



Active Fault Detection and Control

MIROSLAV ŠIMANDL

University of West Bohemia, Pilsen, Czech Republic

simandl@kky.zcu.cz

nonlinear estimation, fault detection, information fusion, adaptive control, system identification

Abstract

The talk will deal with the fault detection problem, which is a very important part of automatic control. Passive and active fault detection approaches that make it possible to increase safety and reliability and to reduce maintenance costs will be explained. The active fault detector, contrary to the passive one, generates not only decisions but also the input signal to the observed or controlled system. The stress will be laid on Active Fault Detection and Control (AFDC), which represents a challenging research topic and provides higher quality of detection and control compared to passive approaches. The talk will start with a brief introduction to passive and active fault detection systems. The idea of active fault detection will be presented and illustrated in a special case, where an active detector with a given input signal generator will be considered. Then, a unified formulation of the active fault detection and control problem for discrete-time stochastic systems and its optimal solution will be proposed. The design of the active fault detector and controller is formulated similarly as in the stochastic optimal control problem, where controller design can be carried out using three different assumptions on measurements availability at individual time steps. These three assumptions, denoted as the Open Loop (OL), Open Loop Feedback (OLF) and Closed Loop (CL) information processing strategies, can be used equally well in AFDC. The best results can be achieved using the CL strategy and the Bellman equation. Nonlinear filtering will also be discussed because the conditional probability density functions of state and output of an observed system are assumed to be known in the optimization problem. The general formulation includes several important special cases depending on how the detection and control aims are preferred. Additionally, constraints on the state and input will be introduced and their influence on the choice of the information processing strategy will be shown. The rest of the talk will focus on computational aspects and illustrative examples. For solving the optimization problem, approximation techniques will have to be applied. Similarly, efficient techniques of nonlinear filtering will be presented. The active fault detection and control system will be illustrated using numerical examples.

Biography

Miroslav Šimandl was born in Czechoslovakia in 1954. He received an Ing. (M.Sc.) degree in automatic control systems in 1978 and a CSc. (Ph.D.) degree in technical cybernetics in 1986, both from the Institute of Technology in Pilsen, Czechoslovakia. In the period of 1978-1992 he held various research and teaching positions at the Institute of Technology in Pilsen. During 1993-2001 he worked as an associate professor at the Department of Cybernetics, Faculty of Applied Sciences, University of West Bohemia (UWB) in Pilsen, Czech Republic. In 2002 he was appointed a professor of technical cybernetics at the UWB. His main research interests are in the fields of nonlinear estimation, fault detection, information fusion, adaptive control, and system identification. He is the author or co-author of more than 125 publications at international level. He has published the main results in prestigious journals of the field (*Automatica*, *IEEE Transactions on Automatic Control*) and at world congresses and symposia of the International Federation on Automatic Control, the American Control Conference, the IEEE Conference on Decision and Control, and the FUSION conference. He has been the principal investigator or a co-investigator of a number of projects of basic research. He has been a co-investigator of the Data-Algorithms-Decision Making Research Centre at the UWB. He has also headed or participated in several application projects for companies, e.g. fault detection for localization, and control of rolling mills. He is also a reviewer of several international journals, a member of program committees of the international IASTED and ACD conferences. He was a co-chair of the international program committee of the IFAC World Congress in Prague and is a member of the IFAC Technical Committee on Modeling, Identification and Signal Processing. He serves as the vice-rector for research and development at the UWB.