Russian Mathematics (Iz. VUZ) *Izvestiya VUZ. Matematika*
Vol. 42, No. 11, pp.45–52, 1998 *UDC 517.9*

RECONSTRUCTION OF CONTROLS AND PARAMETERS OF DYNAMICAL SYSTEMS UNDER INCOMPLETE INFORMATION

A.I. Korotkiĭ

The present article is devoted to investigation of the inverse dynamic problem on reconstruction of a priori unknown controls and parameters of dynamical systems in the conditions of incomplete information about current phase positions of the system by observation over informational sets. These sets are supposed to have a priori unknown phase states of the system. It is well-known that this problem is ill-posed. We suggest dynamical positional regularizing algorithms for solving the problem, which possess the property of physical realizability and can work in real time way. Results of [1]–[3], which use methods of the theory of positional control (see [4]–[8]) and methods of the theory of ill-posed problems (see [9]–[12]) are in the base of our constructions.

1. Statement of the problem

Let us consider a controllable dynamical system, whose current states are described by the phase vector $x = x(t) \in R^n$, which varies along the time t in correspondence with the differential equation

$$\dot{x} = f(t, x, u), \quad t_0 \le t \le \vartheta, \quad x(t_0) = x_0. \tag{1.1}$$

Here $f(t, x, u)$ is a given vector function, which reflects dynamical properties of the system; u is a vector of controlling actions upon the system (briefly, control, parameter), whose admissible (at a given instant t) values $u = u(t)$ obey some given geometrical restrictions

$$u(t) \in P \subset R^m, \tag{1.2}$$

which reflect the possibilities of the control or characterize known estimates of admissible change of the parameter.

From the point of view of its content, the problem under consideration consists of the following. Admit that an observation is realized over a controllable dynamical system (1.1) on the time segment $T = [t_0, \vartheta]$ $(-\infty < t_0 < \vartheta < +\infty)$. In observing the motion of the system, the observer gets a certain information which enables him only to estimate domains $G(t)$ (generally speaking, these are not assumed to be small) in the phase space R^n, which contain current values $x(t)$ of the phase vector x of the system. However, this information is not sufficient for either exact computation of the meaning of $x(t)$, or its satisfactory statistical description within the limits of this informational domain $G(t)$. We do not consider here the question about how the domains $G(t)$ are formed in dependence on a way of observation on system (1.1). We simply assume that the information, which comes to the observer before the instant $t \in T$, allows him to determine, by means of some operations, a domain $G(t)$; besides, we also assume that the observer cannot refine these data at the instant t so that he could find a smaller subdomain in the domain $G(t)$. Some ways to construct those observing operations were described, e. g., in [4], [5], [8]. The problem on reconstruction consists of finding a realization $u = u(t)$, $t \in T$, of controlling action (parameter)

Supported by Russian Foundation for Basic Research (grants 96-01-00846, 97-01-01060).