Construction of Lyapunov’s Functions for a Class of Nonlinear Systems

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Abstract: The conditions of absolute stability for a certain class of nonlinear systems are investigated. It is proved that the systems considered are absolutely stable iff for these systems there exist Lyapunov’s functions of the special form. The results obtained are used for the stability analysis of complex systems in critical cases.

Keywords: Nonlinear systems; Lyapunov’s functions; absolute stability; large scale systems.

Mathematics Subject Classification (2000): 34D20, 93D20, 93D30.

1 Introduction

One of the important problems arising in the investigation of nonlinear systems is the problem of absolute stability [1, 3, 8]. This problem is of both theoretical and applied significance. The main approach for the determination of conditions for the absolute stability is the Lyapunov direct method. By means of this approach, the criteria of absolute stability for many types of systems are obtained. However, it should be noted that until now there are no general methods of construction of Lyapunov’s functions for nonlinear systems.

In the present paper a certain class of differential equations systems is investigated. The method of construction of Lyapunov’s functions for these systems is suggested. The main goal of the paper is to prove that for the absolute stability of systems considered it is necessary and sufficient that the Lyapunov’s functions in the given form exist satisfying the assumptions of the Lyapunov asymptotic stability theorem [3].

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