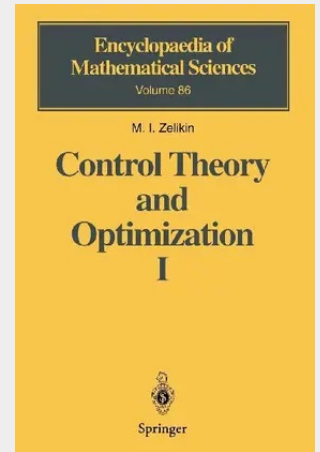


Control Theory and Optimization I

Homogeneous Spaces and the Riccati Equation in the Calculus of Variations

This book is devoted to the development of geometric methods for studying and revealing geometric aspects of the theory of differential equations with quadratic right-hand sides (Riccati-type equations), which are closely related to the calculus of variations and optimal control theory. The book contains the following three parts, to each of which a separate book could be devoted: 1. the classical calculus of variations and the geometric theory of the Riccati equation (Chaps. 1-5), 2. complex Riccati equations as flows on Cartan-Siegel homogeneity domains (Chap. 6), and 3. the minimization problem for multiple integrals and Riccati partial differential equations (Chaps. 7 and 8). Chapters 1-4 are mainly auxiliary. To make the presentation complete and self-contained, I here review the standard facts (needed in what follows) from the calculus of variations, Lie groups and algebras, and the geometry of Grassmann and Lagrange-Grassmann manifolds. When choosing these facts, I prefer to present not the most general but the simplest assertions. Moreover, I try to organize the presentation so that it is not obscured by formal and technical details and, at the same time, is sufficiently precise. Other chapters contain my results concerning the matrix double ratio, complex Riccati equations, and also the Riccati partial differential equation, which the minimization problem for a multiple integral arises in. The book is based on a course of lectures given in the Department of Mechanics and Mathematics of Moscow State University during several years.

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