Pushkin Kachroo and Kaan Özbay

FEEDBACK CONTROL THEORY FOR DYNAMIC TRAFFIC ASSIGNMENT

Advances in Industrial Control

Springer

Feedback Control Theory For Dynamic Traffic Abignment

Satish V. Ukkusuri,Kaan Ozbay

Feedback Control Theory For Dynamic Traffic Abignment:

Feedback Control Theory for Dynamic Traffic Assignment Pushkin Kachroo,Kaan Ozbay,2012-12-06 The series Advances in Industrial Control aims to report and encourage technology transfer in control engineering The rapid development of control technology impacts all areas of the control discipline New theory new controllers actuators sensors new industrial processes computer methods new applications new philosophies new challenges Much of this development work resides in industrial reports feasibility study papers and the reports of advanced collaborative projects The series offers an opportunity for researchers to present an extended exposition of such new work in all aspects of industrial control for wider and rapid dissemination Micro technology and modern communications technology are revolutionising many aspects of our daily lives and so it is not surprising that it is impacting societal transportation systems whether our highways airways seaways or railways The Advances in Industrial Control series reported on these developments for long haul railway systems in a monograph by Howlett and Pudney ISBN 3 S40 19990 X 1995 Now it is the turn of transportation in a contribution from Pushkin Kachroo and Kaan Ozbay The authors viewpoint is that this new set of transportation problems are control problems and that control engineers should be highly active in this field Their volume covers all the aspects of modelling problem formulation and applies various control methodologies to solve the control problems formulated **Feedback Control Theory for Dynamic Traffic Assignment** Pushkin Kachroo,Kaan M.A. Özbay,2018-05-16 This book develops a methodology for designing feedback control laws for dynamic traffic assignment DTA exploiting the introduction of new sensing and information dissemination technologies to facilitate the introduction of real time traffic management in intelligent transportation systems Three methods of modeling the traffic system are discussed partial differential equations representing a distributed parameter setting continuous time ordinary differential equations ODEs representing a continuous time lumped parameter setting and discreet time ODEs representing a discrete time lumped parameter setting Feedback control formulations for reaching road user equilibrium are presented for each setting and advantages and disadvantage of using each are addressed The closed loop methods described are proposed expressly to avoid the counter productive shifting of bottlenecks from one route to another because of driver over reaction to routing information The second edition of Feedback Control Theory for Dynamic Traffic Assignment has been thoroughly updated with completely new chapters a review of the DTA problem and emphasizing real time feedback based problems an up to date presentation of pertinent traffic flow theory and a treatment of the mathematical solution to the traffic dynamics Techinques accounting for the importance of entropy are further new inclusions at various points in the text Researchers working in traffic control will find the theoretical material presented a sound basis for further research the continual reference to applications will help professionals working in highway administration and engineering with the increasingly important task of maintaining and smoothing traffic flow the extensive use of end of chapter exercises will help the graduate student and those new to the field to extend their knowledge

Advances in Dynamic Network Modeling in Complex Transportation Systems Satish V. Ukkusuri,Kaan Ozbay,2013-03-21 This edited book focuses on recent developments in Dynamic Network Modeling including aspects of route guidance and traffic control as they relate to transportation systems and other complex infrastructure networks Dynamic Network Modeling is generally understood to be the mathematical modeling of time varying vehicular flows on networks in a fashion that is consistent with established traffic flow theory and travel demand theory Dynamic Network Modeling as a field has grown over the last thirty years with contributions from various scholars all over the field The basic problem which many scholars in this area have focused on is related to the analysis and prediction of traffic flows satisfying notions of equilibrium when flows are changing over time In addition recent research has also focused on integrating dynamic equilibrium with traffic control and other mechanism designs such as congestion pricing and network design Recently advances in sensor deployment availability of GPS enabled vehicular data and social media data have rapidly contributed to better understanding and estimating the traffic network states and have contributed to new research problems which advance previous models in dynamic modeling A recent National Science Foundation workshop on Dynamic Route Guidance and Traffic Control was organized in June 2010 at Rutgers University by Prof Kaan Ozbay Prof Satish Ukkusuri Prof Hani Nassif and Professor Pushkin Kachroo This workshop brought together experts in this area from universities industry and federal state agencies to present recent findings in this area Various topics were presented at the workshop including dynamic traffic assignment traffic flow modeling network control complex systems mobile sensor deployment intelligent traffic systems and data collection issues This book is motivated by the research presented at this workshop and the discussions that followed **Pedestrian Dynamics** Pushkin Kachroo,2018-10-03 Homeland security transportation and city planning depend upon well designed evacuation routes You can t wait until the day of to realize your plan won t work Designing successful evacuation plans requires an in depth understanding of models and control designs for the problems of traffic flow construction and road closures and the intangible human factors Pedestrian Dynamics Mathematical Theory and Evacuation Control clearly delineates the derivation of mathematical models for pedestrian dynamics and how to use them to design feedback controls for evacuations The book includes Mathematical models derived from basic principles Mathematical analysis of the model Details of past work MATLAB code 65 figures and 400 equations Unlike most works on traffic flow this book examines the development of optimal methods to effectively control and improve pedestrian traffic flow The work of a leading expert it examines the differential equations applied to conservation laws encountered in the study of pedestrian dynamics and evacuation control problem The author presents new pedestrian traffic models for multi directional flow in two dimensions He considers a range of control models in various simulations including relaxed models and those concerned with direction and magnitude velocity commands He also addresses questions of time cost and scalability The book clearly demonstrates what the future challenges are and provides the tools to meet them **Metaheuristics and Optimization in**

