

## Book Reviews

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**DIAGNOSIS AND FAULT-TOLERANT CONTROL**, by M. Blanke, M. Kinnaert, J. Lunze and M. Staroswiecki, with contributions by Jochen Schröder, Springer, Berlin, 2003, hardback, xv + 571 pp., ISBN 3-540-01056-4 (£77.00).

There are many processes where overall failure would be expensive or even catastrophic and there is reason to use one of the techniques described in this book. A distinction is made between reliability achieved, expensively, by physical redundancy or simple duplication of facilities, and that achieved by analytical redundancy. In the latter the fault is diagnosed using a model and the controller is automatically redesigned so that the closed-loop system including the faulty plant satisfies the given specification. Model-based fault-tolerant control is a cheaper way to enhance the dependability of systems than traditional methods based on physical redundancy.

The above is of course an oversimplified picture, since the use of physical redundancy also requires some means of identifying the faulty component. It is also clear that means of achieving fault-tolerant operation should allow continued safe operation and not just a quick fix, and in fact the remedial action may be the means of averting catastrophic failure.

In the Preface it is claimed that the book introduces the main ideas of fault diagnosis and fault-tolerant control, including methods introduced in recent years. It is believed that this is the first work

offering such coverage, with the further advantage of treating all the methods from a common viewpoint. Some of the material is in fact published here for the first time. One aspect of the common viewpoint is that all the methods are discussed in the context of two examples, one a simple tank system and the other a ship controller.

The tank example is very simple, with only two possible faults considered, and is obviously devised to be introductory. The example of the ship controller, however, refers to what seems to be a real problem in the navigation of bulk carriers and supertankers. In the final chapter a further set of applications is discussed. This includes a three-tank liquid handling system that no longer has the “toy problem” character of the introductory example. It also includes fault-tolerant control of a chemical process, and of a ship propulsion system, and of a steam generator. The chapter ends with a very comprehensive set of guidelines for implementation of fault-tolerant control.

Methods are described for the continuous-variable situation, and separately for operation with discrete variables, which can be appropriate where monitoring devices give discrete indications of aspects of plant operation. The hybrid situation where continuous variables are quantised by assignment to ranges is also treated. Familiarity with appropriate mathematics, and particularly control theory, is needed. Statistical considerations enter throughout, and the continuous-variable treatments invoke, among other topics, optimisation and Kalman filtering, while the discrete case depends on automaton theory. The reader is helped by summaries of the necessary mathematical theory in Appendices.

The four authors have respective affiliations in Belgium, Denmark, France and Germany and the book is the outcome of a project funded by the European Science Foundation between 1995 and 1999. The material stems from their work along with colleagues and Ph.D. students. A useful spin-off from the multinational origin is an Appendix listing the main technical terms with their equivalents in German, French and Danish.

It is rather surprising that there seems to be no connection with what would seem to be a related field, namely work on error-detecting and error-correcting coding in information transmission, recently admirably reviewed by MacKay.<sup>1</sup>

The book under review must clearly be unrivalled as the standard textbook and reference source in its field.

## Reference

1. D. J. C. MacKay, *Information Theory, Inference, and Learning Algorithms* (Cambridge University Press, Cambridge, 2003).