

# Robust Adaptive Control of Hypersonic Flight Dynamics

## Bin Xu

Professor  
School of Automation  
Northwestern Polytechnical University, Xi'an, China

## Abstract

This talk addresses the dynamic surface control of hypersonic flight vehicle considering the aerodynamic uncertainty, wind effect and constraint on angle of attack (AOA). For aerodynamic uncertainty, the adaptive design using linearly parameterized form is proposed. Considering the dynamics is unknown, the neural learning based design is proposed using online recorded data. To deal with the disturbance caused by wind effect, the serial-parallel estimation model with intelligent approximation and disturbance estimation is built to obtain the prediction error. The highlight is that different from previous work directly towards asymptotic stability, the transparency of the intelligent approximation and disturbance estimation is included in the control scheme. Furthermore, considering the AOA constraint, the Barrier Lyapunov based robust design is proposed to guarantee the value can fall into the prescribed interval. Through simulation verification, the proposed approach obtains better performance with higher accuracy in case of uncertainty while the robust design can make sure of the bound of the AOA.

## About the speaker...



**Bin Xu** received the B.S. degree in measurement and control from Northwestern Polytechnical University, China, 2006 and the Ph.D. degree in Computer Science from Tsinghua University, China, 2012. He visited ETH Zurich from Mar 2010 to Mar 2011 and from Feb 2012 to Jan 2013 he was Research Fellow with Nanyang Technological University. He is currently professor with School of Automation, Northwestern Polytechnical University. His research interests include intelligent control and adaptive control with application to flight dynamics. Focusing on the characteristics of hypersonic flight vehicle, the problems of system uncertainty, time-varying disturbance, input saturation/nonlinearity, AOS constraint, rigid-flexible coupling are systematically studied. He has published 50 papers on flag-ship journals including IEEE Trans. on Neural Networks and Learning Systems, IEEE Trans. on Cybernetics, IEEE Trans. on Industrial Electronics, etc. Dr. Xu was a recipient of the Outstanding Young

Scholar Award in 2016 by the Natural Science Foundation of China and the Top-Notch Young Talents of China in 2018. Dr. Xu is an Associate Editor of IEEE Access, Neurocomputing, International Journal of Advanced Robotic Systems, Chinese Journal of Aeronautics and Science China Information Sciences.