Computer and Electrical Engineering Navid Razmjooy,Mohsen Ashourian,Zahra Foroozandeh,2020-11-16 The use of artificial intelligence especially in the field of optimization is increasing day by day The purpose of this book is to explore the possibility of using different kinds of optimization algorithms to advance and enhance the tools used for computer and electrical engineering purposes **Handbook of Transportation Science** Randolph Hall,2006-04-11 Over the past thirty five years a substantial amount of theoretical and empirical scholarly research has been developed across the discipline domains of Transportation This research has been synthesized into a systematic handbook that examines the scientific concepts methods and principles of this growing and evolving field The Handbook of Transportation Science outlines the field of transportation as a scientific discipline that transcends transportation technology and methods Whether by car truck airplane or by a mode of transportation that has not yet been conceived transportation obeys fundamental properties The science of transportation defines these properties and demonstrates how our knowledge of one mode of transportation can be used to explain the behavior of another Transportation scientists are motivated by the desire to explain spatial interactions that result in movement of people or objects from place to place Its methodologies draw from physics operations research probability and control theory *The SAGE Handbook of Transport Studies* Jean-Paul Rodrigue,Theo Notteboom,Jon Shaw,2013-06-20 The SAGE Handbook of Transport Studies is an authoritative survey of contemporary transportation systems examined in terms of economic social and technical issues as well as environmental challenges Incorporating an extensive range of approaches from modes terminals planning and policy to more recent developments related to supply chain management information systems and sustainability ecology the work provides a cohesive and extensive overview of transport studies Authored by international experts in their field each individual chapter bridges a broad range of conceptual theoretical and geographical perspectives and the Handbook is divided into six sections Transport in the Global World Transport in Regions and Localities Transport Economy and Society Transport Policy Transport Networks and Models Transport and the Environment This Handbook will be an indispensible resource for academics planners and policy makers **Optimal Trajectory Planning and Train Scheduling for Urban Rail Transit Systems** Yihui Wang,Bin Ning,Ton van den Boom,Bart De Schutter,2016-04-21 This book contributes to making urban rail transport fast punctual and energy efficient significant factors in the importance of public transportation systems to economic environmental and social requirements at both municipal and national levels It proposes new methods for shortening passenger travel times and for reducing energy consumption addressing two major topics 1 train trajectory planning the authors derive a nonlinear model for the operation of trains and present several approaches for calculating optimal and energy efficient trajectories within a given schedule and 2 train scheduling the authors develop a train scheduling model for urban rail systems and optimization approaches with which to balance total passenger travel time with energy efficiency and other costs to the operator Mixed integer linear programming and pseudospectral methods are among the new methods proposed for single and multi train

