Solution Of Polynomial Lyapunov And Sylvester Equations

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single variable, constituting the so-called polynomial Lyapunov equation (PLE): (1) R(? ?) T X(?) + X(? ?) T R(?) = Z(?). Here R(?) , X(?) and Z(?) are q × q real polynomial matrices in the indeterminate

Solution of polynomial Lyapunov and Sylvester equations

A two-variable polynomial approach to solve the one-variable polynomial Lyapunov and Sylvester equations is proposed. Lifting the problem from the one-variable to the two-variable context gives rise to associated lifted equations which live on finite-dimensional vector spaces.

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Solution Of Polynomial Lyapunov And Sylvester Equations

Merely said, the solution of polynomial lyapunov and sylvester equations is universally compatible with any devices to read Analysis and Synthesis of Polynomial Discrete-Time Systems-Mohd Shakir Md Saat 2017-07-10 Analysis and Synthesis of Polynomial Discrete-time Systems: An SOS Approach addresses the analysis and design of polynomial discrete-time control

Solution Of Polynomial Lyapunov And Sylvester Equations ...

The equation ('+,)Y(';,) modR=Q(')T?Q(,) (4) in the unknownR-canonical symmetric two-variable polyno- mial matrixY 2 Cq‡q R;sym. [';,] is called the lifted polynomial Lyapunov equation (LPLE). Solvability of the PLE is equiv- alent to solvability of the LPLE, as the following proposition shows.

A new algorithm to solve the polynomial Lyapunov equation

A two-variable polynomial approach to solve the one-variable polynomial Lyapunov and Sylvester equations is proposed. Lifting the problem from the one-variable to the two-variable context gives rise to associated lifted equations which live on finite-dimensional vector spaces.

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Lyapunov function. In the majority of applications steady flows are better than unsteady flows. Steady flows are usually associated with smaller fuel consumption, less fatigue, and less noise. Theoretically, a steady flow always exists as a solution of the governing equations. However, in engineering applications fluid flows are usually unsteady, or even turbulent, because the corresponding steady flow is unstable, that is, if disturbed it will never return to the steady state.

Polynomial sum of squares in fluid mechanics

associated lifted polynomial Lyapunov equa-tion which lives on a ?nite-dimensional vector space. This allows for the design of an iterative solution method which A new algorithm to solve the polynomial Lyapunov equation require the construction of polynomial Lyapunov functions. The simplest class of polynomial Lyapunov function is the

Solution Of Polynomial Lyapunov And Sylvester Equations

First, positive polynomial system is obtained via the local property of the Lyapunov function as well as its derivative. Then, the positive polynomial system is converted into an equation system by adding some variables. Finally, numerical technique is applied to solve the equation system. Some experiments show the efficiency of our new algorithm.

Constructing the Lyapunov Function through Solving ...

Let p = p (x ?) be a polynomial of degree m ? 2. If p (x ?) is positive definite in R n, then for any d ? m + 1 and every polynomial q (x ?) of the form ? i = m + 1 d q i (x ?), where q i (x ?) is either the zero polynomial or a homogeneous polynomial of degree i, there is a neighborhood U of the origin such that the sum p (x ?) + q (x ?) is positive definite in U. Proof

Discovering polynomial Lyapunov functions for continuous ...

Lyapunov functions and obtain an ERA given by the level set of these functions. These methods rely on the solution of non-convex constraints given by polynomial inequalities derived with the Positivstel-lensatz [8, Theorem 2.14] and require a coordinate-wise search since some polynomial variables appear multiplying the Lyapunov function.

Region of Attraction Analysis Via Invariant Sets

Furthermore, a Lyapunov function can always be found by finding the positive-definite solution to the matrix Lyapunov equation (1) P A + A T P = ? Q, for any Q = Q T ? 0. This is a very powerful result - for nonlinear systems it will be potentially difficult to find a Lyapunov function, but for linear systems it is straight-forward.

Underactuated Robotics: Lyapunov Analysis

By increasing the degree of the approximating SOS polynomial, we again obtain a hierarchy of SDP problems to compute the desired Lyapunov function. Then, we derive the corresponding algorithms for those two techniques, which can be seen as an adaptation of tools available in the literature on polynomial optimization.

Cone-Copositive Lyapunov Functions for Complementarity ...

The simultaneous Lyapunov sector obtained here is the maximum sector for a certain choice of the Lyapunov matrix equation, or more specifically for an arbitrary positive definite matrix Q in eq. (27), which means that the thus obtained sector is not necessarily the maximum simultaneous Lyapunov sector for the given nonlinear feedback system.However, it should be emphasized that the ...

Matrix Lyapunov Equation - an overview | ScienceDirect Topics

Recently, a method was proposed by Goulart & Chernyshenko for exploiting the sum-of-squares (SOS) decomposition [7,8] to construct polynomial Lyapunov functionals differing from E, thus extending the range of Re in which the flow can be proved to be globally stable. In this approach, the Navier–Stokes equations are first reduced to a finite-dimensional uncertain dynamical system, that is a system of ordinary differential equations (ODEs) with right-hand side containing terms for which only ...

Sum-of-squares of polynomials approach to nonlinear ...

sum of squares programs, whose solution directly provides a stabilizing controller and a Lyapunov function. We then derive variations of this result that lead to more advantageous controller designs. The results also reveal connections to the problem of designing a controller starting from a least-square estimate of the polynomial system. I ...

