Springer Book Proposal

A. Project

Author/Editor Names: Da-Wei Zhang and Guo-Ping Liu
Book Title: Predictive Cooperative Control for High-Order Fully Actuated Multiagent Systems

B. Short Book Description

Your book description should motivate potential audiences to read this book. Keep it concise and focused on what makes your book unique. Follow these pointers for an effective description:

- ***Subject**: Identify the book's core subject, avoid describing the topic in detail or giving definitions.*
- ***Importance**: Explain its significance to its target audience.*
- ***Content Summary**: Offer a brief overview of the book's content.*
- ***Key Points**: Highlight the most engaging methods, results, or topics.*
- ***Benefits**: State the main benefits readers will receive.*
- ***Prerequisites**: Note any required background for comprehension.*

Aim for 200-300 words, in 1-3 paragraphs; write in an active, engaging tone; integrate keywords naturally for SEO.

Subject and Importance: High-order fully actuated system (HOFAS) theory has proposed as a novel framework for the analysis and design of control systems, which can simplifies the control design and obtained a linear constant system with a desired closed-loop performance. This book focuses on the predictive cooperative control for high-order fully actuated multiagent systems (HOFAMAS), which provides a new view to design the cooperative control law for improving the control performances.

Content Summary and Key Points: This book aims at multiple constraints in the cooperative control of HOFAMASs, including input saturation and performance constraints, communication constraints, cyberattacks and uncertainties, to develop the corresponding HOFA predictive cooperative control schemes. Then, the experiments of formation control of air-bearing spacecraft simulators are provided to verify the effectiveness and practicability of HOFA predictive cooperative control schemes.

Benefits and Prerequisites: Readers can obtain a further understanding on both predictive control based on HOFAS method and predictive cooperative control for HOFAMASs, which is as a preferred guide and a better foundation for readers to deeply study and promote the predictive control based on HOFAS method and its development in cooperative control of multiagent systems.

C. Table of Contents

For 'Authored Book': a detailed ToC with a second or even further hierarchy is preferred.

For 'Edited Volume': a preliminary ToC with first-level hierarchy is sufficient, however, please list the contributors' names and institutional affiliations for each chapter.

a) Please also include the objectives of each chapter and how the chapters interrelate; b) If available, please

provide sample chapters that are representative of the book's level and style. If the manuscript is complete, attach the entire PDF (If applicable) for our reference.

Part I. Basis of Predictive Control for High-Order Fully Actuated Systems

1 Introduction

- This chapter introduces the research status and developments of HOFA system theory, cooperative control for multiagent systems and predictive cooperative control for multiagent systems, and provides the struture and content of this book.

1.1 Overview

1.2 Development of HOFA system theory

1.3 Status of cooperative control for multiagent systems

1.4 Progress of predictive cooperative control for multiagent systems

1.5 Main contents and organization of this book.

References

2 Predictive control for high-order fully actuated systems

- This chapter proposes the design method of predictive control for high-order fully actauted systems in linear and nonlinear cases, which provides methodology foundation for the predictive cooperative control for high-order fully actauted multiagent systems.

2.1 Overview

2.2 Predictive control for linear high-order fully actuated systems

2.2.1 Problem statement

2.2.2 Design of HOFA predictive control

2.2.3 Analysis of bounded stability and tracking performance

2.2.4 Simulation and experiments

2.3 Predictive control for nonlinear high-order fully actuated systems

2.3.1 Problem statement

2.3.2 Design of HOFA predictive control

2.3.3 Analysis of bounded stability and tracking performance

2.3.4 Simulation and experiments

2.4 Conclusions

References

Part II. Predictive Cooperative Control for High-Order Fully Actuated Multiagent Systems

3 Predictive cooperative control for high-order fully actuated multiagent systems

- This chapter proposes a predictive cooperative control for high-order fully actuated multiagent systems in an ideal case, which provides a foundation for the cooperative control problem under complex cases.

3.1 Overview

3.2 Problem statement

3.3 Design of HOFA predictive cooperative control

3.4 Analysis of simultaneous consensus and stability

3.5 Simulation and experiment

3.6 Conclusions

References

4 Constrained predictive cooperative control for high-order fully actuated multiagent systems with input saturation and dynamic performance constraints

- This chapters proposes a constrained predictive control method to deal with the coopearative control problem of high-order fully actuated multiagent systems with input saturation and dynamic performance constraints.

