

# Stability analysis for neural networks with discrete and leakage time-varying delay systems with delay-range-dependence and delay-derivative-dependence

Pin-Lin Liu<sup>1</sup>

<sup>1</sup>Chienkuo Technology University

June 14, 2021

## Abstract

The paper deals with the stability problem of neural networks with discrete and leakage interval time-varying delays. Firstly, a novel Lyapunov-Krasovskii functional was constructed based on the neural networks leakage time-varying delay systems model. The delayed decomposition approach (DDA) and integral inequality techniques (IIA) were altogether employed, which can help to estimate the derivative of Lyapunov-Krasovskii functional and effectively extend the application area of the results. Secondly, by taking the lower and upper bounds of time-delays and their derivatives, a criterion on asymptotical was presented in terms of linear matrix inequality (LMI), which can be easily checked by resorting to LMI in Matlab Toolbox. Thirdly, the resulting criteria can be applied for the case when the delay derivative is lower and upper bounded, when the lower bound is unknown, and when no restrictions are cast upon the derivative characteristics. Finally, through numerical examples, the criteria will be compared with relative ones. The smaller delay upper bound was obtained by the criteria, which demonstrates that our stability criterion can reduce the conservatism more efficiently than those earlier ones.

## Hosted file

Manuscript1\_Mathematical Methods in the Applied Sciences-202105-30.pdf available at <https://authorea.com/users/419732/articles/526135-stability-analysis-for-neural-networks-with-discrete-and-leakage-time-varying-delay-systems-with-delay-range-dependence-and-delay-derivative-dependence>

## Hosted file

Figs 1-4 \_Mathematical Methods in the Applied Sciences-202105-30.pdf available at <https://authorea.com/users/419732/articles/526135-stability-analysis-for-neural-networks-with-discrete-and-leakage-time-varying-delay-systems-with-delay-range-dependence-and-delay-derivative-dependence>

## Hosted file

Tables 1 -16-Revised 202105-30-Mathematical Methods in the Applied Sciences.pdf available at <https://authorea.com/users/419732/articles/526135-stability-analysis-for-neural-networks-with-discrete-and-leakage-time-varying-delay-systems-with-delay-range-dependence-and-delay-derivative-dependence>