Preface to the Second Edition

It has been encouraging to receive comments and suggestions on this book of *Robust Control Design with MATLAB®* since it was published in 2005. And, we are now very pleased to take the opportunity to offer our readers the 2nd edition of the book.

Robustness is of crucial importance in control systems design, because real engineering systems are vulnerable to external disturbance and measurement noise, and there are always discrepancies between mathematical models used for design and the actual system in practice. Typically a control engineer is required to design a controller which will make the closed loop system stable and achieve certain performance levels in the presence of disturbance signals, noise interference, unmodeled plant dynamics and plant parameter variations. The purpose of this book is to help post-graduate students and control engineers learn how to use well-developed, advanced robust control system design methods and the state-of-the-art MATLAB® tools in practical design cases.

A major feature of the second edition is the inclusion of an introduction to the use of the Robust Control Toolbox®3, as a new Part II between "Basic Methods and Theory" (Part I) and "Design Examples" (now Part III). Main function routines available in Robust Control Toolbox®3, ranging from building dynamic plant models and uncertainty models, systems stability and performance analysis to design of $\mathcal{H}_\infty$ and μ as well as parameter-dependent controllers, are introduced in this new Part II. With relatively simple examples, such as the *mass–spring–damper* system, which is widely used in teaching laboratories of control engineering courses, usage of those MATLAB® routines is explained and illustrated at a level easier to be understood by readers, which of course follows the guidance in writing this book. In addition to this new Part II and correction of a few minor errors in the first edition, there is also a new chapter in Part I on introduction to Linear Matrix Inequalities (LMI). Although LMI is not directly used in those examples presented in Part III, it is indirectly used in some controller solution procedures. With its value in control systems analysis and design and its popularity, a brief introduction on LMI's basic properties and use in control engineering would be welcomed by users, we hope. There are also some changes in Part III. The *mass–spring–damper* sys-

tem case has now been moved to Part II for illustration of using Robust Control Toolbox®3 function routines. The *robust control of a rocket* case has been removed. Instead, we now include two other design examples, namely *robust control of a twin-rotor aerodynamic system* and *robust control of self-balancing two-wheeled robot*. These two new examples are very popular experimental devices widely available in control teaching laboratories. Inclusion of these examples will better help readers to understand robust control design methods and to practice their own design which can be tested and verified in their own experiments. All design examples in Part III are realistic case studies. They are presented in Part III in detail. These design exercises are all conducted using Robust Control Toolbox®3. It is the authors' hope that studying these examples with attached programs used in all designs, with minimum exposure of theory and formulas in earlier parts of the book, will help readers obtain essential ideas and useful insights of several important robust control systems design approaches, including $\mathcal{H}_\infty$ and related methods and μ-synthesis methods, and develop their own skills to design real-world industrial, robust control systems.

The authors are indebted to several people and institutions who helped them in the preparation of the book. We are particularly grateful to The MathWorks, Inc. for their continuous support, to Professor Sigurd Skogestad of Norwegian University of Science and Technology who kindly provided the nonlinear model of the Distillation Column, to Associate Professor Georgi Lehov from Technical University of Russe, Bulgaria, who developed the uncertainty model of the Flexible-Link Manipulator and to Associate Professor Tsonyo Slavov from Technical University of Sofia, Bulgaria, who developed the Simulink® model of the Hydro Turbine Gain Scheduling Control. As always, help from the Springer Editors and comments from the Series Editors in preparing this second edition are highly appreciated.

Using the Downloadable Material

For readers who purchased this book, supporting material, comprised of six folders with 170 M- and MDL-files intended for design, analysis, and simulation of the six design examples in Part III, plus five folders containing 35 files with the examples from Part II, plus a Readme.m file and a pdf, hypertext version of the book can be downloaded from http://www.springer.com/978-1-85233-938-8.

In order to use the M- and MDL-files the reader should have at his/her disposition MATLAB® version R2011a or higher, with Robust Control Toolbox®3, Control System Toolbox v9.1 and Simulink® v7.7. The design and experiments with the last two examples (*Twin-Rotor Aerodynamic System* and *Self-Balancing Two-Wheeled Robot*) are performed with MATLAB® version R2007b in order to have compatibility with the corresponding third-party software for real-time control. Please note also that the programs downloadable are different from those contained on the CD ROM distributed with the first edition of the book, for the convenience of readers to

use the later version of Robust Control Toolbox instead of using functions from the obsolete μ-toolbox.

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http://www.springer.com/978-1-4471-4681-0

Robust Control Design with MATLAB®
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2013, XXI, 468 p. 367 illus., 113 illus. in color. With online files/update., Softcover
ISBN: 978-1-4471-4681-0