

Springer Book Proposal

A. Project

Author/Editor Names: Guang-Ren Duan

Book Title: Introduction to Fully Actuated System Approach for Control

Volume I. Global Fully Actuated Systems

Volume II. Sub-fully Actuated Systems

Volume III. Unidirectionally Connected FASs

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.

This is the first book in the world addressing the fully actuated system (FAS) approach for analysis and control of dynamical systems, written by the proposer of the FAS approach.

State-space models are convenient for solving the state vectors, including their estimates and their infinite-time behaviour, but are not for the control vectors. Therefore, they are actually not the best ones to perform control. Consequently, “from the mid 1990s, the study of problems of feedback design for MIMO nonlinear systems came to a (almost complete) stall” (Alberto Isidori). Apparently, there is no doubt that a model from which the control vector can be completely or partially solved explicitly would best perform the control. Inspired by the practical mechanical FASs, a type of mathematically extended FAS models is established, from which the control vectors can indeed be explicitly solved. Eventually, a FAS approach, which is parallel to the well-known state-space one, has been proposed for analysis and designs of general dynamical control systems. It has found its great power in dealing with control of complicated nonlinear dynamical systems, and has simultaneously attracted rapidly growing attention in the world control community.

This book (volumes), among the others in this book series, gives an elementary introduction to the FAS approach. It provides the best and the easiest gateway for beginners, helps control scientists to enhance both the depth and breadth of their research work, and assists control engineers to implement practical control systems in a more advanced and efficient way.

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. Table of Contents

For Table of Contents of Volume I, please refer to Appendix A.

For Table of Contents of Volume II, please refer to Appendix B.

For Table of Contents of Volume III, please refer to Appendix C.

2. Content Description

This book is divided into three volumes, namely,

Volume I. Global Fully Actuated Systems,

Volume II. Sub-Fully Actuated Systems; and

Volume III. Unidirectionally Connected FASs.

These volumes go deeper in natural sequence. More specifically, sub-FASs contain global FASs as special cases, and describe a much more general and complicated class of dynamical systems than global FASs. Meanwhile, uniformly connected FASs (UC-FASs) contain sub-FASs as special cases, and also describe a much more general and complicated class of dynamical systems than sub-FASs. In each volume, the problem of converting dynamical systems into the class of FAS models is considered, and then the problem of controller design based on the obtained FAS models is solved. Examples range from both theoretical and practical backgrounds are provided to demonstrate the FAS approach proposed in each part. As a consequence, the control techniques proposed in a former part happen to be special cases of those proposed in a latter part.

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: Guang-Ren Duan

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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)

1) Academic qualifications

- Academician of the Chinese Academy of Sciences, since 2019
- Fellow of IEEE, Control Systems Society, since 2017
- Fellow of IET, since 2005
- Phd. Harbin Institute of Technology, China, 1989

2) Previous professional experience

2021-2024, Dean/Professor	School of Automation and Intelligent Manufacturing, Southern University of Science and Technology, Shenzhen, China
2002-2024, Director/Professor	Center for Control Theory and Guidance Technology, Harbin Institute of Technology, China
1991-2002, Full Professor	Harbin Institute of Technology, China
1998-2002, Visiting Fellow	Queen's University of Belfast, UK
1997-1998, Visiting Fellow	University of Sheffield, UK
1996-1997, Visiting Fellow	University of Hull, UK
1989-1991, Post-doc.	School of Mechanical Engineering, Harbin Institute of Technology, China

3) Present academic position

1991-2024, Professor	Center for Control Theory and Guidance Technology, Harbin Institute of Technology, China.
2021-2024, Dean/Professor	School of Automation and Intelligent Manufacturing, Southern University of Science and Technology, Shenzhen, China

2.2 Related Publications

Papers marked the birth of the Fully Actuated System Approach

ACTA Automatica Sinica series

- [1] Guang-Ren Duan, High-order System Approaches: I. Fully-actuated Systems and Parametric Designs, *ACTA Automatica Sinica* (in Chinese), vol. 46, no. 7, pp. 1333-1345, 2020.
- [2] Guang-Ren Duan, High-order System Approaches: II. Controllability and Full-actuation, *ACTA Automatica Sinica* (in Chinese), vol. 46, no. 8, pp. 1571-1581, 2020.
- [3] Guang-Ren Duan, High-order System Approaches: III. Observability and Observer Design, *ACTA Automatica Sinica* (in Chinese), vol. 46, no. 9, pp. 1885-1895, 2020.

