

- Design Control Law for Regulator

System : $\dot{x} = f(x, \hat{x}, u, t, \Delta)$ $\Delta < \beta$

State Space Model: $x = x_1$

$$\dot{x} = \dot{x}_1 = x_2$$

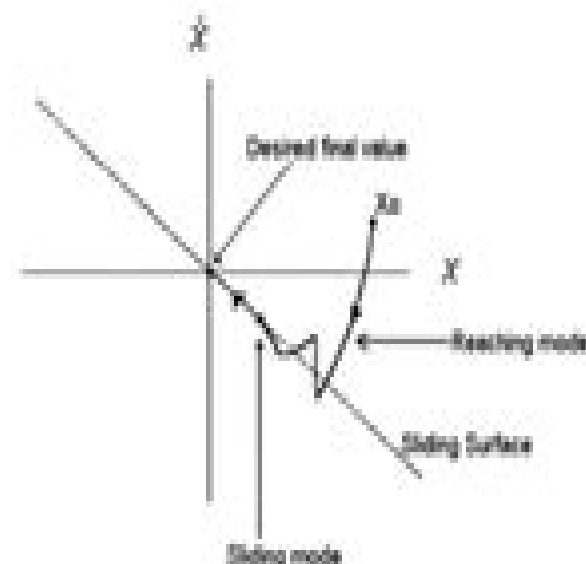
$$\dot{x} = \dot{x}_1 = \dot{x}_2 = f(x, \hat{x}, u, t, \Delta)$$

Sliding Surface: $s = ax_1 + x_2$ $a > 0$

First Derivative of $s \rightarrow \dot{s} = a\dot{x}_1 + \dot{x}_2 = ax_2 + f(x, \hat{x}, u, t, \Delta)$

$$\dot{s} = -k|s|^\gamma \text{sgn}(s) \quad k > 0, 0 > \gamma > 1$$

$$ax_2 + f(x, \hat{x}, u, t, \Delta) = -k|s|^\gamma \text{sgn}(s)$$



Control Law $u = -ax_2 - f(x, \hat{x}, t, \Delta) - k|s|^\gamma \text{sgn}(s)$

Sliding Mode Control Matlab Code

RJ Alexander



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Nonlinear Control Feedback Linearization Sliding Mode Control Mourad Boufadene, 2024-03-06 This book introduces nonlinear control systems for control engineering and science to graduate undergraduate students and researchers it targets control engineering students who do not like to do not have time to derive and prove mathematical results for nonlinear control systems It can be serve as a text book for nonlinear control systems especially for feedback linearization techniques which is a common approach in controlling nonlinear systems The development of computer software for nonlinear control systems has provided many benefits for teaching research and the development of control systems design MATLAB is considered the dominant software platforms for linear and nonlinear control systems analysis This book contains a MATLAB based program that helps teachers students and researchers with an easy to use for finding feedback linearization controller for a specific nonlinear class of systems Chapter 1 is an introduction to theoretical aspects of nonlinear feedback linearization techniques We sue a simple and complex examples to better illustrate the method on how to find the feedback linearization controller for single and multi input output systems In section 1 9 A MATLAB based program is developed and use to find feedback linearization control using symbolic MATLAB libraries for a special class of nonlinear systems Chapter 2 the concept of structure variable control will be introduced in intuitive way with illustrative examples that makes the reader familiar with the theory of sliding mode control in an easy and simple way After having defined the control law the parameters of the controller should be identified hence a simple method is presented to find those parameters In section 2 4 A MATLAB based function is developed to find the sliding mode surfaces and controllers using symbolic MATLAB library for SISO and MIMO nonlinear dynamical systems that could be written in a special form This textbook provides an easy way to learn nonlinear control systems such as feedback linearization technique and slidng mode control Structrue varibale control which are one of the most used techniques in nonlinear control dynamical systems therefore teachers students and 2 researchers are all in need to handle such techniques and since they are too difficult for them to handle such nonlinear controllers especially for a more complicated systems such as induction motor satellite and vehicles dynamical models Thus this document it is an excellent resource for learning the principle of feedback linearization and sliding mode techniques in an easy and simple way a Provides a briefs description of the feedback linearization and sliding mode control strategies b Includes a simple method on how to determine the right and appropriate controller P PI PID for feedback linearization control strategy c Provides a MATLAB symbolic based programs that can solve the Lie derivative of any nonlinear dynamical system that could be written in a special form d A Symbolic Matlab Based function for finding the feedback linearization and sliding mode controllers are developed and tested using several examples e A simple method for finding the approximate sliding mode controller parameters is introduced

