



Introduction to

Dynamics and Control in Mechanical Engineering Systems

Cho W. S. To

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INTRODUCTION TO DYNAMICS AND CONTROL IN MECHANICAL ENGINEERING SYSTEMS

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To my uncle
Mei Chang Cai (a.k.a. Muljanto Tjokro)

Series Preface

The Wiley-ASME Press Series in Mechanical Engineering brings together two established leaders in mechanical engineering publishing to deliver high-quality, peer-reviewed books covering topics of current interest to engineers and researchers worldwide.

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Preface

It is understood that there are many excellent books on system dynamics, control theory, and control engineering. However, the lengths of the majority of these books are of the order of six or seven hundred pages or more. There are, however, very few books that cover sufficient material and are limited to around 300 pages. The present book is aimed at addressing the balance. While it is more concise than those longer books, it does include many detailed steps in the example solutions. The author does believe that the detailed steps in the example solutions are essential in a first course textbook.

This book is based on lecture notes that have been developed and used by the author since 1986. These lecture notes have been employed in courses such as Mechanical Control and Process Control, as well as Dynamics and Control. The first two courses were taught by the author at the University of Western Ontario, London, Ontario, Canada while the third course has been given by the author at the University of Nebraska, Lincoln, Nebraska, USA, since 1996. All three courses have primarily been taken by junior undergraduates with majors in mechanical engineering and chemical engineering. Therefore, the subject matter dealt with in this book covers material for a first course of three credit hours per semester in system dynamics or control engineering. For a course in Mechanical Control or Process Control the material in the entire book, except the second half of Chapter 4, has been used. For a course in Dynamics and Control the material in the entire book except Chapter 11 has been covered. For a four credit hour course, the component of laboratory experiments has been omitted from the present book for two main reasons. First, the inclusion of the laboratory experiments is not feasible in the sense that its inclusion would increase drastically the length of the book. Second, nowadays many laboratory experiments are computer-aided in the sense that major software is required. Exclusion of laboratory experiments in the present book provides freedom for the instructors to select a particular software and allows them to tailor the design of their experiments to the availability of laboratory instrumentation in a particular department or engineering environment.

Under normal conditions, it is expected that the students using the present book have already taken courses in their sophomore year. These courses include linear algebra and matrix theory, a second course in mathematics with Laplace transformation, and engineering dynamics. In addition, students are expected to be able to use MATLAB, which is introduced during their first year or first semester of their sophomore year.

Acknowledgments

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Finally, the author would like to express his sincere thanks to Paul Petralia, Senior Editor, Clive Lawson, Project Editor, Anne Hunt, Associate Commissioning Editor, and their team members for their assistance and effort in the production of this book.

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