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Observer-based model-free adaptive sliding mode predictive control

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ABSTRACT This paper proposes a new observer-based model-free adaptive sliding mode predictive control method (MFASPC) for discrete-time nonlinear systems. This scheme first equates the discrete-time nonlinear system to a linear form using a data-driven compact form dynamic linearization (CFDL) technique, establishes a data model consisting of only the pseudo partial derivatives (PPD), input data and output data, designs adaptive observers to achieve the estimation of the unknown PPD. The controller design part uses integral sliding mode control (SMC) to ensure the system's robustness. In contrast, with its constraint characteristics, the model predictive control (MPC) replaces the traditional switching control of SMC. The closed-loop control quantities are obtained by solving a rolling optimization problem in the finite time domain to provide dynamic optimal control action. The theoretical derivation of the Lyapunov function is used to demonstrate the system's stability. In order to verify the effectiveness of the proposed algorithm, numerical simulations and Photovoltaic power generation system simulation experiments are conducted, respectively, and the results show that the proposed control algorithm has a very reliable tracking capability and control accuracy.

INDEX TERMS Adaptive observer, model free, sliding mode predictive control, rolling optimization, data-driven

I. INTRODUCTION

IN recent years, adaptive control techniques for nonlinear systems have attracted a large number of scholars and much effort has been devoted to them [1]–[3]. However, most methods require dynamical or mechanistic analysis of the control system to obtain an accurate mathematical model first, and there are inevitably approximation links throughout the process [4]. In contrast, the ignored unmodeled dynamics part may be a potential factor that makes the closed-loop system unstable and reduces the controller performance.

Model-free adaptive control (MFAC) is a data-driven control method for discrete-time nonlinear systems to improve modeling difficulties [5], and its most important features compared to other data-driven control methods are the equivalent dynamic linearization process and the introduction of virtual parameters (PPD). MFAC uses the input and output data of the system to update the

virtual parameters online dynamically, thus establishing an equivalent data model, both the PPD and the data model, which depend merely on the data and are unrelated to the structural information of the system, thus thoroughly characterizing the nonlinear and uncertain features of the system [6]. It has been widely used in the past few years, such as urban traffic control, heading control, zero-sum game control, flexible joint control, etc. [7]–[10].

As the research progresses, to further solve the uncertainty problem of the control system and ensure robust performance in control, some scholars bring the SMC into the MFAC algorithm to carry out the research, which produces the model-free adaptive sliding mode control (MFASC) scheme. Among them, the sliding phase of the SMC law ensures the excellent stability performance of the system, and the arrival phase determines the system's dynamic performance. For example, [11]

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Table of Contents Observer Based Model Predictive Control Researchgate

1. Understanding the eBook Observer Based Model Predictive Control Researchgate
 - The Rise of Digital Reading Observer Based Model Predictive Control Researchgate
 - Advantages of eBooks Over Traditional Books
2. Identifying Observer Based Model Predictive Control Researchgate
 - 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 Observer Based Model Predictive Control Researchgate
 - User-Friendly Interface
4. Exploring eBook Recommendations from Observer Based Model Predictive Control Researchgate

- Personalized Recommendations
 - Observer Based Model Predictive Control Researchgate User Reviews and Ratings
 - Observer Based Model Predictive Control Researchgate and Bestseller Lists
5. Accessing Observer Based Model Predictive Control Researchgate Free and Paid eBooks
 - Observer Based Model Predictive Control Researchgate Public Domain eBooks
 - Observer Based Model Predictive Control Researchgate eBook Subscription Services
 - Observer Based Model Predictive Control Researchgate Budget-Friendly Options
 6. Navigating Observer Based Model Predictive Control Researchgate eBook Formats
 - ePub, PDF, MOBI, and More
 - Observer Based Model Predictive Control Researchgate Compatibility with Devices
 - Observer Based Model Predictive Control Researchgate Enhanced eBook Features
 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Observer Based Model Predictive Control Researchgate
 - Highlighting and Note-Taking Observer Based Model Predictive Control Researchgate
 - Interactive Elements Observer Based Model Predictive Control Researchgate
 8. Staying Engaged with Observer Based Model Predictive Control Researchgate
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Observer Based Model Predictive Control Researchgate
 9. Balancing eBooks and Physical Books Observer Based Model Predictive Control Researchgate
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Observer Based Model Predictive Control Researchgate
 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
 11. Cultivating a Reading Routine Observer Based Model Predictive Control Researchgate
 - Setting Reading Goals Observer Based Model Predictive Control Researchgate
 - Carving Out Dedicated Reading Time
 12. Sourcing Reliable Information of Observer Based Model Predictive Control Researchgate

- Fact-Checking eBook Content of Observer Based Model Predictive Control Researchgate
 - 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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what are dmrs what are mdfs how do they compare this white paper focuses on medical device compliance per 21 cfr 820 181 for dmr and iso 13485 2016 4 2 3 for mdf documentation the intent is to demonstrate how these compare as well as how a single system can fulfill the requirements of each what is a device master record dmr

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dec 17 2021 a device master record dmr is a collection of all the records that must be used to produce a medical device product let s imagine that your medical devices company is planning on manufacturing a new and improved coronary stent which is a

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sep 30 2011 section 820 3 j of the federal code defines device master record dmr is a set of documents containing procedures and specifications for a finished medical device simply put device master record dmr is a collection of all the documents required to manufacture and test a medical device

device master record wikipedia - Jun 17 2023

a device master record dmr is a compilation of all the instructions drawings and other records that must be used to produce a product the term is used in quality management systems that cover product design and production contents

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aug 17 2021 overview what is a device master record when it boils down to it investing in a quality management system

qms is the single most important thing you can do to ensure the safekeeping of your device master record as well as your design history files and device history records for that matter

dhf template format and content of design history file - Jul 06 2022

apr 14 2016 for a device master record dmr i recommend creating a dmr index using a template that is organized in accordance with an international standard to meet the needs of a dmr and a technical file

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device master record contents template the device master records contents guide is a listing of items that may appear in a device master record manuals ceo 9 manual set 45 off cfo 5 manual set 34 off accounting manual finance manual it policy manual hr policy manual sales marketing manual iso 9001 quality procedures manual

documents change control and records u s food and drug administration - Oct 09 2022

definitions 21 cfr 820 3 device master record dmr compilation of records containing procedures and specifications for a finished device 21 cfr 820 3 j device history record