

Advances in Industrial Control

Béla Lantos
Lőrinc Márton

Nonlinear Control of Vehicles and Robots

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Nonlinear Control Of Vehicles And Robots Advances In Industrial Control

Thomas J. Böhme, Benjamin Frank



Nonlinear Control Of Vehicles And Robots Advances In Industrial Control:

Nonlinear Control of Vehicles and Robots Béla Lantos, Lőrinc Márton, 2010-12-01 Nonlinear Control of Vehicles and Robots develops a unified approach to the dynamic modeling of robots in terrestrial aerial and marine environments The main classes of nonlinear systems and stability methods are summarized and basic nonlinear control methods useful in manipulator and vehicle control are presented Formation control of ground robots and ships is discussed The book also deals with the modeling and control of robotic systems in the presence of non smooth nonlinearities Robust adaptive tracking control of robotic systems with unknown payload and friction in the presence of uncertainties is treated Theoretical and practical aspects of the control algorithms under discussion are detailed Examples are included throughout the book allowing the reader to apply the control and modeling techniques in their own research and development work Some of these examples demonstrate state estimation based on the use of advanced sensors as part of the control system **Hybrid**

Systems, Optimal Control and Hybrid Vehicles Thomas J. Böhme, Benjamin Frank, 2017-02-01 This book assembles new methods showing the automotive engineer for the first time how hybrid vehicle configurations can be modeled as systems with discrete and continuous controls These hybrid systems describe naturally and compactly the networks of embedded systems which use elements such as integrators hysteresis state machines and logical rules to describe the evolution of continuous and discrete dynamics and arise inevitably when modeling hybrid electric vehicles They can throw light on systems which may otherwise be too complex or recondite Hybrid Systems Optimal Control and Hybrid Vehicles shows the reader how to formulate and solve control problems which satisfy multiple objectives which may be arbitrary and complex with contradictory influences on fuel consumption emissions and drivability The text introduces industrial engineers postgraduates and researchers to the theory of hybrid optimal control problems A series of novel algorithmic developments provides tools for solving engineering problems of growing complexity in the field of hybrid vehicles Important topics of real relevance rarely found in text books and research publications switching costs sensitivity of discrete decisions and their impact on fuel savings etc are discussed and supported with practical applications These demonstrate the contribution of optimal hybrid control in predictive energy management advanced powertrain calibration and the optimization of vehicle configuration with respect to fuel economy lowest emissions and smoothest drivability Numerical issues such as computing resources simplifications and stability are treated to enable readers to assess such complex systems To help industrial engineers and managers with project decision making solutions for many important problems in hybrid vehicle control are provided in terms of requirements benefits and risks **Sensorless AC Electric Motor Control** Alain Glumineau, Jesús de Leon Morales, 2015-03-16 This monograph shows the reader how to avoid the burdens of sensor cost reduced internal physical space and system complexity in the control of AC motors Many applications fields electric vehicles wind and wave energy converters and robotics among them will benefit Sensorless AC Electric Motor Control describes the elimination of

physical sensors and their replacement with observers i.e. software sensors Robustness is introduced to overcome problems associated with the unavoidable imperfection of knowledge of machine parameters resistance inertia and so on encountered in real systems The details of a large number of speed and or position sensorless ideas for different types of permanent magnet synchronous motors and induction motors are presented along with several novel observer designs for electrical machines Control strategies are developed using high order sliding mode and quasi continuous sliding mode techniques and two types of observer controller schemes based on backstepping and sliding mode techniques are described Experimental results validate the performance of these observer and controller configurations with test trajectories of significance in difficult sensorless AC machine problems Control engineers working with AC motors in a variety of industrial environments will find the space and cost saving ideas detailed in Sensorless AC Electric Motor Control of much interest Academic researchers and graduate students from electrical mechanical and control engineering backgrounds will be able to see how advanced theoretical control can be applied in meaningful real systems