4.1 Overview

4.2 Problem statement

4.3 Design of HOFA constrained predictive cooperative control

4.4 Analysis of simultaneous consensus and stability

4.5 Simulation and experiment

4.6 Conclusions

References

Part III. Predictive Cooperative Control for High-Order Fully Actuated Multiagent Systems with Communication Constraints

5 Proportional-integral predictive cooperative control for high-order fully actuated multiagent systems with fixed communication delays

- This chapter addresses the cooperative control problem of high-order fully actuated multiagent systems with fixed communication delays by using a proportional-integral predictive control approach, such that the communication delyas can be actively compensated and the cooperative control performance can be realized.

5.1 Overview

5.2 Problem statement

5.3 Design of HOFA PI predictive cooperative control

5.4 Analysis of simultaneous consensus and stability

5.5 Simulation and experiment

5.6 Conclusions

References

6 Observer-based predictive cooperative control for high-order fully actuated multiagent systems with time-varying communication constraints

- Aiming at the time-varying communication constraints (including communication delays and packet dropouts) and unmeasurable states, this chapter proposes an observer-based predictive control to realize the cooperative control performance of high-order fully actuated multiagent systems.

6.1 Overview

6.2 Problem statement

6.3 Design of HOFA observer-based predictive cooperative control

6.4 Analysis of simultaneous consensus and stability

6.5 Simulation and experiment

9.6 Conclusions

References

10 Conclusions and prospects

D. Author/Editor Information

1. Details (Authors, Volume Editors) – *Full names, affiliations, mailing addresses (street name and number, city/town, postal code, country), contact details (incl. e-mails and URLs).*

Name: Da-Wei Zhang

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Mailing address: No. 1088, Xueyuan Blvd., Nanshan District, Shenzhen, China

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2. Outline CVs (Authors, Editors) – *Career notes, lists of related publications, reviews of these, etc. Please simply link to online sources, if available. In the case of edited volumes provide outline CVs of the editors only, not the chapter contributors.*

2.1 Curriculum Vitae (Career)

2.1.1 Curriculum Vitae of Dr. Da-Wei Zhang

1) Academic qualifications

- Ph.D. degree in Control Science and Engineering, Harbin Institute of Technology, Harbin China, in 2024.

2) Present academic position

Postdoctoral Fellow at the Southern University of Science and Technology, 2024—present.

2.1.2 Curriculum Vitae of Prof. Guo-Ping Liu

1) Academic qualifications

- Ph.D. degree in Control Engineering, University of Manchester, UK, in 1992.

2) Present academic position

Chair Professor at the Southern University of Science and Technology, 2021—present.

3) Previous professional experience

- Professor at Wuhan University, 2019—2021,
- Professor at Harbin Institute of Technology, 2010—2019,
- Professor and Head of Research Unit at University of Glamorgan, 2003--2010,
- Senior Lecturer at University of Nottingham, 2000—2023,
- Principal Engineer and Project Leader at ALSTOM Ltd., 1996—2000,

- Research Fellow at University of Sheffield, 1993—1996,
- Postdoctoral Research Assistant at University of York, 1992—1993,
- Teaching Assistant and Lecturer at Central South University of Technology, 1985—1989.

2.2 List of related publications

2.2.1 Closely related publications

[1] Da-Wei Zhang, Guo-Ping Liu, and Lei Cao. Coordinated control of high-order fully actuated multiagent systems and its application: A predictive control strategy. *IEEE/ASME Transactions on Mechatronics*, vol. 27, no. 6, pp. 4362—4372, 2022.

[2] Da-Wei Zhang, Guo-Ping Liu, and Lei Cao. Proportional integral predictive control of networked high-order fully actuated networked multiagent systems with communication delays. *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, vol. 53, no. 2, pp. 801—812, 2023.

[3] Da-Wei Zhang, Guo-Ping Liu, and Lei Cao. Constrained cooperative control for high-order fully actuated multiagent systems with application to air-bearing spacecraft simulators. *IEEE/ASME Transactions on Mechatronics*, vol. 28, no. 3, pp. 1570—1581, 2023.

