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Diagonal Riccati Stability of a Class of Matrices and Applications

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Abstract: Necessary and sufficient conditions of the diagonal Riccati stability are derived for a class of pairs of matrices with special structures. The obtained conditions are used in the problems of analysis and synthesis of some types of time-delay systems. Results of numerical simulation are presented to illustrate the effectiveness of the proposed approaches.

Keywords: *diagonal stability; delay; Lyapunov–Krasovskii functional; complex system; asymptotic stability; consensus.*

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1 Introduction

The problem of diagonal Riccati stability was introduced in [15] and is motivated by the construction of the diagonal Lyapunov–Krasovskii functionals for linear time-delay systems.

In [4], a criterion for a given pair of matrices to be diagonally Riccati stable has been derived. This result extended the well known condition of Barker, Berman and Plemmons for the diagonal Lyapunov stability [7]. With the aid of this criterion, necessary and sufficient conditions of the existence of diagonal Lyapunov–Krasovskii functionals were found for linear positive differential and difference systems with delay [3, 4].

However, it should be noted that the conditions of the above criterion are not constructive enough. Therefore, an actual problem is to determine the classes of matrices for which simple and constructively verified necessary and sufficient conditions of the diagonal Riccati stability can be obtained. Some of such classes were found in [2, 5].

In the present paper, a class of pairs of matrices is studied. These matrices can be used for the modeling of complex systems composed of second order subsystems with a special structure of connections between the subsystems and with a delay in the feedback law. A criterion of the diagonal Riccati stability is derived for the matrices under consideration. Moreover, it is shown that the obtained result can be applied to the problems of analysis and synthesis of some types of time-delay systems.

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