Optimal Control of Stochastic Difference

Volterra Equations Leonid Shaikhet, 2014-11-27 This book showcases a subclass of hereditary systems that is systems with behaviour depending not only on their current state but also on their past history it is an introduction to the mathematical theory of optimal control for stochastic difference Volterra equations of neutral type As such it will be of much interest to researchers interested in modelling processes in physics mechanics automatic regulation economics and finance biology sociology and medicine for all of which such equations are very popular tools The text deals with problems of optimal control such as meeting given performance criteria and stabilization extending them to neutral stochastic difference Volterra equations In particular it contrasts the difference analogues of solutions to optimal control and optimal estimation problems for stochastic integral Volterra equations with optimal solutions for corresponding problems in stochastic difference Volterra equations Optimal Control of Stochastic Difference Volterra Equations commences with an historical introduction to the emergence of this type of equation with some additional mathematical preliminaries It then deals with the necessary conditions for optimality in the control of the equations and constructs a feedback control scheme The approximation of stochastic quasilinear Volterra equations with quadratic performance functionals is then considered Optimal stabilization is discussed and the filtering problem formulated Finally two methods of solving the optimal control problem for partly observable linear stochastic processes also with quadratic performance functionals are developed Integrating the author's own research within the context of the current state of the art of research in difference equations hereditary systems theory and optimal control this book is addressed to specialists in mathematical optimal control theory and to graduate students in pure and applied mathematics and control engineering

Advances in Applied Nonlinear Optimal Control

Gerasimos Rigatos, Electra Karapanou, 2020-11-19 This volume discusses advances in applied nonlinear optimal control comprising both theoretical analysis of the developed control methods and case studies about their use in robotics mechatronics electric

power generation power electronics micro electronics biological systems biomedical systems financial systems and industrial production processes The advantages of the nonlinear optimal control approaches which are developed here are that by applying approximate linearization of the controlled systems state space description one can avoid the elaborated state variables transformations diffeomorphisms which are required by global linearization based control methods The book also applies the control input directly to the power unit of the controlled systems and not on an equivalent linearized description thus avoiding the inverse transformations met in global linearization based control methods and the potential appearance of singularity problems The method adopted here also retains the known advantages of optimal control that is the best trade off between accurate tracking of reference setpoints and moderate variations of the control inputs The book's findings on nonlinear optimal control are a substantial contribution to the areas of nonlinear control and complex dynamical systems and will find use in several research and engineering disciplines and in practical applications

Optimal Control of Hybrid Vehicles Bram de Jager, Thijs van Keulen, John Kessels, 2013-04-05 Optimal Control of Hybrid Vehicles provides a description of power train control for hybrid vehicles The background environmental motivation and control challenges associated with hybrid vehicles are introduced The text includes mathematical models for all relevant components in the hybrid power train The power split problem in hybrid power trains is formally described and several numerical solutions detailed including dynamic programming and a novel solution for state constrained optimal control problems based on the maximum principle Real time implementable strategies that can approximate the optimal solution closely are dealt with in depth Several approaches are discussed and compared including a state of the art strategy which is adaptive for vehicle conditions like velocity and mass Three case studies are included in the book a control strategy for a micro hybrid power train experimental results obtained with a real time strategy implemented in a hybrid electric truck and an analysis of the optimal component sizes for a hybrid power train Optimal Control of Hybrid Vehicles will appeal to academic researchers and graduate students interested in hybrid vehicle control or in the applications of optimal control Practitioners working in the design of control systems for the automotive industry will also find the ideas propounded in this book of interest

Advances in Robust Control and Applications Mahmut Reyhanoglu, 2025-05-14 Significant advances have been made in developing robust nonlinear control algorithms to tackle challenges related to uncertainties disturbances and noise This book is intended to provide a succinct overview of recent progress in robust control and applications It brings together important contributions from renowned international researchers to provide an excellent survey of new perspectives and paradigms of robust control In particular this book presents important applications of Model Predictive Control and Sliding Mode Control