International Journal of Systems Science series

- [1] Guang-Ren Duan, High-order fully actuated system approaches: Part I. Models and basic procedure, *International Journal of Systems Science*, vol. 52, no. 2, pp. 422-435, 2020.
- [2] Guang-Ren Duan, High-order fully actuated system approaches: Part II. Generalized strict-feedback systems, *International Journal of Systems Science*, vol. 52, no. 3, pp. 437-454, 2022.

- [3] Guang-Ren Duan, High-order fully actuated system approaches: Part III. Robust control and high-order backstepping, *International Journal of Systems Science*, vol. 52, no. 5, pp. 952-971, 2020.
- [4] Guang-Ren Duan, High-order fully actuated system approaches: Part IV. Adaptive control and high-order backstepping, *International Journal of Systems Science*, vol. 52, no. 5, pp. 972-989, 2020.
- [5] Guang-Ren Duan, High-order fully actuated system approaches: Part V. Robust adaptive control, *International Journal of Systems Science*, vol. 52, no. 10, pp. 2129-2143, 2021.
- [6] Guang-Ren Duan, High-order fully actuated system approaches: Part VI. Disturbance attenuation and decoupling, *International Journal of Systems Science*, vol. 52, no. 10, pp. 2161-2181, 2021.
- [7] Guang-Ren Duan, High-order fully actuated system approaches: Part VII. Controllability, stabilizability and parametric design, *International Journal of Systems Science*, vol. 52, no. 14, pp. 3091-3114, 2021.
- [8] Guang-Ren Duan, High-order fully actuated system approaches: Part VIII. Optimal control with application in spacecraft attitude stabilization, *International Journal of Systems Science*, vol. 53, no. 1, pp. 54-73, 2022.
- [9] Guang-Ren Duan, High-order fully actuated system approaches: Part IX. Generalized PID control and model reference tracking, *International Journal of Systems Science*, vol. 53, no. 3, pp. 652-674, 2022.
- [10] Guang-Ren Duan, High-order fully actuated system approaches: Part X. Basics of discrete-time systems, *International Journal of Systems Science*, vol. 53, no. 4, pp. 810-832, 2022.

Other papers closely related to the book volumes

Part I. Sole-author Papers by G. R. Duan

International Journal of Systems Science series

- [1] Guang-Ren Duan, Stabilisation of four types of underactuated systems: a FAS approach, *International Journal of Systems Science*, vol. 55, no. 12, pp. 2421-2441, 2024.
- [2] Guang-Ren Duan, Constrained unidirectionally connected FASs: Part I. Models. *International Journal of Systems Science*, 2025, to appear.
- [3] Guang-Ren Duan, Constrained unidirectionally connected FASs: Part II. Sub-stabilization. *International Journal of Systems Science*, 2025, to appear.
- [4] Guang-Ren Duan, Constrained unidirectionally connected FASs: Part III. Applications. *International Journal of Systems Science*, 2025, to appear.

Science China- Information Sciences series

Series I: Discrete-time delay systems

- [5] Guang-Ren Duan, Discrete-time delay systems: Part 1. Global fully actuated case, *Science China-Information Sciences*, vol. 65, pp. 182201:1-182201:18, 2022.
- [6] Guang-Ren Duan, Discrete-time delay systems: Part 2. Sub-fully actuated case, *Science China-Information Sciences*, vol. 65, pp. 192201:1-192201:15, 2022.

Series II: Continuous-time delay systems

- [7] Guang-Ren Duan, Fully actuated system approaches for continuous-time delay systems: Part 1. Systems with state delays only, *Science China-Information Sciences*, vol. 66, no. 1, pp. 112201:1-112201:30, 2023.
- [8] Guang-Ren Duan, Fully actuated system approaches for continuous-time delay systems: Part 2. Systems with input delays, *Science China-Information Sciences*, vol. 66, no. 2, pp. 122201:1-122201:18, 2023.

Series III: Nonholonomic systems

- [9] Guang-Ren Duan, A FAS approach for stabilization of generalized chained forms: part 1. discontinuous control laws, *Science China Information Sciences*, vol. 67, no. 2, 2024.

- [10] Guang-Ren Duan, A **FAS approach** for stabilization of generalized chained forms: Part 2. continuous control laws, *Science China-Information Sciences*, vol. 67, no. 3, online, 2024..

Journal of Systems Science & Complexity

- [11] Guang-Ren Duan, Stabilization via **fully actuated** system approach: A case study, *Journal of Systems Science & Complexity*, vol. 35, no. 3, pp. 731-747, 2022.
- [12] Guang-Ren Duan, Brockett's first example: An **FAS approach** treatment, *Journal of Systems Science & Complexity*, vol. 35, no. 2, pp. 441-456, 2022.
- [13] Guang-Ren Duan, Brockett's second example: An **FAS approach** treatment, *Journal of Systems Science & Complexity*, 2022, DOI: 10.1007/s11424-022-2282-2.

