The study of a global asymptotic stability of nonlinear model of concrete mechanical system "inverted pendulum on a controlled cart" in conditions of continuously acting unmeasured perturbation with using the method of two Lyapunov functions [1] is performed. It is demonstrated that at given choice of Lyapunov functions and comparison functions the conditions of the basic theorems of the method are fulfilled, i.e. the system "inverted pendulum on a controlled cart" with discontinuous relay-type control, in above conditions is globally asymptotically stable. Here the solution of the nonlinear system is considered in the sense of Gelig et al.(see [1]). In addition, there is established the robustness property of above obtained stabilization algorithms relatively to nonideality of measurements of both "cart" and "pendulum" velocities, since there are no exact differentiators in practice (instead of them the approximative velocity measurements are used). Also, using the method of two Lyapunov functions [1] it is demonstrated that at given algorithm but with above replacement of ideal derivatives, the stability region persists, and its size, when small parameter $\mu \to 0$, essentially increases and in the limit coincides with the full phase space. The numerical simulation of behavior of such singularly perturbed nonlinear system "inverted pendulum on a cart" [2] with a relay-type control is performed [3]. The comparison with results of recent study of this system based on the technique of controlled Lagrangians with taking into account the Lie group symmetry and with a control in the form of sum of dissipative and conservative pieces is performed. The results of investigation of this system are applicable to analysis of a number of concrete problems of stability, e.g. monorail, fault tolerant control as well as satellites and underwater vehicles with internal rotors etc.

---

[1] V.A.Brusin and B.L.Mazov, Differential Equations, **35**, 626-33, (1999)
[2] B.L.Mazov, Int. Congress of Mathematicians ICM'02, Beijing, China , 2002, Abstr.Book, P.127.
[3] B.L.Mazov, math.DS/0312495 (2003) (preprint)