Handbook of Research on Advancements in Robotics and Mechatronics Habib, Maki K., 2014-12-31 The field of mechatronics integrates modern engineering science and technologies with new ways of thinking enhancing the design of products and manufacturing processes This synergy enables the creation and evolution of new intelligent human oriented machines The

Handbook of Research on Advancements in Robotics and Mechatronics presents new findings practices technological innovations and theoretical perspectives on the the latest advancements in the field of mechanical engineering This book is of great use to engineers and scientists students researchers and practitioners looking to develop autonomous and smart products and systems for meeting today s challenges

Unmanned Aerial Vehicles: Breakthroughs in Research and Practice Management Association, Information Resources,2019-05-03 First used in military applications unmanned aerial vehicles are becoming an integral aspect of modern society and are expanding into the commercial scientific recreational agricultural and surveillance sectors With the increasing use of these drones by government officials business professionals and civilians more research is needed to understand their complexity both in design and function Unmanned Aerial Vehicles Breakthroughs in Research and Practice is a critical source of academic knowledge on the design construction and maintenance of drones as well as their applications across all aspects of society Highlighting a range of pertinent topics such as intelligent systems artificial intelligence and situation awareness this publication is an ideal reference source for military consultants military personnel business professionals operation managers surveillance companies agriculturalists policymakers government officials law enforcement IT professionals academicians researchers and graduate level students

Autonomous Flying Robots Kenzo Nonami,Farid Kendoul,Satoshi Suzuki,Wei Wang,Daisuke Nakazawa,2010-09-15 The advance in robotics has boosted the application of autonomous vehicles to perform tedious and risky tasks or to be cost effective substitutes for their man counterparts Based on their working environment a rough classi cation of the autonomous vehicles would include unmanned aerial vehicles UAVs manned ground vehicles UGVs autonomous underwater vehicles AUVs and autonomous surface vehicles ASVs UAVs UGVs AUVs and ASVs are called UVs unmanned vehicles nowadays In recent decades the development of manned autonomous vehicles have been of great interest and different kinds of autonomous vehicles have been studied and developed all over the world In part ular UAVs have many applications in emergency situations humans often cannot come close to a dangerous natural disaster such as an earthquake a ood an active volcano or a nuclear disaster Since the development of the rst UAVs research efforts have been focused on military applications Recently however demand has arisen for UAVs such as aero robotsand ying robotsthat can be used in emergency situations and in industrial applications Among the wide variety of UAVs that have been developed small scale HUAVs helicopter based UAVs have the ability to take off and land vertically as well as the ability to cruise in ight but their most importantcapability is hovering Hoveringat a point enables us to make more eff tive observations of a target Furthermore small scale HUAVs offer the advantages of low cost and easy operation

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

Advances in Automotive Control 2004 (2-volume Set) G Rizzo,L Glielmo,C Pianese,F Vasca,2005-11-07 *The AUN/SEED-Net Joint Regional Conference in Transportation, Energy, and Mechanical Manufacturing Engineering* Anh-Tuan Le, Van-Sang Pham, Minh-Quy Le, Hoang-Luong Pham, 2022-05-31 This book The AUN SEED Net Joint Regional Conference in Transportation Energy and Mechanical Manufacturing Engineering gathers selected papers submitted to the 14th Regional Conference in Energy Engineering and the 13th Regional Conference in Mechanical Manufacturing Engineering in the fields related to intelligent equipment automotive engineering mechanical systems and sustainable manufacturing renewable energy heat and mass transfer Under the theme of Integration and Innovation for Sustainable Development This book consists of papers in the aforementioned fields presented by researchers and scientists from universities research institutes and industry showcasing their latest findings and discussions with an emphasis on innovations and developments in embracing the new norm resulting from the COVID 19 pandemic *Robots, Drones, UAVs and UGVs for Operation and Maintenance* Diego Galar, Uday Kumar, Dammika Seneviratne, 2020-05-07 Industrial assets such as railway lines roads pipelines are usually huge span long distances and can be divided into clusters or segments that provide different levels of functionality subject to different loads degradations and environmental conditions and their efficient management is necessary The aim of the book is to give comprehensive understanding about the use of autonomous vehicles context of robotics for the utilization of inspection and maintenance activities in industrial asset management in different accessibility and hazard levels The usability of deploying inspection vehicles in an autonomous manner is explained with the emphasis on integrating the total process Key Features Aims for solutions for maintenance and inspection problems provided by robotics drones unmanned air vehicles and unmanned ground vehicles Discusses integration of autonomous vehicles for inspection

