PREFACE

The safe and reliable operation of technical systems is of crucial importance, for the protection of human life and health, the environment, and the vested economic value. The correct functioning of those systems has a profound impact also on production costs and product quality. Early detection of faults is critical to the avoidance of performance degradation and damage to the machinery or human life. Accurate diagnosis then helps to make the right decisions on emerging actions and repairs. Moreover, fault tolerant design of technical facilities and their control systems plays an important role in mitigating the effect of faults and permitting safe operation even under faulty conditions. The present special issue covers most of the active research topics in this subject and gives a comprehensive overview of the present state of the art in fault detection and diagnosis as well as fault tolerant control strategies. The papers presented in the issue are selected from among the presentations delivered at the 8th Conference on *Diagnostics of Processes and Systems, DPS,* held in Słubice, Poland, in 2007.

Taking into account the large amount of knowledge about fault diagnosis and fault tolerant control, as well as the theory and practice presented in the papers, the issue is divided into the following parts: *Developments in Fault Diagnosis, Fault Tolerant Control* and *Applications.*

In the first part, the different fault diagnosis approaches are considered. In particular, a fast two-step algorithm to improve the robustness of principal component analysis is proposed. The algorithm avoids the combinatorial explosion of faulty scenarios related to multiple fault diagnosis to be considered. Because in modern fault diagnosis the classical analytical techniques often cannot provide acceptable solutions, in two papers neural network based fault diagnosis is studied. The difficult and important problem of multiple fault diagnosis is investigated and a new approach based on inconsistency analysis is proposed. In another paper, a measure of conditional contradictions of statements, which can be used for monitoring knowledge bases in running expert systems, is discussed. Another topical issue that is considered is stochastic change detection applied in connection with active fault diagnosis. The classical cumulative sum (CUSUM) test is modified with respect to active fault diagnosis. There are also two papers on sensor placement, one of which proposes a new approach to sensor placement based on diagnosability criteria. The other one is devoted to the problem of fault detection in distributed parameter systems. A computational scheme is provided for the design of a network of observation locations in a spatial domain that are supposed to be used while detecting changes in the parameters of the system considered.

The next part is devoted to networked control systems and fault tolerant control. In particular, a very interesting review of the state of the art in networked control systems is described. In another paper, mechanisms of fault tolerance to actuator faults in a control structure with a predictive constrained setpoint optimizer are proposed. An approach to designing a fault tolerant control system with the use of suboptimal methods is investigated as well.

In the last part, the papers are devoted to various applications. In one of them, the method of the extraction of the information about faults from the symptom observation matrix by means of singular value decomposition in the form of generalized fault symptoms is studied. The method is illustrated by processing data from the machine vibration condition monitoring area. Three approaches to the detection of defects in continuous production processes, which are based on local methods of processing image sequences, are also presented. The last paper is devoted to fault diagnosis of a water for injection system using the enhanced structural isolation approach.

We wish to thank all Authors for their excellent contributions and fruitful collaboration during the editorial process, as well as the anonymous Referees for their silent work.

Józef Korbicz
Institute of Control and Computation Engineering
University of Zielona Góra, Poland

Dominique Sauter
Research Centre for Automatic Control
Nancy University, France

December 2008