Methods of Developing Sliding Mode Controllers Reihaneh Kardehi Moghaddam, Mostafa Rabbani, 2025-01-22 Comprehensive fast access guide to different types

of sliding mode controllers and their programming and simulation in MATLAB and Simulink Methods of Developing Sliding Mode Controllers delivers a practical review of sliding mode controllers SMCs and their challenges with coverage of related theorems stability analysis and how to program and simulate SMCs in MATLAB and Simulink The book details the latest methods of their development and their applications in the automotive aerospace and robotics industries Initial chapters detail a range of different types of controllers A combination of sliding and backstepping control is introduced and simulated and the phenomenon of chattering and effective solutions to reduce it are provided along with suitable examples and analytical tables of the results The final two chapters are related to fixed time and event triggered SMCs Extensive Matlab Simulink supported examples and simulation program code block diagrams are included throughout Methods of Developing Sliding Mode Controllers Design and Matlab Simulation explores sample topics including Classic SMCs covering variable structures including relays and feedback control with switching gains as well as controller design and theoretical foundations Terminal SMCs covering nonsingular and fast variations dynamic SMCs and fuzzy SMCs covering fuzzy approximation and equivalent control as well as indirect design Super twisting SMCs adaptive SMCs and backstepping SMCs covering the backstepping method and chaotic duffing oscillator equations Sign Epsilon sign saturation hyperbolic tangent and generalized hyperbolic tangent functions for chatter reduction Methods of Developing Sliding Mode Controllers Design and Matlab Simulation is a concise yet comprehensive and highly practical reference on the subject for graduate postgraduate students in electrical engineering mechanical engineering and biomedical engineering along with academics and professionals in fields related to SMCs

Variable-Structure Systems and Sliding-Mode Control Martin Steinberger, Martin Horn, Leonid Fridman, 2020-02-10 The book covers the latest theoretical results and sophisticated applications in the field of variable structure systems and sliding mode control This book is divided into four parts Part I discusses new higher order sliding mode algorithms including new homogeneous controllers and differentiators Part II then explores properties of continuous sliding mode algorithms such as saturated feedback control reaching time and orbital stability Part III is focused on the usage of variable structure systems VSS controllers for solving other control problems for example unmatched disturbances Finally Part IV discusses applications of VSS these include applications within power electronics and vehicle platooning Variable structure Systems and Sliding Mode Control will be of interest to academic researchers students and practising engineers

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 **Advanced Control of Turbofan Engines** Hanz Richter,2011-10-20

Advanced Control of Turbofan Engines describes the operational performance requirements of turbofan commercial engines from a controls systems perspective covering industry standard methods and research edge advances This book allows the reader to design controllers and produce realistic simulations using public domain software like CMAPSS Commercial Modular Aero Propulsion System Simulation whose versions are released to the public by NASA The scope of the book is centered on the design of thrust controllers for both steady flight and transient maneuvers Classical control theory is not dwelled on but instead an introduction to general undergraduate control techniques is provided Advanced Control of Turbofan Engines is ideal for graduate students doing research in aircraft engine control and non aerospace oriented control engineers who need an introduction to the field **OWC-Based Ocean Wave Energy Plants** Sunil Kumar

Mishra,Dusmanta Kumar Mohanta,Bhargav Appasani,Ersan Kabalcı,2020-11-24 This book discusses about the new techniques of power generation control of oscillating water column OWC using airflow control and maximum power point tracking of OWC using rotational speed control OWCs harness energy from the oscillation of the seawater inside a chamber or hollow caused by the action of waves This book presents the mathematical modeling and control techniques used by OWCs Introducing new concepts to studies of wave energy to provide fresh perspectives on energy extraction and efficiency problems the book will be a valuable resource for researchers and industrial companies involved in thermal energy and coastal engineering It will also be of interest to students as it broadens their view of wave energy *Machine Tools* Wasim

Ahmed Khan,Khalid Rahman,Ghulam Hussain,Ghulam Abbas,Xiaoping Wang,2023-02-02 This book introduces the applications of Industry 4 0 in machine tools through an overview of the latest available digital technologies It focuses on digital twining communication between industrial controls motion and input output devices along with sustainability in SMEs Machine Tools An Industry 4 0 Perspective focuses on the digital twining of machine tools which improves the life of the machines and provides a method of operating a factory during times of complete lockdown resulting from various conditions It presents an overview of the communication between industrial controls motion and input output devices through standardized digital interfaces such as SERCOS and USB The book goes on to discuss industrial cybersecurity systems applicable to discrete manufacturing which includes cyberattacks and human errors and address the security aspects related to software hardware and data The book also explores the application of big data for different stages of production and illustrates the uses such as predictive maintenance product quality product life cycle management PLM and more This book is an ideal reference for undergraduate graduate and postgraduate students of industrial mechanical and mechatronics engineering along with professionals and general readers **Sliding Mode Control** Andrzej Bartoszewicz,2011-04-11 The

main objective of this monograph is to present a broad range of well worked out recent application studies as well as theoretical contributions in the field of sliding mode control system analysis and design The contributions presented here include new theoretical developments as well as successful applications of variable structure controllers primarily in the field of power electronics electric drives and motion steering systems They enrich the current state of the art and motivate and encourage new ideas and solutions in the sliding mode control area

Study of Application of Sliding Mode Control on CNC Machine Tools Masahiro Fujiki,2005

Power Electronics with MATLAB L. Ashok Kumar,A. Kalaiarasi,Y. Uma Maheswari,2018 Discusses the essential concepts of power electronics through MATLAB examples and simulations

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