and maintenance of industrial assets Covers the industrial approach to inspection needs and presents what is needed from the infrastructure end Presents the requirements for robot designers to design an autonomous inspection and maintenance system Includes practical case studies from industries

Advanced Autonomous Vehicle Design for Severe Environments V.V. Vantsevich, M.V. Blundell, 2015-10-20 Classical vehicle dynamics which is the basis for manned ground vehicle design has exhausted its potential for providing novel design concepts to a large degree At the same time unmanned ground vehicle UGV dynamics is still in its infancy and is currently being developed using general analytical dynamics principles with very little input from actual vehicle dynamics theory This technical book presents outcomes from the NATO Advanced Study Institute ASI Advanced Autonomous Vehicle Design for Severe Environments held in Coventry UK in July 2014 The ASI provided a platform for world class professionals to meet and discuss leading edge research engineering accomplishments and future trends in manned and unmanned ground vehicle dynamics terrain mobility and energy efficiency The outcomes of this collective effort serve as an analytical foundation for autonomous vehicle design Topics covered include historical aspects pivotal accomplishments and the analysis of future trends in on and off road manned and unmanned vehicle dynamics terramechanics soil dynamic characteristics uncertainties and stochastic characteristics of vehicle environment interaction for agile vehicle dynamics modeling new methods and techniques in on line control and learning for vehicle autonomy fundamentals of agility and severe environments mechatronics and cyber physics issues of agile vehicle dynamics to design for control energy harvesting and cyber security and case studies of agile and inverse vehicle dynamics and vehicle systems design including optimisation of suspension and driveline systems The book targets graduate students who desire to advance further in leading edge vehicle dynamics topics in manned and unmanned ground vehicles PhD students continuing their research work and building advanced curricula in academia and industry and researchers in government agencies and private companies

Advanced Control of Flight Vehicle Maneuver and Operation Chuang Liu, Honghua Dai, Xiaokui Yue, Yiqing Ma, 2023-03-07 This book focuses on the advanced controller designs of flight vehicle maneuver and operation Chapters explain advanced control mechanisms and algorithms for different controllers required in a flight vehicle system The book topics such as air disturbance fixed time controllers algorithms for orbit and attitude computation adaptive control modes altitude stabilization nonlinear vibration control partial space elevator configuration controls for formation flying and satellite cluster respectively Key features 1 Includes an investigation of high precision and high stability control problems of flight vehicles 2 Multiple complex disturbances are considered to improve robust performance and control accuracy 3 Covers a variety of single spacecraft and distributed space systems including hypersonic vehicles flexible aircraft rigid aircraft and satellites This book will be helpful to aerospace scientists and engineers who are interested in working on the development of flight vehicle maneuver and operation Researchers studying control science and engineering and advanced undergraduate and graduate students and professionals involved in the flight vehicle control field will also benefit from the information

