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## Series Editors' Foreword

The series *Advances in Industrial Control* aims to report and encourage technology transfer in control engineering. The rapid development of control technology has an impact on all areas of the control discipline. New theory, new controllers, actuators, sensors, new industrial processes, computer methods, new applications, new philosophies..., new challenges. Much of this development work resides in industrial reports, feasibility study papers and the reports of advanced collaborative projects. The series offers an opportunity for researchers to present an extended exposition of such new work in all aspects of industrial control for wider and rapid dissemination.

Hard disk drive systems are ubiquitous in today's computer systems and the technology is still evolving. There is a review of hard disk drive technology and construction in the early pages of this monograph that looks at the characteristics of the disks and there it can be read that: "bit density... continues to increase at an amazing rate", "spindle speed... the move to faster and faster spindle speeds continues", "form factors... the trend... is downward... to smaller and smaller drives", "performance... factors are improving", "redundant arrays of inexpensive disks... becoming increasingly common, and is now seen in consumer desktop machines", "reliability... is improving slowly... it is very hard to improve the reliability of a product when it is changing rapidly" and finally "interfaces... continue to create new and improved standards... to match the increase in performance of the hard disks themselves". To match this forward drive in technology, control techniques need to progress too and this is the main reason why Professor Chen and his coauthors T.H. Lee, K. Peng and V. Venkataramanan have produced this second edition of their well-received *Advances in Industrial Control* monograph *Hard Disk Drive Servo Systems*.

The monograph opens with two chapters that create the historical context and the system modeling framework for hard disk drive systems. These chapters are followed by the control and applications content of the monograph. Hard disk drive systems are beset by nonlinear effects arising from friction, high-frequency mechanical resonances and actuator saturation so any control methods used have to be able to deal with these physical problems. Furthermore, there are two operational modes to contend with: track seeking and track following each with different performance specifications. The type of control solution proposed by Professor Chen and his coau-

thors emerges from the interplay between the desire to mitigate the nonlinear effects and yet find a control strategy to unify the control of the two operational modes. To reveal the strategy developed in this Foreword would be like prematurely revealing the ending of a fascinating mystery story.

The monograph also has other valuable features: Chapter 3 contains succinct presentations of five different control methods with formulas given for both continuous and discrete forms. Two chapters on nonlinear control follow that covering linear control techniques. These chapters review classical time-optimal control and introduce the relatively new composite nonlinear feedback (CNF) control method. Again, presentations are given in both the continuous-time and discrete-time domains for completeness.

The second part of the monograph comprises five applications studies presented over five chapters. Whilst the first three of these chapters test out the control methods discussed in earlier chapters, the last two chapters introduce new applications hardware into the hard disk drive servo system problem: micro drive systems and piezoelectric actuators; nonlinear system effects are prominent in these new hardware systems.

Overall, it is an excellent monograph that exemplifies the topicality of control engineering problems today. Many lecturers will find invaluable material within this monograph with which to enthuse and motivate a new generation of control engineering students. Right at the end of this monograph, Professor Chen and his coauthors have extracted a benchmark control design problem for a typical hard disk drive system. The authors present their solution and “invite interested readers to challenge our design”, so happy reading and computing!

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