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Diagnosis and fault-tolerant control. With contributions by Jochen Schröder. (English)

Zbl 1023.93001

Berlin: Springer. xvii, 571 p. (2003).

The book introduces the main ideas of fault diagnosis and fault-tolerant control. It gives a systematic survey of the new methods that have been developed in recent years and illustrates them by application examples. It is important to mention that all major aspects of fault-tolerant control are treated for the first time in a single book from a common viewpoint. All steps of fault-tolerant control are considered. It is shown how the information gained by model-based diagnosis can be used to find remedial actions that adapt the control algorithms to the faulty conditions in order to keep the system in operation. With respect to fault accommodation and control reconfiguration, the book presents the current state of the art. The fault diagnostic parts of the book describe those methods and ideas which can be used to identify the fault with sufficient detail. Several models of dynamical systems are introduced. It is shown how these models can be used in fault-tolerant control. To find the cause-effect chains from the primary faults and to measure fault symptoms, a component-oriented description of the system architecture is used. A structural analysis is introduced to elaborate the analytical redundancies that can be used for fault diagnosis and fault-tolerant control actions. Well-known continuous system representations like the state-space model and the transfer function, diagnostic methods and their extensions to fault-tolerant control algorithms are used. Further novel material that has not yet been described in monographs or textbooks concerning the presentation of diagnostic and reconfiguration methods for discrete-event systems and quantized systems is provided in the book. The book is organized according to the different models used. As each of these models requires its own mathematical background and the methods based on these models follow different lines of thinking, the book does not represent the methods in all detail. It gives a broad view on the field and provides bibliographical notes for further reading. The content of the book is structured in chapters as follows: Introduction to diagnosis and fault-tolerant control, Examples, Models of dynamical systems, Analysis based on components and architecture, Structural analysis, Fault diagnosis of continuous-variable systems, Fault-tolerant control of continuous-variable systems, Diagnosis and reconfigurable control of discrete-event systems, Diagnosis and reconfiguration of quantized systems, Application examples, Bibliographical notes, References, and Appendices. All chapters start with an explanation of the main ideas and illustrate all results by examples. The common use of these examples in all chapters makes a comparison of the alternative approaches very easy. The book provides models, ideas and methods for solving different problems of fault diagnosis and fault-tolerant control. It enables a control engineer to tackle a practical problem of fault-tolerant control under the circumstances given by the particular field of application. The book also contains a review on some basics in the appendices. Its understanding requires knowledge about dynamical systems and controller design. Many figures illustrate the problems, methods and results in an intuitive way and make the interpretation of the rigorous mathematical treatment easier. It will be of great benefit for the graduate students of control, electrical, mechanical or process engineering with knowledge in control, continuous system theory and filtering.

Reviewer: [Tzvetan Semerdjiev \(Sofia\)](#)

MSC:

- 93-02 Research exposition (monographs, survey articles) pertaining to systems and control theory
- 93B51 Design techniques (robust design, computer-aided design, etc.)
- 90B25 Reliability, availability, maintenance, inspection in operations research
- 93E10 Estimation and detection in stochastic control theory
- 93C65 Discrete event control/observation systems
- 93B30 System identification

Cited in **2** Reviews
Cited in **69** Documents

Keywords:

fault detection; fault tolerance; system state and parameters estimation; system identification; control systems applications; control reconfiguration; fault diagnosis; discrete-event systems; quantized systems