Fully Connected Neural Network-Based Fixed-Time Adaptive Sliding Mode Control for Fuzzy Semi-Markov System

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***Abstract*—This article mainly explores the fixed-time control problem of fuzzy semi-Markov systems with uncertainties and unknown transition rates. Firstly, the T-S fuzzy semi-Markov system is established by using the membership relation of fuzzy logic and Markov probability property. Then, unlike the existing fixed-time control strategies, this work uses a hyperbolic sine function to replace the traditional multiple powers fixed-time control method and construct a novel fixed-time adaptive integral sliding mode control strategy, which reduces the complexity of the controller and adaptive law while optimizing the sliding mode surface and improving the fixed-time convergence performance of the system. Moreover, compared with current methods that require the assumption that the unknown function satisfies the Lipschitz condition or is bounded, the fully connected neural network is introduced to approximate the unknown nonlinear function in the system, improving the intelligence and practicality of the controller. Finally, the theoretical results are verified through numerical simulation, showing the superior performance of achieving fixed-time stability through the proposed control scheme, the gap in the study of fixed-time control using hyperbolic sine functions and fully connected neural networks is filled.**

***Index Terms*—Adaptive integral sliding mode control (SMC), fixed-time stability, fully connected neural network, fuzzy semi-Markov system.**

This work was supported in part by the National Natural Science Foundation of China under Grant 62236005, 61936004 and U1913602, the Departmental General Research Fund of ISE of Hong Kong Polytechnic University under grant no. G-UAPM and the Research Grants Council of Hong Kong under Grant 15206223.