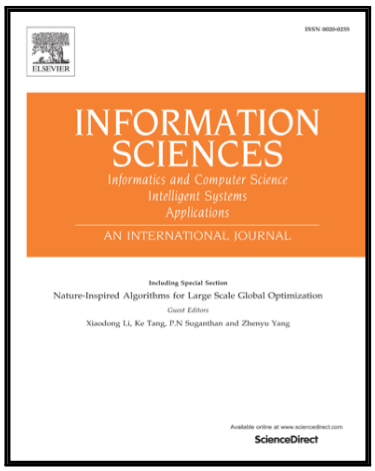


# Adaptive Sliding Mode Fault-Tolerant Control for Type-2 Fuzzy Systems with Distributed Delays

Yue Zhao, Jiahui Wang, Fei Yan, Yi Shen

PII: S0020-0255(18)30691-1
DOI: https://doi.org/10.1016/j.ins.2018.09.002
Reference: INS 13913

To appear in: *Information Sciences*

Received date: 15 March 2018
Revised date: 30 August 2018
Accepted date: 1 September 2018

Please cite this article as: Yue Zhao, Jiahui Wang, Fei Yan, Yi Shen, Adaptive Sliding Mode Fault-Tolerant Control for Type-2 Fuzzy Systems with Distributed Delays, *Information Sciences* (2018), doi: https://doi.org/10.1016/j.ins.2018.09.002

# Adaptive Sliding Mode Fault-Tolerant Control for Type-2 Fuzzy Systems with Distributed Delays

Yue Zhao[a], Jiahui Wang[b], Fei Yan[c,*], and Yi Shen[a]

[a] *Control Theory and Engineering, School of Astronautics, Harbin Institute of Technology, Harbin 150001, P.R. China*
[b] *College of Automation, Harbin Engineering University, Harbin 150001, P.R. China*
[c] *School of Information Science and Technology, Southwest Jiaotong University, Chengdu, 611756, P.R. China*

**Abstract**

In this paper, the problem of sliding-mode fault-tolerant control is addressed for a class of uncertain nonlinear systems with distributed delays and parameter perturbations. By using interval type-2 Takagi-Sugeno (T-S) fuzzy models, the nonlinear systems are formulated, of which uncertain parameters and distributed state delays are represented in a unified type-2 fuzzy framework. In order to tackle with the uncertain parameters in pre-designed membership functions, an adaptive mechanism is utilized to manage the time-varying weightings corresponding to the upper membership functions. A simple linear sliding surface subject to several solvable matrix inequalities is designed by using a reduced-order system. To guarantee the stability of the overall dynamic system, an adaptive sliding mode controller is designed, which can compensate for both uncertainties and distributed delays. Finally, a truck-trailer model system is used in simulations to verify the applicability and effectiveness of the control and estimation schemes.

*Keywords:* Fuzzy sets, sliding mode control, adaptive control, fault tolerance, time-delay systems.

*Corresponding author: Fei Yan
*Email address:* fyan@home.swjtu.edu.cn (Fei Yan)