given in this book Intelligent Control for Electric Power Systems and Electric Vehicles G. Rigatos, M. Abbaszadeh, M. Hamida, P. Siano, 2024-10-30 The present monograph offers a detailed and in depth analysis of the topic of Intelligent Control for Electric Power Systems and Electric Vehicles First Nonlinear optimal control and Lie algebra based control Control based on approximate linearization and Global linearization based control concepts is analyzed Next Differential flatness theory and flatness based control methods Global linearization based control with the use of differential flatness theory and Flatness based control of nonlinear dynamical systems in cascading loops is treated Following the control theoretic part Control of DC and PMBLDC electric motors Control of DC motors through a DC DC converter and Control of Permanent Magnet Brushless DC motors is presented Besides Control of VSI fed three phase and multi phase PMSMs Nonlinear optimal control VSI fed three phase PMSMs and Nonlinear optimal control VSI fed six phase PMSMs is explained Additionally Control of energy conversion chains based on PMSMs Control of wind turbine and PMSM based electric power unit and Control of a PMSM driven gas compression unit is studied Besides Control of energy conversion chains based on Induction Machines Control of the VSI fed three phase induction motor Control of an induction motor driven gas compressor and Control of induction generator based shipboard microgrids is explained Next Control of multi phase machines in gas processing and power units Control of gas compressors actuated by 5 phase PMSMs and Control of 6 phase induction generators in renewable energy units is introduced Moreover Control of Spherical Permanent Magnet Synchronous Motors and Switched Reluctance Motors Control of spherical permanent magnet synchronous motors Control of switched reluctance motors for electric traction and Adaptive control for switched reluctance motors is analyzed Furthermore Control of traction and powertrains in Electric Vehicles and Hybrid Electric Vehicles Control of multi phase motors in the traction system in electric vehicles and Control of synchronous machines and converters in power chains of hybrid electric vehicles is explained Finally Control of renewable power units and heat management units Control of residential microgrids with Wind Generators Fuel Cells and PVs and Control of heat pumps for thermal management in electric vehicles it treated The new control methods which are proposed by the monograph treat the control problem of the complex nonlinear dynamics of electric power systems and electric vehicles without the need for complicated state space model transformations and changes of state variables The proposed control schemes are modular and scalable and can be applied to a large class of dynamic models of electric power systems and electric vehicles They have a clear and easy to implement algorithmic part while they also exhibit a moderate computational load The proposed control schemes foster the optimized exploitation of renewable energy sources and the reliable integration of renewable energy units in the power grid Besides they support the transition to electromotion and the deployment of the use of electric vehicles The manuscript is suitable for teaching nonlinear control estimation and fault diagnosis topics with emphasis to electric power systems and to electric vehicle traction and propulsion systems both at late undergraduate and postgraduate levels **Advanced Control Design with Application to Electromechanical Systems**

Magdi S. Mahmoud, 2018-04-12 *Advanced Control Design with Application to Electromechanical Systems* represents the continuing effort in the pursuit of analytic theory and rigorous design for robust control methods. The book provides an overview of the feedback control systems and their associated definitions with discussions on finite dimension vector spaces mappings and convex analysis. In addition, a comprehensive treatment of continuous control system design is presented along with an introduction to control design topics pertaining to discrete time systems. Other sections introduce linear H1 and H2 theory, dissipativity analysis and synthesis, and a wide spectrum of models pertaining to electromechanical systems. Finally, the book examines the theory and mathematical analysis of multiagent systems. Researchers on robust control theory and electromechanical systems and graduate students working on robust control will benefit greatly from this book. Introduces a coherent and unified framework for studying robust control theory. Provides the control theoretic background required to read and contribute to the research literature. Presents the main ideas and demonstrations of the major results of robust control theory. Includes MATLAB codes to implement during research.

Control of Autonomous Aerial Vehicles Andrea L'Afflitto, Gokhan Inalhan, Hyo-Sang Shin, 2023-11-20 *Control of Autonomous Aerial Vehicles* is an edited book that provides a single volume snapshot on the state of the art in the field of control theory applied to the design of autonomous unmanned aerial vehicles (UAVs) aka drones employed in a variety of applications. The homogeneous structure allows the reader to transition seamlessly through results in guidance navigation and control of UAVs according to the canonical classification of the main components of a UAV's autopilot. Each chapter has been written to assist graduate students and practitioners in the fields of aerospace engineering and control theory. The contributing authors duly present detailed literature reviews conveying their arguments in a systematic way with the help of diagrams, plots, and algorithms. They showcase the applicability of their results by means of flight tests and numerical simulations, the results of which are discussed in detail. *Control of Autonomous Aerial Vehicles* will interest readers who are researchers, practitioners, or graduate students in control theory, autonomous systems, or robotics, or in aerospace mechanical or electrical engineering.

