Springer Book Proposal

A. Project

Author/Editor Names: Ke Zhang, Bin Jiang, Yonghao Ma, Yuhang Xu, Yuan Lu

Book Title: Cooperative Safety Control of Multiagent Systems： A Fully Actuated System Approach

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: Distributed coordination in multi-agent systems has received much attention from multidisciplinary researchers in a wide range,including biology, physics, and engineering. This is partly due to its wide applications to attitude alignment of satellites, cooperative control of unmanned aerial vehicles, and so on. Despite their wide applicability, there are still a number of challenges faced by multiagent systems, including cooperative control for agents aginst faults and external disturbances. This book focuses on cooperative safety control design for multiagent systems. It is essential for engineers, researchers, and postgraduates seeking to master the cooperative control of multiagent systems. It provides recent theoretical results and applications of the cooperative control for multiagent systems subjected to multiple faults and external disturbances in the framework of the fully actuated system approach.

Content summary and key points: Several important topics are studied, such as prescribed-time control, formation control, and fault-tolerant game control. This book intends to provide the readers with a good understanding of cooperative safety control based on the fully actuated system approach.The special feature of this book is that a fully actuated approach is proposed for the cooperative safety control of multi-agent systems, which is beneficial for reducing the complexity of control design and stability analysis.

Benefits and prerequisites: Interested readers can learn a novel approach to cooperative safety control of multiagent systems, and this book can benefit researchers, engineers, and graduate students in the fields of multi-robot cooperation, unmanned aerial vehicle formation, control engineering, etc.

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.

1. Introduction

- This chapter introduces the characteristics and advances in multiagent systems, alongwith the basic theory of the fully actuated systems approach. It sets the stage for understanding the importance of controlling multiagent systems and provides an overview of the book's structure, summarizing the content of each chapter to guide readers on how to navigate the material.

1.1 Multiagent Systems

1.1.1 Cooperative Control for Multiagent Systems

1.1.2 Cooperative Safety Control for Multiagent Systems

1.1.3 Current Deficiencies and Challenges

1.2 Fully Actuated System Theory and Its Application in Multiagent Systems

1.2.1 Development of The Fully Actuated System Approach

1.2.2 Fully Actuated System Approach-Based Cooperative Safety Control for Multi-Agent Systems

1.3 Basic Knowledge

1.4 Organization of the Book

References

Part I Prescribed-Time Cooperative Safety Control of Multiagent Systems

2. Pratical Prescribed-Time Passive Fault-Tolerant Control

- This chapter focuses on cross-dimensional heterogeneous multi-agent systems with external disturbances and actuator faults. A passive fault-tolerant control method is proposed by using the fully actuated system approach, which realizes the containment control of the multi-agent system and improves the safety and reliability of the system.

2.1 Introduction

2.2 Multiagent Systems Description

2.3 Distributed Prescribed-Time Observer

2.4 Prescribed Performance-Based Fully Actuated Fault-Tolerant Control

2.5 Simulation Study

2.6 Conclusion

References

3. Pratical Prescribed-Time Active Fault-Tolerant Control

- For mixed-order heterogeneous multi-agent systems with actuator bias faults, this chapter proposes an active fault-tolerant control based on prescribed-time distributed observer with the help of the fully actuated system approach, which realizes the consensus control of multi-intelligent systems and improves the fault-tolerant ability of the system.

fault estimation observer, and a prescribed-time formation controller is designed by an incremental fully actuated system approach.

6.1 Introduction

6.2 Helicopters Formation System Description

6.3 Fault Estimations for Actuator and Sensor Faults

6.4 Incremental Fully Actuated System Approach-Based Fault-Tolerant Control

6.5 Simulation Study

6.6 Conclusion

References

7. Adaptive Fault-Tolerant Control for Systems with Agent Faults and Communication Network Faults

- This chapter focuses on formation control problem of fixed-wing unmanned aerial vehicles, which suffer from actuator and communication link faults. To address communication link faults within the formation, the distributed state observer is designed for each follower UAV. Subsequently, the model of the fixed-wing unmanned aerial vehicle is transformed into a fully actuated system mode. Drawing from the theory of fully actuated system approach, the fault-tolerant controller is constructed.