[4] Da-Wei Zhang, Guo-Ping Liu. Predictive sliding-mode control for networked high-order fully actuated multiagents under random deception attacks. *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, vol. 54, no. 1, pp. 484—496, 2024.

[5] Da-Wei Zhang, Guo-Ping Liu, and Lei Cao. Secure predictive coordinated control of high-order fully actuated networked multiagent systems under random DoS attacks. *IEEE Transactions on Cybernetics*, vol. 54, no. 4, pp. 2668-2679, 2024.

[6] Da-Wei Zhang, Guo-Ping Liu. Observer-based HOFA predictive cooperative control for networked multi-agent systems under time-variant communication constraints. *ISA Transactions*, vol. 147, pp. 554—566, 2024.

[7] Da-Wei Zhang, Guo-Ping Liu. Robust cooperative control for heterogeneous uncertain nonlinear high-order fully actuated multiagent systems. *IEEE Transactions on Cybernetics*, vol. 54, no. 10, pp. 5721—5732, 2024.

[8] Da-Wei Zhang, Guo-Ping Liu, and Lei Cao. Predictive control of discrete-time high-order fully actuated systems with application to air-bearing spacecraft simulator. *Journal of the Franklin Institute*, vol. 360, no. 8, pp. 5910—5927, 2023.

[9] Da-Wei Zhang, Guo-Ping Liu. Predictive control for networked high-order fully actuated systems subject to communication delays and external disturbances. *ISA Transactions*, vol. 139, pp. 425—435, 2023.

[10] Da-Wei Zhang, Guo-Ping Liu. Predictive sliding-mode control of networked high-order fully actuated systems under random deception attacks. *Science China Information Sciences*, vol. 66, no. 9, pp. 190204, 2023.

[11] Da-Wei Zhang, Guo-Ping Liu. A high-order fully actuated predictive control approach of spacecraft flying-around under time-variant communication constraints (in Chinese). *Acta Aeronautica et Astronautica Sinica*, vol. 45, no. 1, pp. 628633, 2024.

[12] Da-Wei Zhang, Guo-Ping Liu. Disturbance observer-based predictive tracking control of uncertain HOFA cyber-physical systems. *IEEE/CAA Journal of Automatica Sinica*, vol. 11, no. 6, pp. 1711—1713, 2024.

[13] Da-Wei Zhang, Guo-Ping Liu. Secure predictive control for networked high-order fully actuated systems under random DoS attacks. *IEEE Transactions on Industrial Informatics*, vol. 20, no. 4, pp. 6935—6945, 2024.

[14] Da-Wei Zhang, Guo-Ping Liu. A high-order fully actuated predictive control approach for spacecraft flying-around. *International Journal of Systems Science*, vol. 55, no. 12, pp. 2556—2569, 2024.

[15] Guo-Ping Liu. Coordination of networked nonlinear multi-agents using a high order fully-actuated predictive control strategy. *IEEE/CAA Journal of Automatica Sinica*, vol. 9, no.4, pp. 615—623, 2022.

2.2.2 Other related publications

[1] Da-Wei Zhang, Guo-Ping Liu. Coordinated control of quasilinear multiagent systems via output feedback predictive control. *ISA Transactions*, vol. 128, pp. 58—70, 2022.

[2] Guo-Ping Liu. Digital-twin predictive control of nonlinear systems with time delays, unknown dynamics, and communication delays. *IEEE Transactions on Cybernetics*, 2024. DOI: 10.1109/TCYB.2024.3471608

[3] Guo-Ping Liu. Control strategies for digital twin systems. *IEEE/CAA Journal of Automatica Sinica*, vol. 11, no. 1, pp. 170—180, 2024.

[4] Guo-Ping Liu. Tracking control of multi-agent systems using a networked predictive PID tracking scheme. *IEEE/CAA Journal of Automatica Sinica*, vol. 10, no. 1, pp. 216—225, 2023.

[5] Guo-Ping Liu. Predictive control of high-order fully actuated nonlinear systems with time-varying delays. J*ournal of Systems Science & Complexity*, vol. 35, no. 2, pp. 457—470, 2022.

