Guang-Ren Duan

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Analysis and Design of Descriptor Linear Systems

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Analysis and Design of Descriptor Linear Systems

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To Shichao and Jiefu

Preface

Descriptor linear systems theory is an important part in the general field of control systems theory, and has attracted much attention in the last two decades. In spite of the fact that descriptor linear systems theory has been very rich in content, there have been only a few comprehensive books on this topic, e.g., Campbell (1980), Campbell (1982), and Dai (1989b). There do exist some other books and some PhD thesises related to descriptor systems, but they are all focused on very special topics.

This book aims to provide a relatively systematic introduction to the basic results in descriptor linear systems theory. The whole book has 11 chapters, and focuses on the analysis and design problems on continuous-time descriptor linear systems. Materials about analysis and design of discrete-time descriptor linear systems are not included. Besides most of the fundamental context, it also contains some of the author's research work, which are reflected in the topics of response analysis, regularization, dynamical order assignment, eigenstructure assignment, and parametric approaches for observer design, etc.

Many researchers in the world have made great contribution to descriptor linear systems theory. Owing to length limitation and the structural arrangement of the book, many of their published results are not included or even not cited. I would extend my apologies to these researchers.

Most of the materials of the book have been lectured by the author himself in the spring terms of 2002∼2005 in a postgraduate course at Harbin Institute of Technology. My colleagues, Prof. Zhi-Bin Yan and Dr Cang-Hua Jiang, assisted me in lecturing this course in the spring terms of 2006∼2008, respectively, and have helped a lot in proofreading the manuscripts. Prof. Zhi-Bin Yan, Prof. Xian Zhang and Dr Ai-Guo Wu have all coauthored with me a few papers, which have been included in this book. Here, I would like to express my heartfelt appreciation of their contribution.

All my graduate and PhD students and those who took the graduate course "Descriptor Linear Systems" at Harbin Institute of Technology in the spring terms of 2002∼2008 have offered tremendous help in finding the errors and typos in the manuscripts. Their help has greatly improved the quality of the manuscripts, and is indeed very much appreciated. Dr Hai-Hua Yu, Dr Ai-Guo Wu, Dr Bing Liang, Dr Yan-Ming Fu, Dr Ying Zhang, Dr Liu Zhang, Dr Yong-Zheng Shan, and Dr Hong-Liang Liu, who were really my PhD students years ago, have helped me

with the indices, the references, and the parts of the revision of the book. My present Ph.D students, Mr. Da-Ke Gu, Mr. Shi-Jie Zhang, Ms. Ling-Ling Lv, Mr. Yan-Jiang Li, Ms. Shi Li, and Mr. Guang-Bin Cai, all helped me with the examples of the book. Particularly, Dr Hai-Hua Yu, besides all the above, has helped me with the whole formatting of the book. I would extend my great thanks to all of them. My thanks would also go to my colleague, Prof. Hui-Jun Gao, who once was in 2003 a student in my class of the course, has proofread several chapters of the book as well.

I would also like to thank my wife, Ms Shi-Chao Zhang, for her continuous support in every aspect. Sincere thanks also go to my secretary, Ms Ming-Yan Liu, for helping me in typing a few chapters of the manuscripts. Part of the book was written when I was with the Queen's University of Belfast, UK, from September 1998 to October 2002. I would like to thank Professor G. W. Irwin and Dr S. Thompson for their help, suggestions, and support. The reviewers of the book have given some real valuable and helpful comments and suggestions, which are indeed very much appreciated.

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At the last, let me thank in advance all the readers for choosing to read this book. I would be indeed very grateful if readers could possibly provide, via email: g.r.duan@hit.edu.cn, feedback about any problems found. Your help will certainly make any future editions of the book much better.

Harbin Institute of Technology, *Guang-Ren Duan*
12 December 2009

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