systems for the solution of the nonlinear trajectory planning problem which involves constraints such as varying speed restrictions and maximum traction braking force Signaling systems and their effects are also accounted for in the trajectory planning model Origin destination passenger demand is included in the model formulation for train scheduling Iterative convex programming and efficient bi level approaches are utilized in the solution of the train scheduling problem In addition the splitting rates and route choices of passengers are also optimized from the system point of view The problems and solutions described in Optimal Trajectory Planning and Train Scheduling for Urban Rail Transit Systems will interest researchers studying public transport systems and logistics whether from an academic or practitioner background as well as providing a real application for anybody studying optimization theory and predictive control *Applied Predictive Control* Sunan Huang,Tong Heng Lee,2013-03-09 The series Advances in Industrial Control aims to report and encourage technology transfer in control engineering The rapid development of control technology has an impact on all areas of the control discipline New theory new controllers actuators sensors new industrial processes computer methods new applications new philosophies new challenges Much of this development work resides in industrial reports feasibility study papers and the reports of advanced collaborative projects The series offers an opportunity for researchers to present an extended exposition of such new work in all aspects of industrial control for wider and rapid dissemination The Advances in Industrial Control series promotes control techniques which are used by industry The series has useful volumes in various aspects of proportional integral derivative PID control because of the widespread use of PID in applications Predictive control is another technique that quickly became essential in some sectors of the petro chemical and process control industries It was the ability of the method to incorporate operational constraints that lead to this take up by industry The wider industrial applications of predictive control has been slower to develop indeed some practitioners might argue that this technology transfer step is still active or had only just begun in some industrial sectors **Robust Control of Diesel Ship Propulsion** Nikolaos Xiros,2012-12-06 This book covers a number of models and control types An integrated nonlinear state space mode of the marine propulsion system is developed This is based upon physical principles that incorporate uncertainties arising from engine thermodynamics and disturbances arising from propeller hydrodynamics The mode employs artificial neural networks to depict the nonlinearities of the thermochemical processes of engine power torque generation and the engine turbocharger dynamical interaction neural nets combine the required mathematical flexibility and formalism with numerical training and calibration options using either thermodynamic engine models or measured data series The neural state space model is decomposed appropriately to provide a linearised perturbation model suitable for controller synthesis The proportional integral derivative control law is examined under the perspective of shaft speed regulation for enhanced disturbance rejection of the propeller load The typical marine shafting system dynamics and configuration allow for a smart implementation of the D term on shaft torque feedback Full state feedback control is examined for increased robustness of

the compensated plant against parametric uncertainty and neglected dynamics The H requirements on the closed loop transfer matrix are appropriately decomposed to similar ones on scalar transfer functions which give specifications that are easier to manipulate In effect the methods are comparatively assessed and suggestions and practical applications are given This synthetic approach to propulsion plant control and operational problems should prove useful for both theoreticians and practitioners and can be easilty adopted for the control of other proceses or systems outside the marine field as well

Digital Controller Implementation and Fragility Robert Istepanian,James F. Whidborne,2012-12-06 In the usual process of control system design the assumption is made that the controller is implemented exactly This assumption is usually reasonable since clearly the plant uncertainty is the most significant source of uncertainty in the control system while controllers are implemented with high precision hardware However inevitably there will be some amount of uncertainty in the controller a fact that is largely ignored in existing modern advanced robust control techniques If the controller is implemented by analogue means there are some tolerances in the analogue components More commonly the controller will be implemented digitally and consequently there will be uncertainty involved with the quantization in the analogue digital conversion and rounding in the parameter representation and in the numerical computations A failure to account for these uncertainties in the controller may result in a controller that is fragile A controller is fragile in the sense that very small perturbations in the coefficients of the designed controller destabilize the closed loop control system This book collects a number of articles which consider the problems of finite precision computing in digital controllers and filters Written by leading researchers topics that the book covers include analysis of fragility and finite precision effects design of optimal controller realizations design of non fragile robust controllers design of low complexity digital controllers analysis of quantization effects in fuzzy controllers Optimisation of Industrial Processes at Supervisory Level Doris A. Saez,Aldo Cipriano,Andrzej W. Ordys,2012-12-06 In the increasingly competitive modern world the industrial sector faces new challenges such as improving productivity and reducing costs while taking into account the process operational constraints As energy demand increases in many countries especially in big cities where the environmental concerns are very important and resources to produce energy are limited the efficiency of operation of power plants becomes of paramount importance Under this scenario this book presents new methodologies to improve power plants efficiency by using automatic control algorithms This will lead to an improvement in the generation of companies profit and also in the quality of their final product