IEEE Transactions on Cybernetics

- [14] Guang-Ren Duan, Substability and substabilization: Control of **subfully actuated** systems. *IEEE Transactions on Cybernetics*, vol. 53, no. 11, pp. 7309-7322, 2023.
- [15] Guang-Ren Duan, Robust stabilization of time-varying nonlinear systems with time-varying delays: A **fully actuated** system approach. *IEEE Transactions on Cybernetics*, vol. 53, no. 12, pp. 7455-7468, 2023.
- [16] Guang-Ren Duan, **Fully actuated** system approach for control: An overview, *IEEE Transactions on Cybernetics*, vol. 54, no. 12, p. 7285 - 7306, 2024.

Acta Aeronautica et Astronautica Sinica

- [17] 段广仁, 亚严反馈系统镇定的全驱系统方法, *航空学报*, vol. 45, no. 1, Art. no. 629552, 2024.

Part II. Coauthored Papers of G. R. Duan

2024

Theoretical Topics

- [18] Yongqiang Xiao, Guangbin Cai, and **Guangren Duan**, High-order adaptive dynamic surface control for output-constrained non-linear systems based on **fully actuated** system approach, *International Journal of Systems Science*, vol. 55, no. 3, pp. 482-498, 2024.
- [19] **Guang-Ren Duan**, Qin Zhao, and Tianyi Zhao, Complete parametric solutions to the fundamental problem in high-order **fully actuated** system approach, *International Journal of Control, Automation and Systems*, vol. 22, no. 1, pp. 228-240, 2024.
- [20] Yuzhong Wang, **Guangren Duan**, and Ping Li, Event-triggered adaptive sliding mode control of uncertain nonlinear systems based on **fully actuated** system approach, *IEEE Transactions on Circuits and Systems II: Express Briefs*, 2024, early access, doi:10.1109/TCSII.2024.3353316.
- [21] Xiubo Wang and **Guangren Duan**, Comprehensive reconstructions and predictive control for quadrotor uav information gathering tracking missions based on **fully actuated** system approaches, *ISA Transactions*, 2024, early access, doi:10.1016/j.isatra.2024.01.020.
- [22] Zhongcai Zhang and Guangren Duan, Stabilization controller of an extended chained nonholonomic system with disturbance: An **FAS** approach, *IEEE/CAA Journal of Automatica Sinica*, vol. 11, no. 5, pp. 1262-1273, 2024.
- [23] Ping Li and Guang-Ren Duan, High-order **fully actuated** control approach for servo systems based on dynamical compensator and extended state observer, *IEEE/ASME Transactions on Mechatronics*, vol. 29, no. 5, pp. 3717 -3726, 2024.
- [24] Fuxing Yao, Guangtai Tian, Aiguo Wu, Guang-Ren Duan, and He Kong, A high-order **fully actuated** system approach to control of overhead cranes, *IEEE/ASME Transactions on Mechatronics*, 2024, early access, doi: 10.1109/TMECH.2024.3446670.
- [25] Ping Li, Guangren Duan, Bi Zhang, and Yuzhong Wang, Event-triggered control for servo motor systems based on **fully actuated** system approach and dynamical compensator, *IEEE Transactions on Industrial Electronics*, 2024, early access, doi: 10.1109/TIE.2024.3515273.
- [26] Shunli Li, Bin Zhou, Yang Shi, and Guangren Duan, Prescribed-time semi-global control for a class of nonlinear uncertain systems by linear time-varying feedback, *IEEE Transactions on Cybernetics*, 2024, early access, doi: 10.1109/TCYB.2024.3498838.
- [27] Weizhen Liu, Guangren Duan, Mingzhe Hou, Mehdi Golestani, and He Kong, Control of uncertain high-order **fully actuated** strict-feedback systems: A backstepping approach with high-gain observer-based derivative approximation, *IEEE Transactions on Cybernetics*, vol. 54, no. 12, pp. 7456 - 7468, 2024.

