Modeling And Control Of Complex Physical Systems The Port Hamiltonian Approach

Modeling and Control of Complex Physical SystemsPort-Hamiltonian Systems TheoryLinear Port-Hamiltonian Systems on Infinite-dimensional SpacesControl of Interactive Robotic InterfacesModel Reduction of Port-Hamiltonian SystemsFormation Control in the Port-Hamiltonian FrameworkContributions to Port-Hamiltonian SystemsAdvanced Dynamics and Control of Structures and MachinesModel Reduction for Circuit SimulationSurveys in Differential-Algebraic Equations IControl of Port-Hamiltonian SystemsL2-Gain and Passivity Techniques in Nonlinear ControlTopics in MagnetohydrodynamicsPort Hamiltonian SystemsProgress in Differential-Algebraic Equations IIEnergy-based Control Design for Mechanical SystemsPort-Hamiltonian Modeling for ControlPort-Hamiltonian Systems and Their Discontinuous Galerkin DiscretizationSome Notes on Port-Hamiltonian Systems on Banach SpacesSystem Theoretical Properties of Linear Port-Hamiltonian Systems on Infinite-dimensional Spaces Vincent Duindam Schaft Van Der Birgit Jacob Cristian Secchi Rostyslav Valentynovych Polyuga Frédéric Enrico Haller Hans Irschik Peter Benner Achim Ilchmann Aneesh Venkatraman Arjan van der Schaft Linjin Zheng Alessandro Macchelli Timo Reis Rijksuniversiteit Groningen Arjan van der Schaft Xiaoyu Cheng Timo Reis Julia Theresa Kaiser

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energy exchange is a major foundation of the dynamics of physical systems and hence in the study of complex multi domain systems methodologies that explicitly describe the topology of energy exchanges are instrumental in structuring the modeling and the computation of the system s dynamics and its control this book is the outcome of the european project geoplex fp5 ist 2001 34166 that studied and extended such system modeling and control methodologies this unique book starts from the basic concept of port based modeling and extends it to port hamiltonian systems this generic paradigm is applied to various physical domains showing its power and unifying flexibility for real

multi domain systems

port hamiltonian systems theory an introductory overview provides a concise and easily accessible description of the foundations underpinning the subject and emphasizes novel developments in the field which will be of interest to a broad range of researchers

this book provides a self contained introduction to the theory of infinite dimensional systems theory and its applications to port hamiltonian systems the textbook starts with elementary known results then progresses smoothly to advanced topics in current research many physical systems can be formulated using a hamiltonian framework leading to models described by ordinary or partial differential equations for the purpose of control and for the interconnection of two or more hamiltonian systems it is essential to take into account this interaction with the environment this book is the first textbook on infinite dimensional port hamiltonian systems an abstract functional analytical approach is combined with the physical approach to hamiltonian systems this combined approach leads to easily verifiable conditions for well posedness and stability the book is accessible to graduate engineers and mathematicians with a minimal background in functional analysis moreover the theory is illustrated by many worked out examples

this monograph deals with energy based control of interactive robotic interfaces the port hamiltonian framework is exploited both for modeling and controlling interactive robotic interfaces the book provides an energy oriented analysis and control synthesis of interactive robotic interfaces from a single robot to multi robot systems for interacting with real and virtual possibly unstructured environments

this book intended for people in engineering and fundamental sciences presents an integrated mathematical methodology for advanced

dynamics and control of structures and machines ranging from the derivation of models up to the control synthesis problem this point of view is particularly useful as the physical insight and the associated structural properties related e g to the lagrangian or hamiltonian framework can be advantageously utilized to this end up to date results in disciplines like continuum mechanics analytical mechanics thermodynamics and electrodynamics are presented exploiting the differential geometric properties with the basic notions of this coordinate free approach revisited in an own chapter in order to illustrate the proposed methodologies several industrial applications e g the derivation of exact solutions for the deformation compensation by shaped actuation in elastic bodies or the coordination of rigid and flexible joint robots are discussed

simulation based on mathematical models plays a major role in computer aided design of integrated circuits ics decreasing structure sizes increasing packing densities and driving frequencies require the use of refined mathematical models and to take into account secondary parasitic effects this leads to very high dimensional problems which nowadays require simulation times too large for the short time to market demands in industry modern model order reduction mor techniques present a way out of this dilemma in providing surrogate models which keep the main characteristics of the device while requiring a significantly lower simulation time than the full model with model reduction for circuit simulation we survey the state of the art in the challenging research field of mor for ics and also address its future research directions special emphasis is taken on aspects stemming from miniturisations to the nano scale contributions cover complexity reduction using e g balanced truncation krylov techniques or pod approaches for semiconductor applications a focus is on generalising current techniques to differential algebraic equations on including design parameters on preserving stability and on including nonlinearity by means of piecewise