7.1 Introduction

7.2 Fixed-Wing UAVs Formation System Description

7.3 Distributed Observer

7.4 Adaptive Fully Actuated System Fault-Tolerant Control

7.5 Simulation Study

7.6 Conclusion

References

Part III Game-Based Cooperative Safety Control of UAVs Formation Systems

8. Zero-Sum Differential Game-Based Passive Fault-Tolerant Containment Control

- A system model of fixed-wing unmanned aerial vehicles (UAVs) under actuator faults is established, and a passive fault-tolerant optimal control method based on the zero-sum differential graph game is proposed. A reinforcement learning algorithm is designed to realize formation containment control and game Nash equilibrium, which improves the security and intelligence of the system.

8.1 Introduction

8.2 Fixed-Wing UAVs Formation System Description

8.3 Passive Fault-Tolerant Optimal Formation Containment Control

8.4 Fault-Tolerant Game Control Based on Adaptive Dynamic Programming

8.5 Simulation Study

8.6 Conclusion

References

9. Steinberg Game-Based Active Fault-Tolerant Optimal Control

- For a multiagent system that consists of multiple quadrotor helicopters under actuator faults, an attitude tracking and fault-tolerant game control method based on the Steinberg game is proposed in the framework of the fully actuated

system approach, which realizes the synchronous optimal performance of the inner loop and outer loop, and improves the group intelligence and security of the multiagent system.

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).*

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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 Prof. Ke Zhang

1) Academic qualifications

• Ph.D., College of Automation Engineering, Nanjing University of Aeronautics and Astronautics, China, 2012

2) Previous professional experience

• 2018-2019, Visiting scholar, School of Engineering and Digital Arts, University of Kent

3) Present academic position

• College of Automation Engineering, Nanjing University of Aeronautics and Astronautics (Full Professor, 2019-present)

• College of Automation Engineering, Nanjing University of Aeronautics and Astronautics (Associate Professor, 2014-2019)

• College of Automation Engineering, Nanjing University of Aeronautics and Astronautics (Lecturer, 2012-2014)

2.1.2 Curriculum Vitae of Prof. Bin Jiang

1) Academic qualifications

• Ph.D., Northeastern University, China, 1995

2) Previous professional experience

• 2019-2023, Vice President, Nanjing University of Aeronautics and Astronautics

• 2012-2019, Dean of College of Automation Engineering, Nanjing University of Aeronautics and Astronautics

• 2008-2012, Vice Dean of College of Automation Engineering, Nanjing University of Aeronautics and Astronautics

• 2004-2008, Professor, College of Automation Engineering, Nanjing University of Aeronautics and Astronautics

• 2003-2004, Postdoctoral Researcher, University of Louisiana, USA

• 2001-2003, Research Fellow, French National Research Center

• 2000-2001, Postdoctoral Fellow, Lille University of Technology, France

• 1998-2000, Research Fellow, Nanyang Technological University, Singapore

• 1995-1998, Lecturer and Associate Professor, Department of Automation, Tianjin University

3) Present academic position

• Nanjing University of Aeronautics and Astronautics (President, 2023-present)

2.1.3 Curriculum Vitae of Yonghao Ma

1) Academic qualifications

• M.E. degree, School of Automation and Electrical Engineering, University of Science and Technology Beijing, China, 2022.

2) Present academic position

• College of Automation Engineering, Nanjing University of Aeronautics and Astronautics (Ph.D. student, 2022-present)

2.1.4 Curriculum Vitae of Dr. Yuhang Xu

1) Academic qualifications

• Ph.D., College of Automation Engineering, Nanjing University of Aeronautics and Astronautics, China, 2022

2) Previous professional experience

• 2019-2021, Visiting Ph.D. student, KIOS Research and Innovation Center of Excellence, University of Cyprus

3) Present academic position

• College of Automation Engineering, Nanjing University of Aeronautics and Astronautics (Postdoctoral Fellow, 2022-present)

2.1.5 Curriculum Vitae of Yuan Lu

1) Academic qualifications

• M.S. degree, School of Electrical and Automation Engineering, Nanjing Normal University, China, 2023.

