

Diagnosis and Fault-tolerant Control

Lectures

by

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Synopsis

Fault-tolerant control aims at graceful degradation of automates systems in case of faults. It satisfies industrial demands for enhanced availability and safety, in contrast to traditional implementations where a supervisory system just make a sudden shut down, and hence cause loss of availability, when a fault is detected. The lectures present effective model-based analysis and design methods for fault diagnosis and fault-tolerant control.

The lectures provide participants with an understanding of theory and methods that have proven worthy in practical applications.

The lectures use examples from marine control and navigation to illustrate the theory.

Lecture material:

1. Blanke, Kinnaert, Lunze and Staroswiecki: Diagnosis and Fault-tolerant Control, Springer 2003. ISBN 3-540-01056-4
2. A copy of the slides used at the lectures will be available as pdf files.
3. Lorentzen and Blanke: Users Manual for SaTool - a Tool for Structural Analysis of Automated Systems. Section of Automation at Ørsted-DTU, Technical University of Denmark, April 2004.

Part One

Diagnosis and fault-tolerant control in context. Structural analysis, a graph-based method to cope with fundamental system properties in a very efficient way. Demonstration of SaTool, a prototype tool to perform structural analysis and generate parity relations for nonlinear systems.

Chapters 1 and 5.1-5.3

Part two.

Design of residual generators for the nonlinear and linear cases using parity relations. Change detection using a stochastic approach that has proven robust in many real applications, Chapter 6.1-6.2 and parts of 6.4

Part three

Change detection continued. Fault-tolerant implementation that provide graceful degradation

when a fault is diagnosed. Practical architectures for fault-tolerant sensor fusion and control.
Example: fault-tolerant sensor fusion for navigation.
Chapter 7.1-7.4.

CV for lecturer

Mogens Blanke is professor of automatic control at the Technical University of Denmark (DTU). He was formerly five years with the Marine Automation Industry and developed various automation systems, including systems for automatic steering and manoeuvring, roll damping and diesel engine control.

His present research has fault-tolerant automation of systems as the main area. Specific theoretic interests include autonomous fault-tolerance, fault-diagnosis, systems architecture design to obtain desired safety properties, system modelling, identification and control. Application experience includes the areas of spacecraft control, marine systems, and autonomous robotics.

Industrial utilization was done through several collaborative activities with industry. Successful collaboration with Sauer-Danfoss created a patent pending fault-tolerant steering by wire system. A project with American Power Conversion has created prototype tools to include fault-tolerant design into products. The control system for the Danish Ørsted satellite (in operation in space since 1999), was designed and build by M. Blanke and his team in Aalborg who employed fault-tolerant principles for the attitude control of the satellite.

In addition to authorship of 140 academic research papers, Mogens Blanke is one of the four authors of the recent textbook *Diagnosis and Fault-tolerant Control*.