A.I. Subbotin, V.E. Tretyakov, V.N. Ushakov, A.G. Chentsov, S.N. Shimanov. The following topics will be covered. (1) Solution of the time-optimal control problem for a linear system in the problem interpretation as a functional momentum problem. (2) Transformation of the necessary optimality conditions of the maximum principle into sufficient conditions of local optimality for a nonlinear system taking into account the controllability property of the system of linear approximation. (3) Problems of control and observation. (4) Problems of optimal stabilization of ordinary, hereditary and stochastic systems risen in papers by A.M. Letov and R.E. Kalman. (5) A conflict pursuit-evasion problem with transition to the general concept of a positional differential game. (6) The pursuit-evasion alternative on the basis of the family of "constructive" motions. (7) Transition to interpretation of results in the sense of the Hamiltonian formalization with the peculiar accent on the unification of differential games. (8) Integration of results of the theory of differential games with interpretation of the generalized minimax solutions introduced by A.I. Subbotin for the Hamilton-Jacobi equations. (9) Discussion of basic models.

Key Words: Optimal control, differential games, observation problems, stabilization, pursuit-evasion alternative, unification scheme, Hamilton-Jacobi equations