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A typical multivariable control problem requires the design of dynamic compensation to guarantee the following desirable behavior of the closed loop system. 1. Each of an assigned set of output...

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(1976). Poles and zeros of linear multivariable systems : a survey of the algebraic, geometric and complex-variable theory. International Journal of Control: Vol. 24, No. 1, pp. 33-74.

Poles and zeros of linear multivariable systems : a survey ...

A linear system with multiple-inputs and/or -outputs is called a linear multivariable system (or linear a MIMO system). The history of the emergence of multivariable linear control systems theory is written nicely in Pearson (1991) describing how Kalman's state space approach appeared after Freeman and Kavanagh's multivariable control

Control Of Linear Multivariable Systems

W.M. Wonham. Springer New York, 1985 - Gardening - 334 pages. 0 Reviews. In wntmg this monograph my aim has been to present a "geometric" approach to the structural synthesis of multivariable...

Linear Multivariable Control: A Geometric Approach - W.M ...

Wonham is the author and co-author of about seventy-five research papers, as well as the book Linear Multivariable Control: A Geometric Approach. Wonham is a Fellow of the Royal Society of Canada and the Institute of Electrical and Electronics Engineers (IEEE).

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In writing this monograph my objective is to present arecent, 'geometrie' approach to the structural synthesis of multivariable control systems that are linear, time-invariant, and of finite dynamic order. The book is addressed to graduate students specializing in control, to engineering scientists engaged in control systems research and development, and to mathematicians with some previous acquaintance with control problems. The label 'geometrie' is applied for several reasons. First and obviously, the setting is linear state space and the mathematics chiefly linear algebra in abstract (geometrie) style. The basic ideas are the familiar system concepts of controllability and observability, thought of as geometrie properties of distinguished state subspaces. Indeed, the geometry was first brought in out of revulsion against the orgy of matrix manipulation which linear control theory mainly consisted of, not so long ago. But secondlyand of greater interest, the geometrie setting rather quickly suggested new methods of attacking synthesis which have proved to be intuitive and economical; they are also easily reduced to matrix arith metic as soonas you want to compute. The essence of the 'geometrie' approach is just this: instead of looking directly for a feedback laW (say u = Fx) which would solve your synthesis problem if a solution exists, first characterize solvability as a verifiable property of some constructible state subspace, say J. Then, if all is weIl, you may calculate F from J quite easily.

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This monograph is aiming at researchers of systems control, especially those interested in multiagent systems, distributed and decentralized control, and structured systems. The book assumes no prior background in geometric control theory; however, a first year graduate course in linear control systems is desirable. Since not all control researchers today are exposed to geometric control theory, the book also adopts a tutorial style by way of examples that illustrate the geometric and abstract algebra concepts used in linear geometric control. In addition, the matrix calculations required for the studied control synthesis problems of linear multivariable control are illustrated via a set of running design examples. As such, some of the design examples are of higher dimension than one may typically see in a text; this is so that all the geometric features of the design problem are illuminated.

"Control theory represents an attempt to codify, in mathematical terms, the principles and techniques used in the analysis and design of control systems. Algebraic geometry may, in an elementary way, be viewed as the study of the structure and properties of the solutions of systems of algebraic equations. The aim of this book is to provide access to the methods of algebraic geometry for engineers and applied scientists through the motivated context of control theory" .* The development which culminated with this volume began over twenty-five years ago with a series of lectures at the control group of the Lund Institute of Technology in Sweden. I have sought throughout to strive for clarity, often using constructive methods and giving several proofs of a particular result as well as many examples. The first volume dealt with the simplest control systems (i.e., single input, single output linear time-invariant systems) and with the simplest algebraic geometry (i.e., affine algebraic geometry). While this is quite satisfactory and natural for scalar systems, the study of multi-input, multi-output linear time invariant control systems requires projective algebraic geometry. Thus, this second volume deals with multi-variable linear systems and pro jective algebraic geometry. The results are deeper and less transparent, but are also quite essential to an understanding of linear control theory. A review of * From the Preface to Part 1. viii Preface the scalar theory is included along with a brief summary of affine algebraic geometry (Appendix E).

The foundation of linear systems theory goes back to Newton and has been followed over the years by many improvements such as linear operator theory, Laplace Transformation etc. After the World War II, feedback control theory has shown a rapid development, and standard elegant analysis and synthesis techniques have been discovered by control system workers, such as root-locus (Evans) and frequency response methods (Nyquist, Bode). These permitted a fast and efficient analysis of simple-loop control systems, but in their original "paper-and-pencil" form were not appropriate for multiple loop high-order systems. The advent of fast digital computers, together with the development of multivariable multi-loop system techniques, have eliminated these difficulties. Multivariable control theory has followed two main avenues; the optimal control approach, and the algebraic and frequency-domain control approach. An important key concept in the whole multivariable system theory is "ob servability and controllability" which revealed the exact relationships between transfer functions and the state variable representations. This has given new insight into the phenomenon of "hidden oscillations" and to the transfer function modelling of dynamic systems. The basic tool in optimal control theory is the celebrated matrix Riccati differential equation which provides the time-varying feedback gains in a linear-quadratic control system cell. Much theory presently exists for the characteristic properties and solution of this Riccati equation.

An excellent introduction to feedback control system design, this book offers a theoretical approach that captures the essential issues and can be applied to a wide range of practical problems. Its explorations of recent developments in the field emphasize the relationship of new procedures to classical control theory, with a focus on single input and output systems that keeps concepts accessible to students with limited backgrounds. The text is geared toward a single-semester senior course or a graduate-level class for students of electrical engineering. The opening chapters constitute a basic treatment of feedback design. Topics include a detailed formulation of the control design program, the fundamental issue of performance/stability robustness tradeoff, and the graphical design technique of loopshaping. Subsequent chapters extend the discussion of the loopshaping technique and connect it with notions of optimality. Concluding chapters examine controller design via optimization, offering a mathematical approach that is useful for multivariable systems.