- [28] Guangtai Tian, Jin Tan, Bin Li, and Guangren Duan, Optimal **fully actuated** system approach-based trajectory tracking control for robot manipulators, *IEEE Transactions on Cybernetics*, vol. 54, no. 12, pp. 7469 - 7478, 2024.
- [29] Yuzhong Wang, Guangren Duan, and Ping Li, Event-triggered adaptive control of uncertain strict-feedback nonlinear systems using **fully actuated** system approach, *IEEE Transactions on Cybernetics*, vol. 54, no. 11, pp. 6371 - 6383, 2024.
- [30] Fuxing Yao, Ai-Guo Wu, Mehdi Golestani, Derong Liu, Guang-Ren Duan, and He Kong, Adaptive tracking control for underactuated double pendulum overhead cranes with variable cable length, *IEEE Transactions on Cybernetics*, vol. 54, no. 12, pp. 7728 - 7741, 2024.
- [31] Hong Jiang, Guangren Duan, and Mingzhe Hou, State and disturbance observer-based controller design for **fully actuated** systems, *IEEE Transactions on Circuits and Systems I: Regular Papers*, vol. 71, no. 11, pp. 5261 - 5270, 2024.
- [32] Weizhen Liu, Guangren Duan, Mingzhe Hou, and He Kong, Robust adaptive control of high-order **fully-actuated** systems: Command filtered backstepping with concurrent learning, *IEEE Transactions on Circuits and Systems I: Regular Papers*, vol. 71, no. 12, pp. 5780 - 5791, 2024.
- [33] Xiubo Wang and Guangren Duan, **Fully actuated** system approaches: Predictive elimination control for discrete-time nonlinear time-varying systems with full state constraints and time-varying delays, *IEEE Transactions on Circuits and Systems I: Regular Papers*, vol. 71, no. 1, pp. 383 - 396, 2024.
- [34] Yuzhong Wang, Guangren Duan, and Ping Li, Event-based neural networks adaptive control of nonlinear systems: A **fully actuated** system approach, *IEEE Transactions on Circuits and Systems I: Regular Papers*, vol. 71, no. 9, pp. 4211 - 4221, 2024.
- [35] Kai-Xin Cui, Guang-Ren Duan, and Ming-Zhe Hou, Discrete-time model reference tracking control for a class of combined spacecraft: A high-order **fully actuated** system approach, *IEEE Transactions on Automation Science and Engineering*, vol. 21, no. 4, pp. 6966 - 6977, 2024.
- [36] Tao Guan, Bin Li, Yongduan Song, and Guang-Ren Duan, Fixed-time spacecraft attitude control with unwinding-free performance, *IEEE Transactions on Automatic Control*, 2024, early access, doi: 10.1109/TAC.2024.3471333.
- [37] Kai Zhang, Bin Zhou, Mingzhe Hou, and Guang-Ren Duan, Practical prescribed-time stabilization of a class of nonlinear systems by event-triggered and self-triggered control, *IEEE Transactions on Automatic Control*, vol. 69, no. 5, p. 3426 - 3433, 2024.
- [38] Kai-Xin Cui, Guang-Ren Duan, Da-Wei Zhang, and Da-Ke Gu, Discrete-time high-order **fully actuated** adaptive stabilization control for a type of combined spacecraft with unknown parameters, *IEEE Transactions on Aerospace and Electronic Systems*, vol. 60, no. 3, pp. 3379 - 3389, 2024.
- [39] Guangtai Tian, Bin Li, Qin Zhao, and Guangren Duan, High-precision trajectory tracking control for free-flying space manipulators with multiple constraints and system uncertainties, *IEEE Transactions on Aerospace and Electronic Systems*, vol. 60, no. 1, p. 789 - 801, 2024.
- [40] Zhijun Chen and Guangren Duan, A **fully actuated** system approach: Desired compensation adaptive robust control for uncertain nonlinear systems, *Journal of the Franklin Institute*, vol. 361, no. 9, art. 106855, 2024.
- [41] Liyao Hu, Guangren Duan, and Mingzhe Hou, Robust switching adaptive tracking control for uncertain highorder **fully actuated** systems based on fully actuated system approaches, *Journal of the Franklin Institute*, vol. 361, no. 4, art. 106659, 2024.
- [42] Zhijun Chen and Guangren Duan, Adaptive rise-based tracking control of uncertain nonlinear systems: A **FAS approach**, *ISA Transactions*, online, 2024, doi.org/10.1016/j.isatra.2024.10.034.
- [43] Liyao Hu, Guangren Duan, and Mingzhe Hou, Adaptive guaranteed cost control for nonlinear systems with unknown parameters and time delays based on **fully actuated** system approaches, *ISA Transactions*, vol. 145, pp. 112-123, 2024.
- [44] Hong Jiang, Guangren Duan, and Mingzhe Hou, Generalized proportional-integral extended state observerbased controller design for **fully actuated** systems, *ISA Transactions*, vol. 155, pp. 137-147, 2024.
- [45] Xiubo Wang and Guangren Duan, Comprehensive reconstructions and predictive control for quadrotor UAV information gathering tracking missions based on **fully actuated** system approaches, *ISA Transactions*, vol. 147, pp. 540-553, 2024.
- [46] Shiyu Zhang and Guangren Duan, Robust control of uncertain **fully actuated** systems with nonlinear uncertainties and perturbed input matrices, *ISA Transactions*, vol. 154, pp. 160-170, 2024.