Optimization and Cooperative Control Strategies Michael Hirsch, Clayton W. Commander, Panos M. Pardalos, Robert Murphey, 2009-01-17 Cooperative collaborating autonomous systems are at the forefront of research efforts in numerous disciplines across the applied sciences. There is constant progress in solution techniques for these systems. However, despite this progress, cooperating systems have continued to be extremely difficult to model, analyze, and solve. Theoretical results are very difficult to come by. Each year the International Conference on Cooperative Control and Optimization (CCO) brings together top researchers from around the world to present new cutting edge ideas, theories, applications, and advances in the fields of autonomous agents, cooperative systems, control theory, information flow, and optimization. The works in this volume are a result of invited papers and selected presentations at the Eighth Annual International Conference on Cooperative Control and Optimization held in Gainesville, Florida, January 30 - February 1, 2008.

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Table of Contents Nonlinear Control Of Vehicles And Robots Advances In Industrial Control

1. Understanding the eBook Nonlinear Control Of Vehicles And Robots Advances In Industrial Control
 - The Rise of Digital Reading Nonlinear Control Of Vehicles And Robots Advances In Industrial Control
 - Advantages of eBooks Over Traditional Books
2. Identifying Nonlinear Control Of Vehicles And Robots Advances In Industrial Control
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Nonlinear Control Of Vehicles And Robots Advances In Industrial Control
 - User-Friendly Interface
4. Exploring eBook Recommendations from Nonlinear Control Of Vehicles And Robots Advances In Industrial Control
 - Personalized Recommendations
 - Nonlinear Control Of Vehicles And Robots Advances In Industrial Control User Reviews and Ratings

- Nonlinear Control Of Vehicles And Robots Advances In Industrial Control and Bestseller Lists
- 5. Accessing Nonlinear Control Of Vehicles And Robots Advances In Industrial Control Free and Paid eBooks
 - Nonlinear Control Of Vehicles And Robots Advances In Industrial Control Public Domain eBooks
 - Nonlinear Control Of Vehicles And Robots Advances In Industrial Control eBook Subscription Services
 - Nonlinear Control Of Vehicles And Robots Advances In Industrial Control Budget-Friendly Options
- 6. Navigating Nonlinear Control Of Vehicles And Robots Advances In Industrial Control eBook Formats
 - ePub, PDF, MOBI, and More
 - Nonlinear Control Of Vehicles And Robots Advances In Industrial Control Compatibility with Devices
 - Nonlinear Control Of Vehicles And Robots Advances In Industrial Control Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Nonlinear Control Of Vehicles And Robots Advances In Industrial Control
 - Highlighting and Note-Taking Nonlinear Control Of Vehicles And Robots Advances In Industrial Control
 - Interactive Elements Nonlinear Control Of Vehicles And Robots Advances In Industrial Control
- 8. Staying Engaged with Nonlinear Control Of Vehicles And Robots Advances In Industrial Control
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Nonlinear Control Of Vehicles And Robots Advances In Industrial Control
- 9. Balancing eBooks and Physical Books Nonlinear Control Of Vehicles And Robots Advances In Industrial Control
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Nonlinear Control Of Vehicles And Robots Advances In Industrial Control
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Nonlinear Control Of Vehicles And Robots Advances In Industrial Control
 - Setting Reading Goals Nonlinear Control Of Vehicles And Robots Advances In Industrial Control
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Nonlinear Control Of Vehicles And Robots Advances In Industrial Control
 - Fact-Checking eBook Content of Nonlinear Control Of Vehicles And Robots Advances In Industrial Control
 - Distinguishing Credible Sources

13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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