2) Present academic position

• College of Automation Engineering, Nanjing University of Aeronautics and Astronautics (Ph.D. student, 2023-present)

2.2 List of related publications

2.2.1 Closely related publications

[1] Yonghao Ma, Ke Zhang and Bin Jiang, "Practical Prescribed-Time Active Fault-Tolerant Control for Mixed-Order Heterogenous Multiagent Systems: A Fully Actuated System Approach," Automatica, vol. 166, Article No. 111721, 2024.

[2] Yonghao Ma, Ke Zhang and Bin Jiang, "Neuroadaptive Cooperative Fault-Tolerant Control of Heterogeneous Multi-Agent Systems based on Fully Actuated System Approaches," IEEE Transactions on Cybernetics, vol. 54, no. 8, pp. 4581-4592, 2024.

[3] Yonghao Ma, Ke Zhang and Bin Jiang, "Prescribed-Time Fault-Tolerant Control for Fully Actuated Heterogeneous Multiagent Systems: A Hierarchical Design Approach," IEEE Transactions on Aerospace and Electronic Systems, vol. 59, no. 5, pp. 6624-6636, 2023.

[4] Yuan Lu, Ke Zhang, and Bin Jiang. Fully actuated system approach based prescribed-time fault-tolerant formation control for unmanned helicopters under fixed and switching topologies. IEEE Transactions on Circuits and Systems I: Regular Papers. vol. 71, no. 11, pp. 5249-5260, 2024.

[5] Qiyang Miao, Ke Zhang Bin Jiang. Incremental fully actuated system approach-based prescribed-time fault-tolerant formation control of helicopters under multiple faults. Aerospace Science and Technology, vol. 151, Article No.

109334, 2024.

[6] Mingsong Li, Ke Zhang, Yonghao Ma, Bin Jiang. Prescribed-time fault-tolerant control for the formation of quadrotors based on fully-actuated system approaches. International Journal of Systems Science, vol. 55, no. 12, pp. 2541–2555, 2024.

[7] Bo Meng, Lihua Shen, Ke Zhang. Fully actuated system approach-based fault-tolerant formation reconstruction control and optimal task assignment for fixed-wing UAVs. Nonlinear Dynamics, vol. 113, pp. 645–659, 2024.

[8] Yuhang Xu, Bin Jiang, Li Guo, Fault-tolerant Game Control for Quadrotor Helicopters' Formation: A Fully Actuated System Approach, IEEE Transactions on Aerospace and Electronic Systems, accepted

[9] Jiao Hu, Yuhang Xu and Bin Jiang. Differential Game-based Fault-tolerant Formation Tracking-containment Control for Fixed-wing UAVs under the Fully Actuated System Framework. Journal of Astronautics, under review

2.2.2 Other related publications

[1] Wanglei Cheng, Ke Zhang, and Bin Jiang. Fixed-time and prescribed-time fault-tolerant optimal tracking control for heterogeneous multiagent systems. IEEE Transactions on Automation Science and Engineering, 2024, 21(4): 7275-7286.

[2] Qiyang Miao, Ke Zhang, and Bin Jiang. Fixed-time collision-free fault-tolerant formation control of multi-UAVs under actuator faults, IEEE Transactions on Cybernetics, 2024, 54(6): 3679-3691.

[3] Qingyi Liu, Ke Zhang, Bin Jiang. Fixed-time fault estimation and prescribed performance fault-tolerant control for interconnected systems. IEEE Transactions on Cybernetics, 2024, 54(2): 1084-1095.

[4] Qingyi Liu, Ke Zhang, Bin Jiang. Zero-sum differential game-based optimal fault-tolerant control for interconnected systems with actuator faults. IEEE Transactions on Control of Network Systems, 2024, 11(3): 1287-1299.

[5] Qingyi Liu, Ke Zhang, Bin Jiang. Fixed-time fault estimation and prescribed performance fault-tolerant control for interconnected systems. IEEE Transactions on Cybernetics, 2024, 54(2): 1084-1095.

[6] Wanglei Cheng, Ke Zhang, Bin Jiang, and Silvio Simani. Neural network observer-based prescribed-time fault-tolerant tracking control for heterogeneous multiagent systems with a leader of unknown disturbances. IEEE Transactions on Aerospace and Electronic Systems, 2023, 59(6): 9042-9053.

[7] Wanglei Cheng, Ke Zhang, and Bin Jiang. Distributed adaptive fixed-time fault-tolerant formation control for heterogeneous multiagent systems with a leader of unknown input. IEEE Transactions on Cybernetics, 2023, 53(11): 7285-7294.

