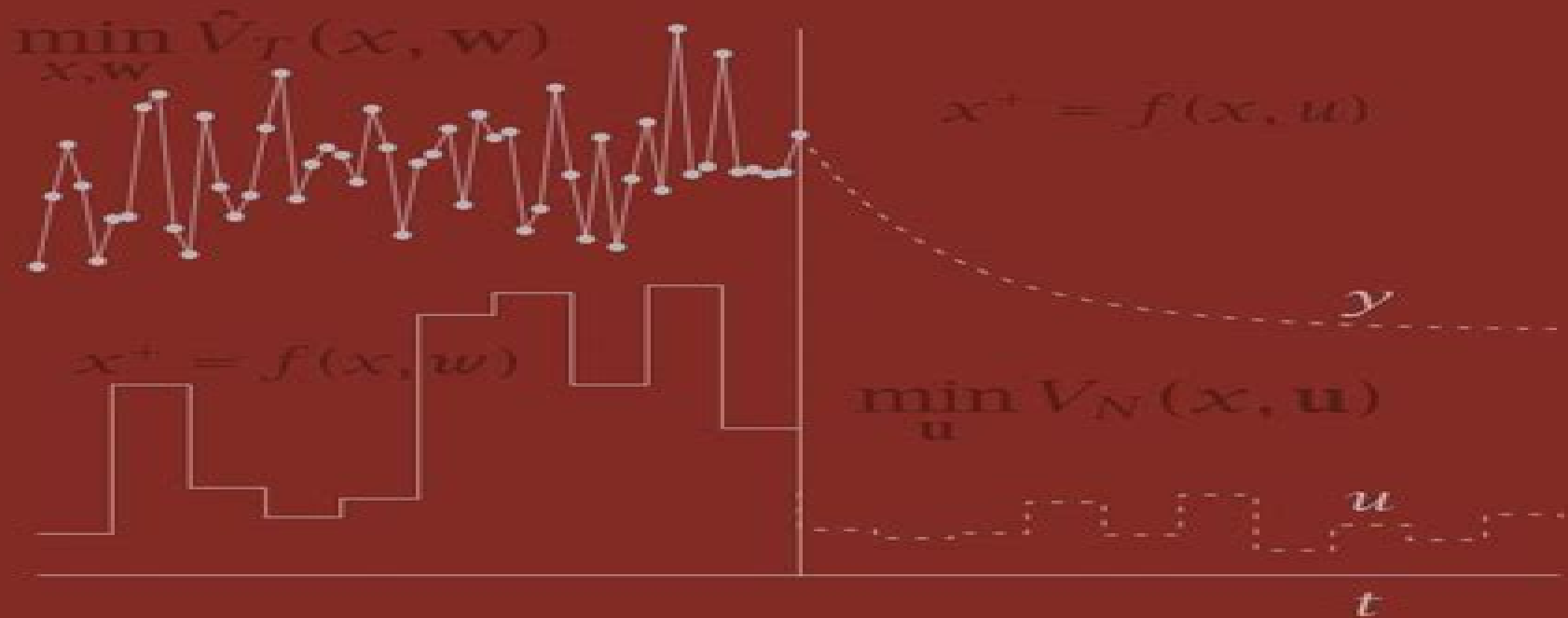


Model Predictive Control: Theory, Computation, and Design

2nd Edition

James B. Rawlings
David Q. Mayne
Moritz M. Diehl



Nob Hill Publishing

Model Predictive Control Theory Computation And Design

Esteban A. Hernandez-Vargas



Model Predictive Control Theory Computation And Design:

Model Predictive Control James Blake Rawlings, David Q. Mayne, Moritz Diehl, 2017 Model Predictive Control James Blake Rawlings, 2024 **Model Predictive Control** Aris Daniilidis, Lars Grüne, Josef Haunschmied, Gernot Tragler, 2025-06-07 The book explores the field of model predictive control MPC It reports on the latest developments in MPC current applications and presents various subfields of MPC The book features topics such as uncertain and stochastic MPC variants learning and neural network approaches easy to use numerical implementations as well as multi agent systems and scheduling and coordination tasks While MPC is rooted in engineering science this book illustrates the potential of using MPC theory and methods in non engineering sciences and applications such as economics finance and environmental sciences Recent Advances in Model Predictive Control Timm Faulwasser, Matthias A. Müller, Karl Worthmann, 2021-04-17 This book focuses on distributed and economic Model Predictive Control MPC with applications in different fields MPC is one of the most successful advanced control methodologies due to the simplicity of the basic idea measure the current state predict and optimize the future behavior of the plant to determine an input signal and repeat this procedure ad infinitum and its capability to deal with constrained nonlinear multi input multi output systems While the basic idea is simple the rigorous analysis of the MPC closed loop can be quite involved Here distributed means that either the computation is distributed to meet real time requirements for very large scale systems or that distributed agents act autonomously while being coupled via the constraints and or the control objective In the latter case communication is necessary to maintain feasibility or to recover system wide optimal performance The term economic refers to general control tasks and thus goes beyond the typically predominant control objective of set point stabilization Here recently developed concepts like strict dissipativity of optimal control problems or turnpike properties play a crucial role The book collects research and survey articles on recent ideas and it provides perspectives on current trends in nonlinear model predictive control Indeed the book is the outcome of a series of six workshops funded by the German Research Foundation DFG involving early stage career scientists from different countries and from leading European industry stakeholders **Learning-based Model Predictive Control with closed-loop guarantees** Raffaele Soloperto, 2023-11-13 The performance of model predictive control MPC largely depends on the accuracy of the prediction model and of the constraints the system is subject to However obtaining an accurate knowledge of these elements might be expensive in terms of money and resources if at all possible In this thesis we develop novel learning based MPC frameworks that actively incentivize learning of the underlying system dynamics and of the constraints while ensuring recursive feasibility constraint satisfaction and performance bounds for the closed loop In the first part we focus on the case of inaccurate models and analyze learning based MPC schemes that include in addition to the primary cost a learning cost that aims at generating informative data by inducing excitation in the system In particular we first propose a nonlinear MPC framework that ensures desired performance bounds for the resulting closed loop and then we

focus on linear systems subject to uncertain parameters and noisy output measurements In order to ensure that the desired learning phase occurs in closed loop operations we then propose an MPC framework that is able to guarantee closed loop learning of the controlled system In the last part of the thesis we investigate the scenario where the system is known but evolves in a partially unknown environment In such a setup we focus on a learning based MPC scheme that incentivizes safe exploration if and only if this might yield to a performance improvement

Advanced Model Predictive Control for Autonomous Marine Vehicles Yang Shi,Chao Shen,Henglai Wei,Kunwu Zhang,2023-02-13 This book provides a comprehensive overview of marine control system design related to underwater robotics applications In particular it presents novel optimization based model predictive control strategies to solve control problems appearing in autonomous underwater vehicle applications These novel approaches bring unique features such as constraint handling prioritization between multiple design objectives optimal control performance and robustness against disturbances and uncertainties into the control system design They therefore form a more general framework to design marine control systems and can be widely applied Advanced Model Predictive Control for Autonomous Marine Vehicles balances theoretical rigor providing thorough analysis and developing provably correct design conditions and application perspectives addressing practical system constraints and implementation issues Starting with a fixed point positioning problem for a single vehicle and progressing to the trajectory tracking and path following problem of the vehicle and then to the coordination control of a large scale multi robot team this book addresses the motion control problems increasing their level of challenge step by step At each step related subproblems such as path planning thrust allocation collision avoidance and time constraints for real time implementation are also discussed with solutions In each chapter of this book compact and illustrative examples are provided to demonstrate the design and implementation procedures As a result this book is useful for both theoretical study and practical engineering design and the tools provided in the book are readily applicable for real world implementation

Advanced Chemical Process Control Morten Hovd,2023-06-06 Advanced Chemical Process Control Bridge the gap between theory and practice with this accessible guide Process control is an area of study which seeks to optimize industrial processes applying different strategies and technologies as required to navigate the variety of processes and their many potential challenges Though the body of chemical process control theory is robust it is only in recent decades that it has been effectively integrated with industrial practice to form a flexible toolkit The need for a guide to this integration of theory and practice has therefore never been more urgent Advanced Chemical Process Control meets this need making advanced chemical process control accessible and useful to chemical engineers with little grounding in the theoretical principles of the subject It provides a basic introduction to the background and mathematics of control theory before turning to the implementation of control principles in industrial contexts The result is a bridge between the insights of control theory and the needs of engineers in plants factories research facilities and beyond Advanced Chemical Process Control readers will also