linearisations along solution trajectories tpwl and interpolation techniques for nonlinear parts furthermore the influence of interconnects and power grids on the physical properties of the device is considered and also top down system design approaches in which detailed block descriptions are combined with behavioral models further topics consider mor and the combination of approaches from optimisation and statistics and the inclusion of pde models with emphasis on mor for the resulting partial differential algebraic systems the methods which currently are being developed have also relevance in other application areas such as mechanical multibody systems and systems arising in chemistry and to biology the current number of books in the area of mor for ics is very limited so that this volume helps to fill a gap in providing the state of the art material and to stimulate further research in this area of mor model reduction for circuit simulation also reflects and documents the vivid interaction between three active research projects in this area namely the eu marie curie action tok project o moore nice members in belgium the netherlands and germany the eu marie curie action rtn project comson members in the netherlands italy germany and romania and the german federal project system reduction in nano electronics syrene

the need for a rigorous mathematical theory for differential algebraic equations daes has its roots in the widespread applications of controlled dynamical systems especially in mechanical and electrical engineering due to the strong relation to ordinary differential equations the literature for daes mainly started out from introductory textbooks as such the present monograph is new in the sense that it comprises survey articles on various fields of daes providing reviews presentations of the current state of research and new concepts in controllability for linear daes port hamiltonian differential algebraic systems robustness of daes solution concepts for daes daes in circuit modeling the results in the individual chapters are presented in an accessible style making this book suitable not only for active researchers but also for graduate

students with a good knowledge of the basic principles of daes for self study

this standard text gives a unified treatment of passivity and l2 gain theory for nonlinear state space systems preceded by a compact treatment of classical passivity and small gain theorems for nonlinear input output maps the synthesis between passivity and l2 gain theory is provided by the theory of dissipative systems specifically the small gain and passivity theorems and their implications for nonlinear stability and stabilization are discussed from this standpoint the connection between l2 gain and passivity via scattering is detailed feedback equivalence to a passive system and resulting stabilization strategies are discussed the passivity concepts are enriched by a generalised hamiltonian formalism emphasising the close relations with physical modeling and control by interconnection and leading to novel control methodologies going beyond passivity the potential of l2 gain techniques in nonlinear control including a theory of all pass factorizations of nonlinear systems and of parametrization of stabilizing controllers is demonstrated the nonlinear h infinity optimal control problem is also treated and the book concludes with a geometric analysis of the solution sets of hamilton jacobi inequalities and their relation with riccati inequalities for the linearization l2 gain and passivity techniques in nonlinear control third edition is thoroughly updated revised reorganized and expanded among the changes readers will find updated and extended coverage of dissipative systems theory substantial new material regarding converse passivity theorems and incremental shifted passivity coverage of recent developments on networks of passive systems with examples a completely overhauled and succinct introduction to modeling and control of port hamiltonian systems followed by an exposition of port hamiltonian formulation of physical network dynamics updated treatment of all pass factorization of nonlinear systems the book provides graduate students and researchers in systems and control with a compact presentation of a fundamental and rapidly developing area

of nonlinear control theory illustrated by a broad range of relevant examples stemming from different application areas

to understand plasma physics intuitively one need to master the mhd behaviors as sciences advance gap between published textbooks and cutting edge researches gradually develops connection from textbook knowledge to up to dated research results can often be tough review articles can help this book contains eight topical review papers on mhd for magnetically confined fusion one can find toroidal mhd theory for tokamaks magnetic relaxation process in spheromaks and the formation and stability of field reversed configuration in space plasma physics one can get solar spicules and x ray jets physics as well as general sub fluid theory for numerical methods one can find the implicit numerical methods for resistive mhd and the boundary control formalism for low temperature plasma physics one can read theory for newtonian and non newtonian fluids etc

this book contains articles presented at the 9th workshop on differential algebraic equations held in paderborn germany from 17 20 march 2019 the workshop brought together more than 40 mathematicians and engineers from various fields such as numerical and functional analysis control theory mechanics and electromagnetic field theory the participants focussed on the theoretical and numerical treatment of descriptor systems i e differential algebraic equations daes the book contains 14 contributions and is organized into four parts mathematical analysis numerics and model order reduction control as well as applications it is a useful resource for applied mathematicians with interest in recent developments in the field of differential algebraic equations but also for engineers in particular those interested in modelling of constraint mechanical systems thermal networks or electric circuits

this article provides a concise summary of the basic ideas and concepts in port hamiltonian systems theory and its use in analysis and control of complex multiphysics systems it gives special attention to new and unexplored research directions and relations with other mathematical frameworks emergent control paradigms and open problems are indicated including the relation with thermodynamics and the question of uniting the energy processing view of control as emphasized by port hamiltonian systems theory with a complementary information processing viewpoint

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