[8] Y. Xu, H. Yang, B. Jiang and M. M. Polycarpou, Multiplayer Pursuit-Evasion Differential Games With Malicious Pursuers, IEEE Transactions on Automatic Control, vol. 67, no. 9, pp. 4939-4946, 2022.

[9] Y. Xu, H. Yang, B. Jiang and M. M. Polycarpou, Distributed Optimal Fault Estimation and Fault-Tolerant Control for Interconnected Systems: A Stackelberg Differential Graphical Game Approach, IEEE Transactions on Automatic Control, vol. 67, no. 2, pp. 926-933, 2022.

[10] Hao Yang, Qinglong Han, Xiaohua Ge, Yuhang Xu, Bin Jiang, and Donghua Zhou. Fault-tolerant cooperative control of multi-agent systems: A survey of trends and methodologies. IEEE Transactions on Industrial Informatics, vol. 16, no. 1, pp. 4-17, 2019.

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.*

Prof. Ke Zhang received the Ph.D. degree in control theory and engineering from the Nanjing University of Aeronautics and Astronautics, Nanjing, China, in 2012. He is currently a full professor with the Nanjing University of Aeronautics and Astronautics.

He has published two books and over 100 referred international journal papers and conference papers. From May 2018 to April 2019, he was a visiting scholar in the School of Engineering and Digital Arts at University of Kent. He currently serves as Associate Editor for Franklin Open. He was a recipient of the Second-Class Prize of National Natural Science Award of China. His research interests include fault diagnosis and fault tolerant control of dynamical systems and their applications.

Prof. Bin Jiang received the Ph.D. degree in automatic control from Northeastern University, Shenyang, China, in 1995. He had ever been a Post-Doctoral Fellow, a Research Fellow, an Invited Professor, and a Visiting Professor in Singapore, France, USA, and Canada, respectively.

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and Systems, an Associate Editor or an Editorial Board Member for a number of journals, such as the IEEE Transactions on Cybernetics, IEEE Transactions on Industrial Informatics, IEEE Transactions on Neural Networks and Learning Systems, Journal of the Franklin Institute, et al. He is also a Chair of Control Systems Chapter in IEEE Nanjing Section, a member of IFAC Technical Committee on Fault Detection, Supervision, and Safety of Technical Processes

Yonghao Ma received the B.Eng. degree in electrical engineering and automation from Guangzhou University (GZHU), Guangzhou, China in 2019 and the M.E. degree in control engineering from University of Science and Technology Beijing (USTB), Beijing, China in 2022. He is currently working toward the Ph.D. degree in Nanjing University of Aeronautics and Astronautics (NUAA), Nanjing, China. His research interests include fault-tolerant control for multi-agent systems and adaptive control for distributed parameter systems.

Dr. Yuhang Xu received the B.Sc. degree in automation from Nanjing University of Aeronautics and Astronautics (NUAA), Nanjing, China, in 2016, and the Ph.D. degree in automatic control from NUAA in 2022. She was a visiting Ph.D. student at the KIOS Research and Innovation Center of Excellence at the University of Cyprus during 2019-2021. She is currently the postdoctor in NUAA. Her current research interests include fault-tolerant control and game control for multi-agent systems.

Yuan Lu received the M.S. degree in electric engineering from Nanjing Normal University, Nanjing, China, in 2023. He is currently pursuing the Ph.D. degree in control science and engineering with Nanjing University of Aeronautics and

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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.?*

The 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. There are no books related to the fully actuated system approach in the research and application of multiagent 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: Safety control, fault-tolerant control, multi-robot cooperation, unmanned aerial vehicle formation, and control engineering.

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

Multiagent Systems, Fully Actuated System Approachs, Safety Control, Fault-Tolerant Control, Prescribed-Time Control, Game Control

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

1) Offers a systematic and comprehensive introduction to cooperative safety control for multiagent systems in the framework of the fully actuated system approach.
2) Combines more practical scenarios toward the distributed control design of multiagent systems
3) Provides guidelines for engineers to improve the safety of engineering systems

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 are 210 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.*

Please reply to Dr.Celine Lanlan Chang, Computer Science (celine.chang@springer.com)