

Jinkun Liu
Xinhua Wang

Advanced Sliding Mode Control for Mechanical Systems

Design, Analysis and
MATLAB Simulation



Advanced Sliding Mode Control For Mechanical Systems Design Analysis And Matlab Simulation

**Sundarapandian Vaidyanathan, Chang-
Hua Lien**



Advanced Sliding Mode Control For Mechanical Systems Design Analysis And Matlab Simulation:

Advanced Sliding Mode Control for Mechanical Systems Jinkun Liu,Xinhua Wang,2012-09-07 Advanced Sliding Mode Control for Mechanical Systems Design Analysis and MATLAB Simulation takes readers through the basic concepts covering the most recent research in sliding mode control The book is written from the perspective of practical engineering and examines numerous classical sliding mode controllers including continuous time sliding mode control discrete time sliding mode control fuzzy sliding mode control neural sliding mode control backstepping sliding mode control dynamic sliding mode control sliding mode control based on observer terminal sliding mode control sliding mode control for robot manipulators and sliding mode control for aircraft This book is intended for engineers and researchers working in the field of control Dr Jinkun Liu works at Beijing University of Aeronautics and Astronautics and Dr Xinhua Wang works at the National University of Singapore

Sliding Mode Control Using MATLAB Jinkun Liu,2017-05-25 Sliding Mode Control Using MATLAB provides many sliding mode controller design examples along with simulation examples and MATLAB programs Following the review of sliding mode control the book includes sliding mode control for continuous systems robust adaptive sliding mode control sliding mode control for underactuated systems backstepping and dynamic surface sliding mode control sliding mode control based on filter and observer sliding mode control for discrete systems fuzzy sliding mode control neural network sliding mode control and sliding mode control for robot manipulators The contents of each chapter are independent providing readers with information they can use for their own needs It is suitable for the readers who work on mechanical and electronic engineering electrical automation engineering etc and can also be used as a teaching reference for universities Provides many sliding mode controller design examples to help readers solve their research and design problems Includes various implementable robust sliding mode control design solutions from engineering applications Provides the simulation examples and MATLAB programs for each sliding mode control algorithm

Applications of Sliding Mode Control in Science and Engineering Sundarapandian Vaidyanathan,Chang-Hua Lien,2017-04-06 Gathering 20 chapters contributed by respected experts this book reports on the latest advances in and applications of sliding mode control in science and engineering The respective chapters address applications of sliding mode control in the broad areas of chaos theory robotics electrical engineering physics chemical engineering memristors mechanical engineering environmental engineering finance and biology Special emphasis has been given to papers that offer practical solutions and which examine design and modeling involving new types of sliding mode control such as higher order sliding mode control terminal sliding mode control super twisting sliding mode control and integral sliding mode control This book serves as a unique reference guide to sliding mode control and its recent applications for graduate students and researchers with a basic knowledge of electrical and control systems engineering

Advanced Robust Nonlinear Control Approaches for Quadrotor Unmanned Aerial Vehicle Moussa Labbadi,Yassine Boukal,Mohamed Cherkaoui,2021-09-14 This book studies selected advanced flight control schemes for an

uncertain quadrotor unmanned aerial vehicle UAV systems in the presence of constant external disturbances parametric uncertainties measurement noise time varying external disturbances and random external disturbances Furthermore in all the control techniques proposed in this book it includes the simulation results with comparison to other nonlinear control schemes recently developed for the tracking control of a quadrotor UAV The main contributions of the present book for quadrotor UAV systems are as follows i the proposed control methods are based on the high order sliding mode controller SMC and hybrid control algorithm with an optimization method ii the finite time control schemes are developed by using fast terminal SMC FTSMC nonsingular FTSMC NFTSMC global time varying SMC and adaptive laws iii the fractional order flight control schemes are developed by using the fractional order calculus theory super twisting algorithm NFTSMC and the SMC This book covers the research history and importance of quadrotor system subject to system uncertainties external wind disturbances and noise measurements as well as the research status of advanced flight control methods adaptive flight control methods and flight control based on fractional order theory The book would be interesting to most academic undergraduate postgraduates researchers on flight control for drones and applications of advanced controllers in engineering field This book presents a must survey for advanced finite time control for quadrotor system Some parts of this book have the potential of becoming the courses for the modelling and control of autonomous flying machines Readers academic researcher undergraduate student postgraduate student MBA executive and education practitioner interested in nonlinear control methods find this book an investigation This book can be used as a good reference for the academic research on the control theory drones terminal sliding mode control and related to this or used in Ph D study of control theory and their application in field engineering

