



Stability Analysis for a Class of Nonlinear Nonstationary Systems via Averaging

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Abstract: A class of nonlinear nonstationary systems of Persidskii type is studied. The right-hand sides of the systems are represented in the form of linear combinations of sector nonlinearities with time-varying coefficients. It is assumed that the coefficients possess mean values. By means of the Lyapunov direct method, it is proved that if the investigated systems are essentially nonlinear, i.e. the right-hand sides of the systems do not contain linear terms with respect to phase variables, then the asymptotic stability of the zero solutions of the corresponding averaged systems implies the local uniform asymptotic stability of the zero solutions for original nonstationary systems. We treat both cases of delay free and time delay systems. Furthermore, it is shown that the proposed approaches can be used as well for the stability analysis of some classes of nonlinear systems with nontrivial linear approximation.

Keywords: *asymptotic stability; Lyapunov function; averaging technique; nonstationary systems; time delay.*

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1 Introduction

A general approach for the stability analysis of nonlinear systems is the Lyapunov direct method (the Lyapunov functions method). By means of this approach, the stability conditions for many types of systems were obtained, see, for example, [9, 11, 17–19, 26] and the references cited therein. However, it should be noted that until now there are no general constructive methods for the finding of Lyapunov functions for nonlinear systems.

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