This Festschrift, published on the occasion of the sixtieth birthday of Yutaka - mamoto ('YY' as he is occasionally casually referred to), contains a collection of articles by friends, colleagues, and former Ph.D. students of YY. They are a tribute to his friendship and his scienti?c vision and oeuvre, which has been a source of inspiration to the authors. Yutaka Yamamoto was born in Kyoto, Japan, on March 29, 1950. He studied applied mathematics and general engineering science at the Department of Applied Mathematics and Physics of Kyoto University, obtaining the B.S. and M.Sc. degrees in 1972 and 1974. His M.Sc. work was done under the supervision of Professor Yoshikazu Sawaragi. In 1974, he went to the Center for Mathematical System T- ory of the University of Florida in Gainesville. He obtained the M.Sc. and Ph.D. degrees, both in Mathematics, in 1976 and 1978, under the direction of Professor Rudolf Kalman.

This book provides the mathematical foundations of networks of linear control systems, developed from an algebraic systems theory perspective. This includes a thorough treatment of questions of controllability, observability, realization theory, as well as feedback control and observer theory. The potential of networks for linear systems in controlling large-scale networks of interconnected dynamical systems could provide insight into a diversity of scientific and technological disciplines. The scope of the book is quite extensive, ranging from introductory material to advanced topics of current research, making it a suitable reference for graduate students and researchers in the field of networks of linear systems. Part I can be used as the basis for a first course in Algebraic System Theory, while Part II serves for a second, advanced, course on linear systems. Finally, Part III, which is largely independent of the previous parts, is ideally suited for advanced research seminars aimed at preparing graduate students for independent research. "Mathematics of Networks of Linear Systems" contains a large number of exercises and examples throughout the text making it suitable for graduate courses in the area.

Analysis and Synthesis of Polynomial Discrete-time Systems: An SOS Approach addresses the analysis and design of polynomial discrete-time control systems. The book deals with the application of Sum of Squares techniques in solving specific control and filtering problems that can be useful to solve advanced control problems, both on the theoretical side and on the practical side. Two types of controllers, state feedback controller and output feedback controller, along with topics surrounding the nonlinear filter and the H-infinity performance criteria are explored. The book also proposes a solution to global stabilization of discrete-time systems. Presents recent developments of the Sum of Squares approach in control of Polynomial Discrete-time Systems Includes numerical and practical examples to illustrate how design methodologies can be applied Provides a methodology for robust output controller design with an H-infinity performance index for polynomial discrete-time systems Offers tools for the analysis and design of control processes where the process can be represented in polynomial form Uses the Sum of Squares method for solving controller and filter design problems Provides MATLAB® code and simulation files of all illustrated example

This book reviews new results in the application of polynomial and rational matrices to continuous- and discrete-time systems. It provides the reader with rigorous and in-depth mathematical analysis of the uses of polynomial and rational matrices in the study of dynamical systems. It also throws new light on the problems of positive realization, minimum-energy control, reachability, and asymptotic and robust stability.

This book presents recent research on the stability analysis of polynomial-fuzzy-model-based control systems where the concept of partially/imperfectly matched premises and membership-function dependent analysis are considered. The membership-function-dependent analysis offers a new research direction for fuzzy-model-based control systems by taking into account the characteristic and information of the membership functions in the stability analysis. The book presents on a research level the most recent and advanced research results, promotes the research of polynomial-fuzzy-model-based control systems, and provides theoretical support and point a research direction to postgraduate students and fellow researchers. Each chapter provides numerical examples to verify the analysis results, demonstrate the effectiveness of the proposed polynomial fuzzy control schemes, and explain the design procedure. The book is comprehensively written enclosing detailed derivation steps and mathematical derivations also for readers without extensive knowledge on the topics including students with control background who are interested in polynomial fuzzy model-based control systems.

Mathematical models are used to simulate, and sometimes control, the behavior of physical and artificial processes such as the weather and very large-scale integration (VLSI) circuits. The increasing need for accuracy has led to the development of highly complex models. However, in the presence of limited computational accuracy and storage capabilities model reduction (system approximation) is often necessary. Approximation of Large-Scale Dynamical Systems provides a comprehensive picture of model reduction, combining system theory with numerical linear algebra and computational considerations. It addresses the issue of model reduction and the resulting trade-offs between accuracy and complexity. Special attention is given to numerical aspects, simulation questions, and practical applications.

This book focuses on methods to solutions regarding matrix equations: algebraic, periodic, and unilateral Riccati equations, Lyapunov equations, Silvester equations, generalized Silvester equations, and factorization of matrix polynomials in continuous and discrete cases. These equations are used to solve problems of the synthesis of optimal controllers. Also presented is the problem of the synthesis of optimal controllers in the frequency domain when measuring part of the phase coordinates. A general parameterization algorithm is proposed for its solution. The well-known parameterizations (Youla–Jabr–Bongiorno (1976) and Desoer–Liu–Murrau–Saeks (1980)) are demonstrated by us to form a special case of the proposed general parameterization algorithm. The obtained results can be applied to solve various problems in oil production by the gas-lift method and rod pump systems, unmanned aerial vehicles, and walking machines. Each section is illustrated by examples. The MATLAB environment is used for numerical solution of the problems. The book is intended for students and experts in applied mathematics and control systems theory.

This volume on mathematical control theory contains high quality articles covering the broad range of this field. The internationally renowned authors provide an overview of many different aspects of control theory, offering a historical perspective while bringing the reader up to the very forefront of current research.