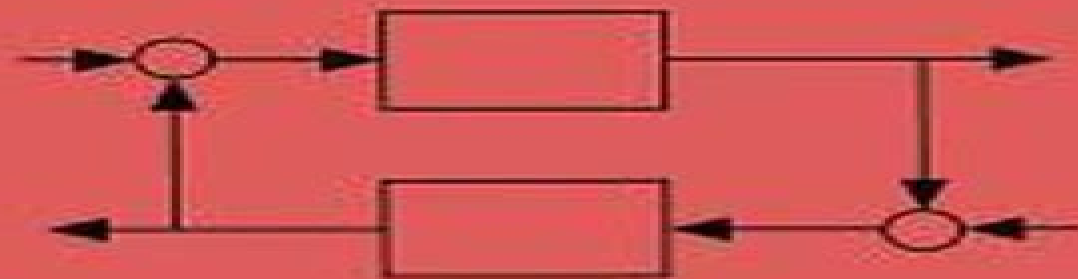


Lecture Notes in Control and Information Sciences 221

Atul Kelkar and Suresh Joshi

Control of Nonlinear Multibody Flexible Space Structures



Springer

Control Of Nonlinear Multibody Flexible Space Structures

G. Cooperman, G. Michler, H. Vinck



Control Of Nonlinear Multibody Flexible Space Structures:

Control of Nonlinear Multibody Flexible Space Structures Atul G. Kelkar, Suresh M. Joshi, 2014-03-12 Addressing the difficult problem of controlling flexible spacecraft having multiple articulated appendages is the aim of this volume. Such systems are needed for space mission concepts including multi payload space platforms and autonomous space based manipulators. These systems are characterised by highly nonlinear dynamics, flexibility in members and joints, low inherent damping and modeling uncertainty. A complete nonlinear rotational dynamic model of a generic multibody flexible system is derived and is shown to possess certain passivity properties. The main result is a class of passivity based nonlinear and linear output feedback control laws that enable globally stable closed loop manoeuvres. The control laws are robust to parametric uncertainties, unmodeled uncertainties and in some cases actuator and sensor nonlinearities. All results given are also applicable to flexible terrestrial manipulators.

Robust Control of Nonlinear Multibody Flexible Space Structures Atul G. Kelkar, 1993

Control of Nonlinear Flexible Space Structures Jianjun Shi, 2005 With the advances made in computer technology and efficiency of numerical algorithms over last decade, the MPC strategies have become quite popular among control community. However, application of MPC or GPC to flexible space structure control has not been explored adequately in the literature. The work presented in this thesis primarily focuses on application of GPC to control of nonlinear flexible space structures. This thesis is particularly devoted to the development of various approximate dynamic models, design and assessment of candidate controllers and extensive numerical simulations for a realistic multibody flexible spacecraft, namely Jupiter Icy Moons Orbiter (JIMO), a Prometheus class of spacecraft proposed by NASA for deep space exploratory missions. A stable GPC algorithm is developed for Multi Input Multi Output (MIMO) systems. An end point weighting penalty is used in the GPC cost function to guarantee the nominal stability of the closed loop system. A method is given to compute the desired end point state from the desired output trajectory. The methodologies based on Fake Algebraic Riccati Equation (FARE) and constrained nonlinear optimization are developed for synthesis of state weighting matrix. This makes this formulation more practical. A stable reconfigurable GPC architecture is presented and its effectiveness is demonstrated on both aircraft as well as spacecraft model. A representative in orbit maneuver is used for assessing the performance of various control strategies using various design models. Different approximate dynamic models used for analysis include linear single body flexible structure, nonlinear single body flexible structure and nonlinear multibody flexible structure. The control laws evaluated include traditional GPC, feedback linearization based GPC, FLGPC, reconfigurable GPC and nonlinear dissipative control. These various control schemes are evaluated for robust stability and robust performance in the presence of parametric uncertainties and input disturbances. Finally, the conclusions are made with regard to the efficacy of these controllers and potential directions for future research.

Control System Applications William S. Levine, 2018-10-24 Control technology permeates every aspect of our lives. We rely on them to perform a wide variety of tasks.

without giving much thought to the origins of the technology or how it became such an important part of our lives Control System Applications covers the uses of control systems both in the common and in the uncommon areas of our lives From the everyday to the unusual it s all here From process control to human in the loop control this book provides illustrations and examples of how these systems are applied Each chapter contains an introduction to the application a section defining terms and references and a section on further readings that help you understand and use the techniques in your work environment Highly readable and comprehensive Control System Applications explores the uses of control systems It illustrates the diversity of control systems and provides examples of how the theory can be applied to specific practical problems It contains information about aspects of control that are not fully captured by the theory such as techniques for protecting against controller failure and the role of cost and complexity in specifying controller designs Dynamics of Flexible Multibody Systems American Society of Mechanical Engineers. Winter Annual Meeting,1992 **Large Space Structures & Systems in the Space Station Era** ,1993 Proceedings of the 1993 American Control Conference ,1993 Scientific and Technical Aerospace Reports ,1989 *The Control Handbook* William S. Levine,1996-02-23 This is the biggest most comprehensive and most prestigious compilation of articles on control systems imaginable Every aspect of control is expertly covered from the mathematical foundations to applications in robot and manipulator control Never before has such a massive amount of authoritative detailed accurate and well organized information been available in a single volume Absolutely everyone working in any aspect of systems and controls must have this book **Control and Intelligent Systems** ,2001 **Proceedings of the ASME Aerospace Division** American Society of Mechanical Engineers. Aerospace Division,2005 Journal of Dynamic Systems, Measurement, and Control ,2007 **Large Space Structures & Systems in the Space Station Era** ,1993 **NASA Langley Scientific and Technical Information Output, 1995** ,1996 This document is a compilation of the scientific and technical information that the Langley Research Center has produced during the calendar year 1995 Included are citations for formal reports high numbered conference publications high numbered technical memorandums contractor reports journal articles and other publications meeting presentations technical talks computer programs tech briefs and patents *NASA SP.* ,1991 **Workshop on High Performance Computing and Gigabit Local Area Networks** G. Cooperman,G. Michler,H. Vinck,1997-06-20 The combination of fast low latency networks and high performance distributed tools for mathematical software has resulted in widespread affordable scientific computing facilities Practitioners working in the fields of computer communication networks distributed computing computational algebra and numerical analysis have been brought together to contribute to this volume and explore the emerging distributed and parallel technology in a scientific environment This collection includes surveys and original research on both software infrastructure for parallel applications and hardware and architecture infrastructure Among the topics covered are switch based high speed networks ATM over local and wide area networks network performance application support finite element

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Large Space Structures and Systems in the Space Station Era: A Bibliography with Indexes (supplement 05)
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