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Computational Intelligence and Optimization Methods for Control Engineering Maude Josée Blondin, Panos M. Pardalos, Javier Sanchis Sáez, 2019-09-20 This volume presents some recent and principal developments related to computational intelligence and optimization methods in control Theoretical aspects and practical applications of control engineering are covered by 14 self contained contributions Additional gems include the discussion of future directions and research perspectives designed to add to the reader's understanding of both the challenges faced in control engineering and the insights into the developing of new techniques With the knowledge obtained readers are encouraged to determine the appropriate control method for specific applications

Optimization of Complex Systems: Theory, Models, Algorithms and Applications Hoai An Le Thi, Hoai Minh Le, Tao Pham Dinh, 2019-06-15 This book contains 112 papers selected from about 250 submissions to the 6th World Congress on Global Optimization WCGO 2019 which takes place on July 8-10 2019 at University of Lorraine Metz France The book covers both theoretical and algorithmic aspects of Nonconvex Optimization as well as its applications to modeling and solving decision problems in various domains It is composed of 10 parts each of them deals with either the theory and or methods in a branch of optimization such as Continuous optimization DC Programming and DCA Discrete optimization Network optimization Multiobjective programming Optimization under uncertainty or models and optimization methods in a specific application area including Data science Economics Finance Energy Water management Engineering systems Transportation Logistics Resource allocation Production management The researchers and practitioners working in Nonconvex Optimization and several application areas can find here many inspiring ideas and useful tools techniques for their works

Emerging Electronics and Automation Peter Han Joo Chong, Akhtar

Kalam, Antonio Pascoal, Manas Kumar Bera, 2022-11-09 This book constitutes peer reviewed proceedings of the International Conference on Emerging Electronics and Automation E2A 2021 The book presents new ideas research findings and novel techniques in the fields of sensors and instrumentation automation and control artificial intelligence MEMS sensors soft computing signal processing and communication It includes contributions received from both academia and industry The proceedings will be helpful for beginners as well as advanced researchers in the area of automation and other allied fields

Handbook of Model Predictive Control Saša V. Raković, William S. Levine, 2018-09-01 Recent developments in model predictive control promise remarkable opportunities for designing multi input multi output control systems and improving the control of single input single output systems This volume provides a definitive survey of the latest model predictive control methods available to engineers and scientists today The initial set of chapters present various methods for managing

uncertainty in systems including stochastic model predictive control With the advent of affordable and fast computation control engineers now need to think about using computationally intensive controls so the second part of this book addresses the solution of optimization problems in real time for model predictive control The theory and applications of control theory often influence each other so the last section of Handbook of Model Predictive Control rounds out the book with representative applications to automobiles healthcare robotics and finance The chapters in this volume will be useful to working engineers scientists and mathematicians as well as students and faculty interested in the progression of control theory Future developments in MPC will no doubt build from concepts demonstrated in this book and anyone with an interest in MPC will find fruitful information and suggestions for additional reading

Hierarchical Power Systems: Optimal Operation Using Grid Flexibilities Tim Aschenbruck, Jörg Dickert, Willem Esterhuizen, Bartosz Filipecki, Sara

Grundel, Christoph Helmborg, Tobias K. S. Ritschel, Philipp Sauerteig, Stefan Streif, Andreas Wasserrab, Karl Worthmann, 2023-03-18 This book explains the power grid as a hierarchy made up of the transmission distribution and microgrid levels Interfaces among these levels are explored to show how flexibility in power demand associated with residential batteries can be communicated through the entire grid to facilitate optimal power flow computations within the transmission grid To realize this approach the authors combine semi definite optimal power flow with model order reduction at the distribution level and with a new heuristic algorithm for stable power flow at the transmission level To demonstrate its use a numerical case study based on modified IEEE 9 bus and 33 bus systems for the transmission and distribution grid respectively is included This book shows how exploiting the flexibility on the residential level improves the performance of the power flow with the transmission grid