Methods and Applications for Modeling and Simulation of Complex Systems Gary Tan,Axel Lehmann,Yong Meng Teo,Wentong Cai,2019-10-21 This volume constitutes the proceedings of the 19th Asia Simulation Conference AsiaSim 2019 held in Singapore Singapore in October 2019 The 19 revised full papers and 5 short papers presented in this volume were carefully reviewed and selected from 36 submissions The papers are organized in topical sections on simulation and modeling methodology numerical and Monte Carlo simulation simulation applications blockchain deep learning and cloud simulation and visualization simulation applications short papers

Intelligent Computing Methodologies De-Shuang Huang,Zhi-Kai Huang,Abir Hussain,2019-07-30 This two volume set of LNCS 11643 and LNCS 11644 constitutes in conjunction with the volume LNAI 11645 the refereed proceedings of the 15th International Conference on Intelligent Computing ICIC 2019 held in Nanchang China in August 2019 The 217 full papers of the three proceedings volumes were carefully reviewed and selected from 609 submissions The ICIC theme unifies the picture of contemporary intelligent computing techniques as an integral concept that highlights the trends in advanced computational intelligence and bridges theoretical research with applications The theme for this conference is Advanced Intelligent Computing Methodologies and Applications Papers related to this theme are especially solicited including theories

methodologies and applications in science and technology Smart Energy Empowerment in Smart and Resilient Cities
Mustapha Hatti, 2019-12-24 International Conference on Artificial Intelligence in Renewable Energetic Systems IC
AIRES2019 26 28 November 2019 Taghit Bechar Algeria The challenges of the energy transition in the medium term lead to
numerous technological breakthroughs in the areas of production optimal distribution and the rational use of energy and
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systems cogeneration and energy recovery processes new and renewable energies etc The fall in the cost of renewable
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establish growing and vibrant socioeconomic communities by academics students in engineering and data computing from
around the world who have chosen an academic path leading to an electric power and energy engineering and artificial
intelligence to advancing technology for the advantage of humanity **Model-based calibration of automated**
transmissions Huang, Hua, 2016-11-18 With continuous restrictions on emission standards and demands for higher driving
comfort the calibration of shift quality is linked deeply and widely to automated transmission control algorithms This
calibration process is typically implemented with real vehicles on the road under poorly reproducible conditions where the
calibration engineer has no other choice but to try different control parameters till the subjective assessment on the shift
quality meets certain requirements such as shifting comfort or sportiness Compared with today's multiplying number of
variants in vehicle engine transmission combinations and exponential growth of control parameters this traditional method is
backward and costly An efficient way to rise to the challenge is the model based automatic calibration In contrast to the
conventional shift quality calibration this novel method uses a closed loop approach based on a dynamic model instead of
human know how A shift quality correlated position trajectory is proposed Compared to the traditional control parameter

adjustment method the guided trajectory has a higher tolerance to the system's hardware components and a better compatibility with TCUs from diverse suppliers. Since shift quality is not restricted to a general summarized grade, e.g. comfort and sportiness are always two conflicting influence factors in the terms of shift quality calibrations, a multi-objective evolutionary algorithm is applied to search the set of Pareto optimal front which includes all the optimal compromised control parameters of the gear shifting trajectory for possible choice. In this work, a hydro-mechanical AMT synchronization system is used as an example to explain the proposed optimization process. A Modelica-based non-linear hydro-mechanical AMT system is modeled which describes the transient behavior during gear shifting in detail. An effective fuzzy sliding mode position controller is designed for the referenced position tracking during synchronization in contrast to the conventional trial and error tuning method, a genetic algorithm is applied to automatically identify and optimize the sliding mode controller parameters. A novel multi-objective evolutionary algorithm MLIA is developed to find out the optimal control set for the synchronization trajectories. Verification at a transmission test bench shows that this model-based multi-objective optimization method has a guiding capability in automated transmission calibration.