Hard Disk Drive Servo Systems Ben M. Chen,Tong Heng Lee,Venkatakrishnan Venkataramanan,2013-04-17 The series Advances in Industrial Contral aims to report and encourage technology transfer in control engineering The rapid development of control technology has an impact on all areas of the control discipline New theory new controllers actuators sensors new industrial processes computer methods new applications new philosophies new challenges Much of this development work resides in industrial reports feasibility study papers and the reports of advanced collaborative projects The

series offers an opportunity for researchers to present an extended exposition of such new work in all aspects of industrial control for wider and rapid dissemination From time to time a particular practical control problem emerges as a challenge to the design capabilities of the control community One example has been the activated sludge process in wastewater systems where the process is highly nonlinear and measurements are few A second example is the hard disk drive servo system These widely used systems are critical to the operation of modem computing devices They are nonlinear and demand a high precision control system for the operations of track seeking and track following There are also alternative actuation systems available to achieve these objectives In this Advances in Industrial Control monograph B M Chen T H Lee and V

Data-driven Methods for Fault Detection and Diagnosis in Chemical Processes Evan L. Russell,Leo H. Chiang,Richard D. Braatz,2012-12-06 Early and accurate fault detection and diagnosis for modern chemical plants can minimise downtime increase the safety of plant operations and reduce manufacturing costs The process monitoring techniques that have been most effective in practice are based on models constructed almost entirely from process data The goal of the book is to present the theoretical background and practical techniques for data driven process monitoring Process monitoring techniques presented include Principal component analysis Fisher discriminant analysis Partial least squares Canonical variate analysis The text demonstrates the application of all of the data driven process monitoring techniques to the Tennessee Eastman plant simulator demonstrating the strengths and weaknesses of each approach in detail This aids the reader in selecting the right method for his process application Plant simulator and homework problems in which students apply the process monitoring techniques to a nontrivial simulated process and can compare their performance with that obtained in the case studies in the text are included A number of additional homework problems encourage the reader to implement and obtain a deeper understanding of the techniques The reader will obtain a background in data driven techniques for fault detection and diagnosis including the ability to implement the techniques and to know how to select the right technique for a particular application **Intelligent Transportation Systems** Robert Gordon,2015-11-02 Intelligent Transportation Systems Functional Design for Economical and Efficient Traffic Management provides practical guidance on the efficient use of resources in the design of ITS The author explains how functional design alternatives can meet project objectives and requirements with optimal cost effectiveness and clarifies how transportation planning and traffic diversion principles relate to functional ITS device selections and equipment locations Methodologies for translating objectives to functional device types determining device deployment densities and determining the best placement of CCTV cameras and message signs are provided as are models for evaluating the benefits of design alternatives based on traffic conditions Readers will learn how to reduce recurrent congestion improve incident clearance time in non recurrent congestion provide real time incident information to motorists and leverage transportation management center data for lane control through important new active transportation and demand management ATDM methods Finally the author examines exciting

developments in connected vehicle technologies exploring their potential to greatly improve safety mobility and energy efficiency This resource will greatly benefit all ITS designers and managers and is of pivotal importance for operating agencies performing evaluations to justify operational funding and system expansions **Autotuning of PID Controllers** Cheng-Ching Yu,2013-04-17 Recognising the benefits of improved control this book aims to provide simple and yet effective methods of improving controller performance It bridges the gap between the conventional tuning practice and new generations of autotuning methods Practical issues facing controller tuning are treated such as measurement noises process nonlinearity load disturbances and multivariable interaction and tools are also given Numerous worked examples and case studies are used to illustrate the autotuning procedure and MATLAB programs to execute autotuning steps are given This book is intended to be an independent learning tool and is particularly invaluable to practitioners and scientist as well as graduate and undergraduate students The reader will therefore find it useful particularly as it is applicable to engineering practice Practical and Experimental Robotics Ferat Sahin,Pushkin Kachroo,2017-12-19 Taking a completely hands on approach using cheap and easily available robotics kits Practical and Experimental Robotics provides a detailed exploration of the construction theory and experiments for different types of robots With topics ranging from basic stamp microcontrollers to biped and propeller based robots the text contains laboratory experiments examples with solutions and case studies The authors begin with a review of the essential elements of electronics and mechanics They describe the basic mechanical construction and electrical control of the robot then give at least one example of how to operate the robot using microcontrollers or software The book includes a reference chapter on Basic Stamp Microcontollers with example code pieces and a chapter completely devoted to PC interfacing Each chapter begins with the fundamentals then moves on to advanced topics thus building a foundation for learning from the ground up Building a bridge between technicians who have hands on experience and engineers with a deeper insight into the workings the book covers a range of machines from arm wheel and leg robots to flying robots and robotic submarines and boats Unlike most books in this field this one offers a complete set of topics from electronics mechanics and computer interface and programming making it an independent source for knowledge and understanding of robotics **Structure and Synthesis of PID Controllers** Aniruddha Datta,Ming-Tzu Ho,Shankar P. Bhattacharyya,2013-03-14 In many industrial applications the existing constraints mandate the use of controllers of low and fixed order while typically modern methods of optimal control produce high order controllers The authors seek to start to bridge the resultant gap and present a novel methodology for the design of low order controllers such as those of the P PI and PID types Written in a self contained and tutorial fashion this book first develops a fundamental result generalizing a classical stability theorem the Hermite Biehler Theorem and then applies it to designing controllers that are widely used in industry It contains material on current techniques for PID controller design stabilization of linear time invariant plants using PID controllers optimal design with PID controllers robust and non fragile PID controller

