



Safety, Survivability and Sliding Modes

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sliding mode control and observation with application to fault detection and fault tolerant control problems

Abstract

Sliding modes in dynamical systems have been historically studied because of their strong robustness properties to a certain class of uncertainty. In feedback control systems, this is achieved by employing nonlinear control/injection signals to force the system trajectories to attain, in finite time, a motion along a surface in the state-space. The associated reduced order dynamics the system exhibits, whilst constrained to the surface, is called the sliding motion. This motion possesses strong robustness properties to so-called matched uncertainty. These nonlinear injection techniques can also be applied to observer problem formulations, and result in intriguing properties. This talk will consider how sliding mode ideas can be exploited for fault tolerant control. The talk will attempt to demonstrate the practicality of these methods with examples of applications of these ideas to aerospace systems. This will include results demonstrating the successful real-time implementation of a sliding mode fault tolerant control scheme on a motion flight simulator configured to represent the aircraft associated with the EI-AL Bijlmermeer incident.

Biography

Christopher Edwards is a professor of control engineering in the College of Engineering, Mathematics and Physical Sciences at the University of Exeter, UK. He began his academic career in the Department of Engineering at the University of Leicester as a lecturer in 1996. He was promoted to a senior lecturer in 2004, a reader in 2008 and awarded a personal chair in 2010, before moving to the University of Exeter in 2012 as a professor of control engineering. He is a member of the IEEE and a member of the IMA (which constitutes chartered mathematician status). He is currently a member of the IEEE Technical Committee on Variable Structure Systems and a subject editor for the *International Journal of Robust and Nonlinear Control*. In 2006, Prof. Edwards was awarded a Royal Academy of Engineering Senior Research Fellowship. His current research interests are in sliding mode control and observation, and their application to fault detection and fault tolerant control problems. He is the author of over 250 refereed papers in these areas, and two books: *Sliding Mode Control: Theory and Applications* (1998), and *Fault Detection and Fault Tolerant Control Using Sliding Modes* (2011). In addition he recently co-edited the monograph *Fault Tolerant Flight Control: A Benchmark Challenge* (2010) based on GARTEUR AG16. He has been involved in the recent European FP7 project ADDSAFE which seeks to study state-of-the-art model based FDD techniques to assist in the 'greening' of aircraft to help reduce fuel consumption and carbon emissions.