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ROBUST STABILITY FOR NEUTRAL TIME-VARYING DELAY SYSTEMS WITH NON-LINEAR PERTURBATIONS

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Abstract. *This paper investigates the robust stability of linear neutral time-varying delay systems with non-linear perturbations. The uncertainties under consideration are nonlinear time-varying parameter perturbations and norm-bounded uncertainties, respectively. Using new Lyapunov-Krasovskii functional and integral inequality matrices, less conservative delay-dependent robust stability conditions for such systems in terms of linear matrix inequalities (LMIs) are derived. The linear matrix inequality can be easily solved by efficient convex optimization algorithms. Moreover, it can be easily extended to the system with time-varying structured uncertainties and time-varying discrete delay. Numerical examples are given to indicate significant improvements over some existing results.*

Keywords: Lyapunov-Krasovskii functional, Integral inequality matrix, Neutral system, Convex optimization algorithm, Linear matrix inequality

1. **Introduction.** Time-delay systems, which are also, sometimes, known as hereditary systems or systems with memory, aftereffects or time-lag, represent a class of infinite-dimensional systems, and are used to describe, among other types of systems, propagation and transport phenomena, population dynamics, economic systems, communication networks and neural network models. These issues have been studied intensively during the past decades. Results are readily available in the literature [1-20], and the references therein. There are two types of time-delay systems: the retarded and neutral. The retarded type contains delays only in its states, whereas the neutral type contains delays both in its states and in the derivatives of its states. As is well known, neutral systems are frequently encountered in various engineering systems, including population ecology, distributed networks containing lossless transmission lines, heat exchangers and repetitive control [1]. There are a lot of reports about stability conditions for neutral systems in the literature, such as [5-10,12,15,16,19] and the references therein. On the other hand, in practical systems, uncertainties can be seen everywhere, which make it more complex and more difficult to study the stability and control, and which are the roots of the unstable and poor performance for the systems. At present, the stability analysis and control for systems with time delay are the topics in the domain of control theory and control engineering, and attract more and more attention. For linear systems with time-varying delays, the reported results are generally based on the assumption that the derivative of time-varying delays is less than one, that is, $h_d < 1$ [2,7,8,11,12,14-16,18,20]. Such restriction is very conservative and of no practical signification. Recently, much attention has been focused on the study of linear system with delays, which is bounded but otherwise