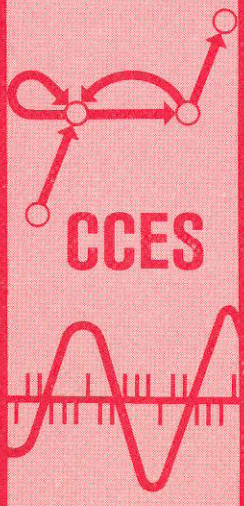

S. Bittanti · A. J. Laub
J. C. Willems (Eds.)

The Riccati Equation

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Frontispiece: Portrait of Count Jacopo Riccati reproduced by courtesy of the municipal library of Castelfranco Veneto (TV), Italy

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Preface

Conceived by Count Jacopo Francesco Riccati more than a quarter of a millennium ago, the Riccati equation has been studied in subsequent centuries by a number of distinguished scientists, including several members of the Bernoulli family, L. Euler and J. Liouville, to name but a few. The last thirty years have witnessed a considerable renaissance of the research around this equation, stemming from the widespread developments in and diffusion of systems and control concepts and applications. Indeed, since its introduction in control theory at the beginning of the sixties, the Riccati equation has known an impressive range of applications, such as linear quadratic optimal control, stability theory, stochastic filtering and stochastic control, synthesis of linear passive networks, differential games and, more recently, H_∞-control and robust stabilization.

The state of the art in this area was reviewed at a recent Workshop on the Riccati Equation in Control, Systems, and Signals held in Como (Italy) June 26-28, 1989. This workshop constituted the foundation from which the idea of this book germinated.

The purpose of this book is to present a self-contained treatment of the main issues evolving around the Riccati equation, in particular theory, applications, and numerical algorithms. The book, which consists of coordinated tutorial chapters written by different authors, is intended as a graduate text as well as a reference for scientists, especially engineers, and mathematicians.

The organization is as follows. Chapter 1 is devoted to the history and pre-history of the Riccati equation. Chapters 2 and 3 supply a comprehensive view of the algebraic Riccati equation, mainly based on a linear algebra approach. A geometrical analysis of the equation is carried out in Chapters 4 and 5. Chapters 2 to 5 deal with the constant coefficient case. The periodically time-varying Riccati equation is the subject of Chapter 6. The leading numerical techniques for the solution of the Riccati equation are overviewed in Chapter 7. The remaining four chapters address connections between the Riccati equation and some important problems in systems and control. More precisely, in Chapter 8, the role of the Riccati equation in the study of dissipative systems is elucidated. The linear quadratic optimal control problem in its various facets is the subject of Chapters 9 and 10. Finally, a unified survey on generalized Riccati equations in dynamic games is presented in Chapter 11.

The book is reasonably self-contained, but the reader should have some familiarity with basic concepts in system theory and linear algebra. Section 2 of

Chapter 2 presents a concise overview of some of these concepts. Some knowledge of geometric concepts is also useful, mainly for Chapters 4 and 5.

The editors would like to express their sincere thanks and acknowledgment to all authors for care and diligence in providing their contribution.

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Conceived by Count Jacopo Francesco Riccati more than a quarter of a millennium ago, the Riccati equation has been widely studied in subsequent centuries. Since its introduction in control theory in the sixties, the matrix Riccati equation has known an impressive range of applications, such as optimal control, H_∞ optimization and robust stabilization, stochastic realization, and synthesis of linear passive networks, to name but a few.

This book consists of 11 chapters surveying the main concepts and results related to the matrix Riccati equation, both in continuous and discrete time. Theory, applications, and numerical algorithms are extensively presented in an expository way. As a foreword, the history and prehistory of the Riccati equation are concisely presented.

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