Process Control Steve S. Niu, Deyun Xiao, 2022-08-01 Process Control details the core knowledge and practical skills that a successful process control practitioner needs It explains the essential technologies that are in use in current industrial practice or which may be wanting for the future The book focuses on practical considerations not only on those that make a control solution work but also on those that prevent it from failing especially for complex control loops and plant wide control solutions After discussing the indispensable role of control in modern process industries the authors concentrate on the skills required for process analysis control design and troubleshooting One of the first books to provide a systematic approach and structured methodology for process analysis and control design Process Control illustrates that methodology with many practical examples that cover process control equipment control and control calculations derived from real projects and applications The book uses 229 drawings and 83 tables to make the concepts it presents more intuitive and its methodology easy to follow Process Control will help the practising control engineer to benefit from a wealth of practical experience and good ideas on how to make control work in the real world and students training to take up roles in process control are shown the applied relevance of control theory in the efficient functioning of industrial plant and the considerations needed to make it work Advances in Industrial Control

reports and encourages the transfer of technology in control engineering The rapid development of control technology has an impact on all areas of the control discipline The series offers an opportunity for researchers to present an extended exposition of new work in all aspects of industrial control

Dynamic Programming and Optimal Control Dimitri Bertsekas, 2012 This is the leading and most up to date textbook on the far ranging algorithmic methodology of Dynamic Programming which can be used for optimal control Markovian decision problems planning and sequential decision making under uncertainty and discrete combinatorial optimization The treatment focuses on basic unifying themes and conceptual foundations It illustrates the versatility power and generality of the method with many examples and applications from engineering operations research and other fields It also addresses extensively the practical application of the methodology possibly through the use of approximations and provides an extensive treatment of the far reaching methodology of Neuro Dynamic Programming Reinforcement Learning Among its special features the book 1 provides a unifying framework for sequential decision making 2 treats simultaneously deterministic and stochastic control problems popular in modern control theory and Markovian decision popular in operations research 3 develops the theory of deterministic optimal control problems including the Pontryagin Minimum Principle 4 introduces recent suboptimal control and simulation based approximation techniques neuro dynamic programming which allow the practical application of dynamic programming to complex problems that involve the dual curse of large dimension and lack of an accurate mathematical model 5 provides a comprehensive treatment of infinite horizon problems in the second volume and an introductory treatment in the first volume The electronic version of the book includes 29 theoretical problems with high quality solutions which enhance the range of coverage of the book

A Course in Reinforcement Learning: 2nd Edition Dimitri Bertsekas, 2024-12-20 This is the 2nd edition of the textbook used at the author's ASU research oriented course on Reinforcement Learning RL offered in each of the last six years Its purpose is to give an overview of the RL methodology particularly as it relates to problems of optimal and suboptimal decision and control as well as discrete optimization While in this book mathematical proofs are deemphasized there is considerable related analysis which supports the conclusions and can be found in the author's recent RL and DP books These books also contain additional material on off line training of neural networks on the use of policy gradient methods for approximation in policy space and on aggregation

Mathematical Modeling, Simulation and Optimization for Power Engineering and Management Simone Göttlich, Michael Herty, Anja Milde, 2021-02-02 This edited monograph offers a summary of future mathematical methods supporting the recent energy sector transformation It collects current contributions on innovative methods and algorithms Advances in mathematical techniques and scientific computing methods are presented centering around economic aspects technical realization and large scale networks Over twenty authors focus on the mathematical modeling of such future systems with careful analysis of desired properties and arising scales Numerical investigations include efficient methods for the simulation of possibly large scale interconnected energy

systems and modern techniques for optimization purposes to guarantee stable and reliable future operations The target audience comprises research scientists researchers in the R D field and practitioners Since the book highlights possible future research directions graduate students in the field of mathematical modeling or electrical engineering may also benefit strongly

