Fault-Tolerant Control Systems: Design and Practical Applications

Hassan Noura, Didier Theilliol, Jean-Christophe Ponsart and Abbas Chamseddine
Springer London, (2009),
233 pp., Hardbound, 209 USD, ISBN 978-1-84882-652-6

Fault-Tolerant Control Systems is formatted to be a primer textbook on the title subject and no doubt has been used for that specific purpose since its publication in 2009. However, I find that it suffers from a "curse of knowledge" writing style which adds unnecessary difficulties to an already difficult field of study.

I like the primer format of the book with theoretical derivations in Chapter 2, supported and supplemented by descriptions, design and experimental results conducted on the three experimental models given in the next three chapters. But unless you are a mathematician, I would not recommend reading Chapter 2 straight through — only as a mathematical reference when working through each example. Fortunately the table of contents is in a descriptive outline format that makes it easy to find specific concepts as they are needed.

Although the text mentions the importance of fault-tolerant control design in other fields, the examples and text have a focus on industrial processes and controlling processes to maximize profit. A majority of citations listed throughout the book are simple bibliographic listings and are not actual references for the development of the text.

The hardcover printing has several instances of sentences repeated verbatim, which adds nothing to the text, and a few half-paragraph, copy-and-paste duplications which adds to the confusion.

Chapter 2 is a rigorous development of the mathematics used to define a system and its control logic. Unfortunately, several "curse of knowledge" type faults make the chapter more difficult than it needs to be. Instructive examples are given but not in sufficient detail to allow duplicating the example results by the reader. Mathematical terms are used in equations before they are defined. Specialized terminology, jargon and abbreviations (for example: Brunovsky canonical form, diffeomorphism, switching surface, reaching law, Page-Hinkley test, "d" faults, "ν–d" faults, ARX, PRBS, LQ, and Luenberger observer) are used without definition or reference.

The control model examples given in the remaining chapters assume that the reader is proficient in and has access to MATLAB/Simulink, which can be a fairly expensive assumption.

The analysis in Chapter 3 of a winding machine is not given in enough detail to duplicate. The analysis is basically an overview description of the control system that the authors developed for their particular winding machine and graphs of how it performed under various sensor and actuator faults. Bits of MATLAB code are given; however, variable names are not defined, and again, there is no way for the reader to apply the code. Important steps are glossed over with minimal explanation. Chapter 3 ends up reading more like a test report than an instructive example.

In Chapter 4 the analysis of a three-tank system is the "Hello World" example for control system design. Here, the authors give the reader access to a MATLAB simulation; however, I was disappointed to find the simulation has restricted access and cannot be downloaded except by registered teaching staff passcode. Even without the benefit of the simulation, the text concentrates on analyzing the particular system rather than explaining the design of the control.

The active suspension control system developed in Chapter 5 promises to be the most completely described and fully developed model in the text, but unfortunately its MATLAB simulation is not shared. Each of the three models seems to fall short of its full potential as a teaching aid.

Presently, *Fault-Tolerant Control Systems* appears to be restricted to the usefulness as a very specific graduate textbook. Future editions should concentrate on increasing its accessibility.

Jon W. Mooney
KJWW Engineering Consultants
Rock Island, IL 61201, USA
acoustics@jwmooney.com