design stabilization of first order systems with time delay constant gain stabilization with desired damping constant gain stabilization of discrete time plants Robust Aeroservoelastic Stability Analysis Rick Lind,Marty Brenner,2012-12-06 The series Advances in Industrial Control aims to report and encourage technology transfer in control engineering The rapid development of control technology impacts all areas of the control discipline New theory new controllers actuators sensors new industrial processes computer methods new applications new philosophies new challenges Much of this deVelopment work resides in industrial reports feasibility study papers and the reports of advanced collaborative projects The series offers an opportunity for researchers to present an extended exposition of such new work in all aspects of industrial control for wider and rapid dissemination The high performance control systems applications in aerospace and astronautics almost have a tradition of exploiting the most advanced control theoretical developments first The optimal control and ffitering paradigm associated with the names of Kalman Bucy Anderson and Moore found application in the astronautics of the 1960 S and 1970 S At the beginning of the 1980 S control theory moved on to robustness singular values and mu analysis This new work was associated with the names of Zames Doyle Glover Balas among others The Advances in Industrial Control monograph series have published several volumes over the years which have archived the applications experience garnered from applying robust control to the aerospace sector problems Rick Lind and Marty Brenner add to this set with their volume on robust aeroservoelastic stability This volume reports the application of the structured singular value to aeroelastic and aeroservoelastic aerospace problems **Python Programming** Vijay Kumar Sharma,Vimal Kumar,Swati Sharma,Shashwat Pathak,2021-09-06 Maintaining a practical perspective Python Programming A Practical Approach acquaints you with the wonderful world of programming The book is a starting point for those who want to learn Python programming The backbone of any programming which is the data structure and components such as strings lists etc have been illustrated with many examples and enough practice problems to instill a level of self confidence in the reader Drawing on knowledge gained directly from teaching Computer Science as a subject and working on a wide range of projects related to ML AI deep learning and blockchain the authors have tried their best to present the necessary skills for a Python programmer Once the foundation of Python programming is built and the readers are aware of the exact structure dimensions processing building blocks and representation of data they can readily take up their specific problems from the area of interest and solve them with the help of Python These include but are not limited to operators control flow strings functions module processing object oriented programming exception and file handling multithreading synchronization regular expressions and Python database programming This book on Python programming is specially designed to keep readers busy with learning fundamentals and generates a sense of confidence by attempting the assignment problems We firmly believe that explaining any particular technology deviates from learning the fundamentals of a programming language This book is focused on helping readers attempt implementation in their areas of interest through the skills imparted through this book We have attempted to present

the real essence of Python programming which you can confidently apply in real life by using Python as a tool Salient Features Based on real world requirements and solution Simple presentation without avoiding necessary details of the topic Executable programs on almost every topic Plenty of exercise questions designed to test readers skills and understanding Purposefully designed to be instantly applicable Python Programming A Practical Approach provides implementation examples so that the described subject matter can be immediately implemented due to the well known versatility of Python in handling different data types with ease

This book delves into Feedback Control Theory For Dynamic Traffic Abignment. Feedback Control Theory For Dynamic Traffic Abignment is an essential topic that must be grasped by everyone, from students and scholars to the general public. The book will furnish comprehensive and in-depth insights into Feedback Control Theory For Dynamic Traffic Abignment, encompassing both the fundamentals and more intricate discussions.

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