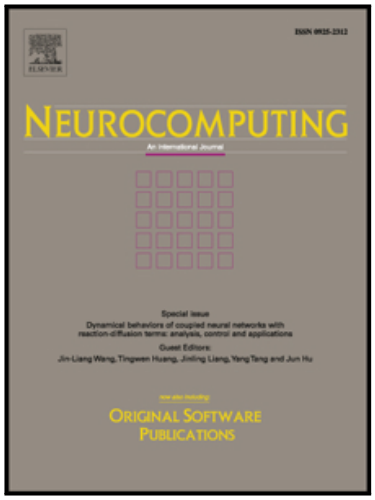
Communicated by Dr Bin xu

Accepted Manuscript



Adaptive neural flight control for an aircraft with time-varying distributed delays

Dawei Wu, Mou Chen, Huajun Gong

PII: S0925-2312(18)30472-7
DOI: 10.1016/j.neucom.2018.04.038
Reference: NEUCOM 19505

To appear in: *Neurocomputing*

Received date: 24 November 2017
Revised date: 17 March 2018
Accepted date: 1 April 2018

Please cite this article as: Dawei Wu, Mou Chen, Huajun Gong, Adaptive neural flight control for an aircraft with time-varying distributed delays, *Neurocomputing* (2018), doi: 10.1016/j.neucom.2018.04.038

Adaptive neural flight control for an aircraft with time-varying distributed delays

Dawei Wu, Mou Chen *, Huajun Gong

College of Automation Engineering, Nanjing University of Aeronautics and Astronautics, Nanjing 210016, PRC

Abstract: A novel adaptive neural network (NN) flight control law is developed for the high angle of attack (AOA) longitudinal motion control of an aircraft. Considering the unsteady effects, a new longitudinal dynamic model is proposed, which is an uncertain nonstrict-feedback nonlinear system with time-varying distributed delays. Via combining a variable separation technique with the Lyapunov-Krasovskii function method, a robust adaptive NN high AOA flight control scheme is designed. Only the direction of the control gains is needed in the developed controller. Meanwhile, to reduce the computational burden, only two adaptive parameters are needed in the proposed control law. It is proven that the closed-loop system is stable, and all the signals of the closed-loop system are bounded. Finally, simulations are given to confirm the effectiveness of the proposed control law.

Keywords: Flight control; distributed delay; nonstrict-feedback nonlinear system; input saturation; neural network.

1 Introduction

The post-stall maneuver is a typical feature of modern advanced fighters, which can greatly improve the maneuverability of the aircraft [1]. The unsteady aerodynamic modeling and the flight control law design are the keys to achieving the post-stall maneuver [2–4]. However, the aircraft suffers severe unsteady effects at high angle of attack (AOA), which is mainly caused by the drastic airflow separation and reattachment [5]. At present, the research of unsteady aerodynamic modeling is still at the stage of theoretical exploration [6]. Hence, the existing unsteady modeling methods are difficult to be used in the high AOA flight control.

Up to now, few high AOA flight control researches have considered the unsteady effects. In [7], the unsteady effects were taken as the system uncertainty and handled by the small perturbation method. In [8], the unsteady effects were considered in the design of high AOA flight control law, which was achieved through simple perturbation of the aircraft's aerodynamic parameters. In [9], the

*Corresponding author. E-mail: chenmou@nuaa.edu.cn.