3. About the Author Text – *Please provide a brief biography that highlights the areas of your work, expertise, publication record related to the proposed book's topic, and any other relevant information such as honors, achievements, etc.*

Dr. Da-Wei Zhang received the B.S. degree in electrical engineering and automation from the China University of Mining and Technology, Xuzhou, China, in 2017, the M.S. degree in control science and engineering from Northeast Electric Power University, Jilin, China, in 2020, and the Ph.D. degree in control science and engineering from Harbin Institute of Technology, Harbin, China, in 2024. He is now a Postdoctoral Fellow at the Southern University of Science and Technology, Shenzhen, China. His current research interests include cooperative control for networked multiagent systems, predictive control, fully actuated system theory, and anti-disturbance control, as well as their applications in spacecraft control.

Prof. Guo-Ping Liu received the B.Eng and M.Eng degrees in automation from the Central South University, Changsha, China, in 1982 and 1985, respectively, and the Ph.D. degree in control engineering from the University of Manchester, Manchester, U.K., in 1992. He is a professor with the Southern University of Science and Technology, Shenzhen, China. He has authored/co-authored over 400 journal papers and 10 books on control systems. His current research interests include networked multi-agent control systems, nonlinear system identification and control, advanced control of industrial systems, and multiobjective optimization and control.
Prof. Liu served as the General Chair of the 2007 IEEE International Conference on Networking, Sensing and Control, the 2011 International Conference on Intelligent Control and Information Processing, and the 2012 UKACC International Conference on Control. He also served as an Editor-in-Chief for the International Journal of Automation and Computing from 2004 to 2021. He is a Member of Academia Europaea, an IEEE Fellow, an IET Fellow and a CAA Fellow.

E. Book Context

1. Type – *Is your book mainly a research monograph, undergraduate or graduate/advanced textbook, professional book, state-of-the-art survey, major reference work (>1000 pages), etc.?*

This book is a research monograph.

2. Competing Titles – *Please provide titles, authors, ISBNs – publisher or Amazon URLs if possible – of competing titles, and a brief comment on how your proposed book compares.*

There are currently no direct competing titles for the prepared book. Fully actuated system approach was proposed in 2020 and 2021 as a general framework for control system analysis and design based on a newly discovered general type of fully actuated models for dynamical systems.

3. Readers – *Please select from and reorder the following list to match the expected audience share: scientists and researchers; lecturers and tutors; academic and corporate libraries; practitioners and professionals; postgraduates; undergraduates; others (specify).*

And which research areas are they from?

1) Readers: researchers; academic and corporate libraries; practitioners and professionals; postgraduates; undergraduates;
2) Research area: predictive control, cooperative control for multiagent systems, fully actuated system method

4. Keywords (5 -20 keywords in order of importance and relevance):

Full actuated system methods, predictive control, cooperative control for multiagent systems, simultaneous consensus and stability, input saturation and dynamic performance constraints, communication constraints, cyberattacks, uncertainties.

5. Unique Selling Points that indicate the features and benefits (3 points, each point less than 120 characters):

1) A HOFA predictive control approach is proposed to expand the research range of FAS method.
2) A predictive cooperative control scheme is developed to address the cooperative control problem of high-order fully actuated multiagent systems under multiple constraints.
3) The spacecraft formation control experiments are provided to verify the effectiveness and practicability.

F. Manuscript Plan

1. Planned Date of Manuscript Submission: The planned date of manuscript submission is May 30, 2025.
2. Planned Pages of Manuscript (*Standard Springer book format: 155x235mm, with approx. 500 words per page***):**
The planned pages of manuscript is 220 pages.
3. Open Access option: Yes
(*i.e. e-book available to anyone for free from SpringerLink, more information: https://www.springer.com/gp/open-access/books/faqs*)
If interested, please discuss this with your Publishing Editor. This is an extra option that entails a processing fee, where you locate funders to provide payment to cover those costs.

G. Textbook

Not applicable.

H. Sample Content – *Please specify the status of any sample content accompanying this proposal.*

The sample chapter was submitted as an attachment to this proposal.

I. Other Notes – *Please provide any further relevant comments or suggestions.*