Preface

Do we need another textbook on classical control? Who needs another textbook on classical control when there are a few dozen existing ones that we have learned or taught from, such as *Modern Control Systems* (11th Edition) by Dorf and Bishop, *Feedback Control of Dynamic Systems* (5th Edition) by Franklin, Powell, and Emami-Naeini, *Modern Control Engineering* (4th Edition) by Ogata? No, we by no means believe that we can do a significantly better job in presenting the classical control theory to justify the writing of another textbook on the subject. However, we believe that the development of modern optimal and robust control theory in the last 30 years now calls for a significant change in the teaching of classical control. It is our goal to integrate the modern optimal and robust control theory into the classical control theory using tools already available from the context of classical control. We hope this objective has been achieved in our book.

Obviously, we still include a significant portion of the well-known classical control material in our work, albeit with some twists whenever appropriate in consideration of recent developments and the available modern computational tools. For example, we completely take out the material on the signal flow graph covered in many classical control textbooks, provide significant coverage on two-degree-of-freedom control, add Kharitonov robust stability results of polynomials, discuss in detail the effects of nonminimum phase zeros on the system performance and their relationship with overshoot and undershoot, and introduce a Routh table method for computing the 2-norm of a signal. Instead of introducing the detailed techniques of drawing an accurate root locus, we emphasize on how to quickly sketch a root locus with minimum effort indicating the trend of the root loci to help the analysis and design of a control system, leaving the detailed work to modern computational tools. In the frequency-domain analysis, we introduce a completely new method to visualize frequency responses from the Riemann sphere in addition to the classical Bode diagram, Nyquist plot, and Nichols chart. It turns out that this representation of a frequency response on the Riemann sphere is arguably the most natural method of considering the robustness issue of dynamical systems.

We add considerable material on modern optimal and robust control without introducing undue advanced tools. Consequently, we limit our presentation to single-input and single-output (SISO) systems with rational transfer functions. We do this to avoid the introduction of state space techniques which are widely used in modern optimal and robust control theory in dealing with multi-input and multi-output (MIMO) systems, but which require advanced linear algebra tools. On the other hand, we have tried to make the book self-contained and we have tinted parts of the text containing sophisticated mathematical reasoning to indicate that these parts may be skipped without affecting the basic understanding of the book.

We have intentionally tried to keep the book as short as possible so that most of the materials in the book can be covered in a one-semester course. Hence, we have faced many tough choices and ultimately this book reflects our own preference. We do intend to expand our presentation and coverage beyond this book in the future through a web site. We expect to update and improve our presentation continuously as we receive more feedbacks from readers. Hence a web site is maintained (**http://www.ee.ust.hk/∼eeqiu/minisites/ifc**), where readers can obtain updates, corrections, and additional materials related to the book and post their comments and feedback to the authors.

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This book is written for the next generation of engineers, researchers, and practitioners interested in feedback control. We dedicate this book to the next generation of our families, Luna Qiu, Celina Qiu, Eric Zhou, Catherine Zhou, and Albert Zhou.

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