Mit deutlich strengeren gesetzlichen Anforderungen hinsichtlich der Abgasemissionen und einer zunehmend anspruchsvolleren Nachfrage bezüglich des Fahrkomforts rückt die Frage nach der Schaltqualität stärker in den Fokus der Getriebeentwicklung. Die Kalibrierung umgangssprachlich die Applikation ist deshalb ein Schwerpunkt bei der Entwicklung von Algorithmen für die Schaltqualität von automatisierten Getriebesteuerungen. Der Kalibrierungsprozess wird in der Regel im Fahrzeugversuch auf der Straße durchgeführt. Der Applikationsingenieur versucht unter diesen nicht reproduzierbaren Bedingungen verschiedene Steuerparameter zu adaptieren. Dies wird für eine Schaltung solange durchgeführt bis die subjektive Beurteilung der Schaltqualität und die zugehörigen Eigenschaften wie zum Beispiel Schaltkomfort und Sportlichkeit erfüllt ist. Dieser beschriebene Prozess ist zeit- und personalaufwendig was mit dem aktuellen Angebot an Motor-Getriebe-Fahrzeugvarianten kaum bewältigt werden kann. Als weitere Herausforderung steigt die Anzahl der kalibrierbaren Parameter der Regler und Steuerungsmethoden stetig um die Kundenbedürfnisse zu befriedigen weshalb auch aus Kostensicht ein besserer Prozess gefunden werden muss. Eine effiziente Möglichkeit zur Lösung der skizzierten Problemstellungen ist die modellbasierte automatische Kalibrierung. Im Gegensatz zu der herkömmlich auf Fahrversuche basierende Kalibrierung der Schaltqualität verwendet dieses neue Verfahren ein dynamisches Modell in einer geschlossenen Schleife. Anstelle des Applikationsingenieurs für die Fahrvorgaben wird in der Schleife ein Fahrerregler und ein Optimierungsalgorithmus verwendet um so eine hohe Reproduzierbarkeit des Schaltereignisses sicherzustellen. Es wird vorgeschlagen die Bewegung der Schaltstellung zu optimieren da diese mit der Schaltqualität korreliert. Diametral steht dem die allgemeine Regleranpassung verschiedener Parameter für die Synchronisation gegenüber. Die vorgeschlagene Methode der geführten Schaltbewegung weist eine deutlich höhere Toleranz gegenüber der Varianz an Hardwarekomponenten und damit eine bessere Kompatibilität zu den Getriebesteuergeräten TCUs

verschiedener Lieferanten auf. Die Schaltqualität lässt sich nicht auf ein subjektives Kriterium zusammenfassen, es werden immer unterschiedliche Faktoren wie z.B. Komfort und Sportlichkeit den Schaltvorgang bestimmen. Deshalb wird für die Optimierung des Schaltvorgangs ein mehrkriterieller evolutionärer Algorithmus angewandt, um die Paretofront zu identifizieren, was alle Kompromisse der Schaltbewegungsregelung einschließt. Es wird ein Modell eines hydromechanischen Synchronisationssystems für ein automatisiertes Getriebe als Beispielanwendung benutzt, um den vorgeschlagenen Optimierungsprozess zu demonstrieren. Das nichtlineare hydromechanische Synchronisationssystem wird mit der objektorientierten Sprache Modelica modelliert. Mit dem Modell werden Schaltvorgänge detailliert beschrieben. Ein Fuzzy Sliding Mode Regler wird für die jeweilige Bewegung der Schaltung während der Synchronisation benutzt. Im Gegensatz zur herkömmlichen empirischen Anpassung der Reglerparameter wird ein genetischer Algorithmus angewendet, um die automatische Erkennung und Bewertung der Parameter vom Fuzzy Sliding Mode Regler zu optimieren. Ein neuartiger evolutionärer mehrkriterieller Algorithmus MLIA wurde angewandt, um eine optimale Bewegung der Schaltstellung während der Synchronisierung zu finden. Die Validierung am Getriebeprüfstand zeigt, dass diese modellbasierte Methode der mehrkriteriellen Optimierung in der automatisierten Getriebekalibrierung eine deutliche Verbesserung darstellt.

Mathematical Techniques of Fractional Order Systems Ahmad Taher Azar, Ahmed G. Radwan, Sundarapandian Vaidyanathan, 2018-06-11. Mathematical Techniques of Fractional Order Systems illustrates advances in linear and nonlinear fractional order systems relating to many interdisciplinary applications including biomedical control circuits, electromagnetics and security. The book covers the mathematical background and literature survey of fractional order calculus and generalized fractional order circuit theorems from different perspectives in design analysis and realizations of nonlinear fractional order circuits and systems, the fractional order memristive circuits and systems in design analysis, emulators, simulation and experimental results. It is primarily meant for researchers from academia and industry and for those working in areas such as control engineering, electrical engineering, computer science and information technology. This book is ideal for researchers working in the area of both continuous time and discrete time dynamics and chaotic systems. Discusses multidisciplinary applications with new fundamentals, modeling, analysis, design, realization and experimental results. Includes circuits and systems based on new nonlinear elements. Covers most of the linear and nonlinear fractional order theorems that will solve many scientific issues for researchers. Closes the gap between theoretical approaches and real world applications. Provides MATLAB and Simulink code for many applications in the book. Proceedings of International Conference on Industrial Instrumentation and Control Subhasis Bhaumik, Subrata Chattopadhyay, Tanushyam Chattopadhyay, Srijan Bhattacharya, 2022-02-15. This book is a collection of selected high quality research papers presented at the International Conference on Industrial Instrumentation and Control ICI2C 2021 organized by the Department of Applied Electronics Instrumentation Engineering, RCC Institute of Information Technology, Kolkata, India, during 20 August 22.

2021 It includes novel and innovative work from experts practitioners scientists and decision makers from academia and industry It covers topics such as instrumentation application in industry instrumentation in electrical applications and instrumentation in recent trends with computation approach

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