Feedback Control for Personalized Medicine Esteban A. Hernandez-Vargas,2022-04-21 Feedback Control for Personalized Medicine provides ideas on ongoing efforts and obstacles by members of the control engineering community in different biological and medical applications In addition the book presents key challenges insights tools and theoretical developments that arise from personalized medicine along with medical concepts that are explained by engineers to help non experts follow research topics Several clinical trials have tried to find therapeutic approaches to achieve eradication or at least lifelong therapy free host control of the infection This has been performed integrating clinical observations empirical knowledge and information from medical tests to treat patients As this trial and error approach is becoming more challenging and unfeasible by the steep increase in the number of different pieces of information and the complexity of large datasets a systematic and tractable approach that integrates a variety of biological and medical research data into mathematical models and computational algorithms is crucial to harness knowledge and to develop new therapies towards personalized medicine Presents the most recent research in personalized medicine using control theoretical tools Offers numerical simulations that are analyzed in detail and compared with control experiments Brings the most recent research of control theory in medicine

Solving Urban Infrastructure Problems Using Smart City Technologies John R. Vacca,2020-09-22 Solving Urban Infrastructure Problems Using Smart City Technologies is the most complete guide for integrating next generation smart city technologies into the very foundation of urban areas worldwide showing how to make urban areas more efficient more sustainable and safer Smart cities are complex systems of systems that encompass all aspects of modern urban life A key component of their success is creating an ecosystem of smart infrastructures that can work together to enable dynamic real time interactions between urban subsystems such as transportation energy healthcare housing food entertainment work social interactions and governance Solving Urban Infrastructure Problems Using Smart City Technologies is a complete reference for building a holistic system level perspective on smart and sustainable cities leveraging big data analytics and strategies for planning zoning and public policy It offers in depth coverage and practical solutions for how smart cities can utilize resident s intellectual and social capital press environmental sustainability increase personalization mobility and higher quality of life Brings together experts from academia government and industry to offer state of the art solutions for urban system problems showing how smart technologies can be used to improve the lives of the billions of people living in cities across the globe Demonstrates practical implementation solutions through real life case studies Enhances reader comprehension with learning aid such as hands on exercises questions and answers checklists chapter summaries chapter review questions exercise problems and more

Tunnelling into a Sustainable Future -

Methods and Technologies Fredrik Johansson, Anders Ansell, Daniel Johansson, Johan Funeag, Jenny Norrman, 2025-05-12
Tunnelling into a Sustainable Future Methods and Technologies contains the contributions presented at the ITA AITES World Tunnel Congress 2025 Stockholm Sweden 9 15 May 2025 The contributions cover a wide range of topics in the fields of tunnelling and underground engineering including 1 Innovating tunneling 2 Safety Underground 3 Use of underground space 4 Investigations and ground characterisation 5 Planning and design of underground space 6 Conventional tunnelling 7 Mechanised tunnelling 8 Complex geometries including shafts and ramps 9 Grouting and groundwater control 10 Instrumentation and monitoring 11 Operation inspection and maintenance 12 Contractual aspects financing and risk management 13 Impact from climate change Tunnelling into a Sustainable Future Methods and Technologies will serve as a valuable reference to all concerned with tunnelling and underground engineering including students researchers and engineers

Control and Information Sciences I. Thirunavukkarasu, Roshan Kumar, 2024-10-28 This book presents the select proceedings of the Control Instrumentation and System Conference CISCON 2023 held at Manipal Institute of Technology MAHE Manipal It examines a broad spectrum covering the latest trends in instrumentation sensors and systems and industrial automation and control The topics covered include image and signal processing robotics renewable energy power systems and power drives performance attributes of MEMS multi sensor data fusion machine learning optimization techniques process control safety monitoring safety critical control supervisory control system modeling and virtual instrumentation The book is a valuable reference for researchers and professionals interested in sensors adaptive management automation and control and allied fields

Model Predictive Control Theory Computation And Design Book Review: Unveiling the Magic of Language

In an electronic era where connections and knowledge reign supreme, the enchanting power of language has been apparent than ever. Its capability to stir emotions, provoke thought, and instigate transformation is really remarkable. This extraordinary book, aptly titled "**Model Predictive Control Theory Computation And Design**," written by a very acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound impact on our existence. Throughout this critique, we shall delve into the book's central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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