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IMPROVED COMPUTATIONAL EFFICIENCY AND STABILITY CRITERIA FOR UNCERTAIN NEUTRAL SYSTEMS

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Abstract. *Much effort has been devoted to the stability analysis of neutral systems, while the computational efficiency of the stability conditions has not been well addressed in the existing work. Aiming to improve both robust stability criteria and their computational efficiency, this paper constructs an uncorrelated augmented matrix (UAM) for delay-dependent robust stability analysis of neutral systems with uncertainties. The UAM approach inherits the advantages of the augmented Lyapunov functional method, but discards free weighting matrices and model transformations. As a result, the computational efficiency of the robust stability analysis is significantly improved, and less conservative stability conditions are also obtained. Numerical examples are given to demonstrate the effectiveness of the proposed approach.*
Keywords: Neutral systems, Robust stability, Uncertainties, Delay-dependent stability

1. Introduction.

Neutral systems are a class of dynamic systems whose dynamics depend on delayed system state and its derivative. They represent a wide range of practical systems. Examples of neutral delay-differential systems include aircraft stabilization, chemical engineering systems, distributed networks, manual control, neural network, nuclear reactor, and population dynamic models [1, 2, 3].

Since stability is an essential requirement for many practical systems, including a wide range of neutral systems, stability analysis of neutral systems has received considerable attention in recent years. Introductions to delay-dependent stability results of neutral systems can be found in [1, 2, 4, 5, 6, 7, 8, 9] and references therein.

In the stability analysis of neutral systems, how to obtain improved stability conditions has been a focus for many years. Several approaches have been developed to reduce the conservativeness of delay-dependent conditions for neutral systems. Examples include the bounding technique [4, 10, 11, 12], the model transformation method [8, 13, 14], and the free weighting matrices method [5, 15, 16, 17, 18]. The free weighting matrices method has been shown to be less conservative than previous methods such as Park's inequality [4, 12] and the parameterized model transformation technique [8, 14].

Recently, much effort has been devoted to the investigation of the method of introducing augmented matrices into the Lyapunov functional candidate [15, 19, 20, 21, 22]. Generally speaking, the augmented matrices in Lyapunov functional candidate give one more potential relaxation than traditional methods [15]. However, in [15, 20, 21, 22], the free weighting matrices method and the model transformation technique are employed