- [47] Guangren Duan, Bin Zhou, and Xuefei Yang, Fully actuated system theory and applications: new developments in 2023, *International Journal of Systems Science*, vol. 55, no. 12, pp. 2419-2420, 2024.
- [48] Yu Liu, Zhao-Yan Li, Yajun Gao, and Guang-Ren Duan, On transforming commensurate time-delay systems with multi-inputs to fully actuated systems via differential flatness, *International Journal of Systems Science*, 2024, doi. 10.1080/00207721.2024.2437132.
- [49] Yongqiang Xiao, Guangbin Cai, and Guangren Duan, High-order adaptive dynamic surface control for output-constrained non-linear systems based on fully actuated system approach, *International Journal of Systems Science*, vol. 55, no. 3, pp. 482-498, 2024.
- [50] Shiyu Zhang and Guangren Duan, Fully actuated system approach to robust control of uncertain multi-order sub-fully actuated systems, *International Journal of Robust and Nonlinear Control*, vol. 34, no. 14, pp. 9697-9715, 2024.
- [51] Guang-Ren Duan, Qin Zhao, and Tianyi Zhao, Complete parametric solutions to the fundamental problem in high-order fully actuated system approach, *International Journal of Control, Automation and Systems*, vol. 22, no. 1, pp. 228 - 240, 2024.
- [52] Ya-Jun Gao and Guang-Ren Duan, Robust model reference tracking control for high-order descriptor linear systems subject to parameter uncertainties, *IET Control Theory and Applications*, vol. 18, no. 4, pp. 479-494, 2024.
- [53] Xiang Xu and Guang-Ren Duan, High-order fully actuated system models for strict-feedback systems with increasing dimensions, *IEEE/CAA Journal of Automatica Sinica*, vol. 11, no. 12, pp. 2451-2462, 2024.

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Theoretical Topics

- [54] Liyao Hu, Guangren Duan, and Mingzhe Hou, Robust adaptive guaranteed cost tracking control for high-order nonlinear systems with uncertainties based on high-order fully actuated system approaches, *International Journal of Robust and Nonlinear Control*, vol. 33, no. 13, pp. 7583-7605, 2023.
- [55] Weizhen Liu, Guangren Duan, and Mingzhe Hou, High-order command filtered adaptive backstepping control for second-and high-order fully actuated strict-feedback systems, *Journal of the Franklin Institute*, vol. 360, no. 6, pp. 3989-4015, 2023.
- [56] Liyao Hu, and Guangren Duan, Adaptive guaranteed cost tracking control for high-order nonlinear systems based on fully actuated system approaches, *Transactions of the Institute of Measurement and Control*, DOI: org/10.1177/014233122311836, 2023.
- [57] Liyao Hu, Guangren Duan, and Mingzhe Hou, Adaptive guaranteed cost control for nonlinear systems with unknown parameters and time delays based on fully actuated system approaches, *ISA transactions*, 2023, DOI: org/10.1016/j.isatra.2023.11.021.
- [58] Mingzhe Hou, Wenrui Shi, Leyan Fang, and Guangren Duan, Adaptive dynamic surface control of high-order strict feedback nonlinear systems with parameter estimations, *Science China Information Sciences*, vol. 66, pp.159203, 2023, doi:org/10.1007/s11432-021-3488-6.
- [59] Weizhen Liu, Guangren Duan, and Mingzhe Hou, Concurrent learning adaptive command filtered backstepping control for high-order strict-feedback systems, *IEEE Transactions on Circuits and Systems I: Regular Papers*, 2023, vol. 70, no. 4, pp. 1696-1709.
- [60] Yang Cui, Guangren Duan, Xiaoping Liu, and Hongyu Zheng, Adaptive fuzzy fault-tolerant control of high-order nonlinear systems: A fully actuated system approach, *International Journal of Fuzzy Systems*, vol. 25, pp. 1895-1906, 2023.
- [61] Xiubo Wang and Guangren Duan, High-order fully actuated system approaches: Model predictive control with applications to under-actuated systems, *Journal of the Franklin Institute*, vol. 360, pp. 6953-6975, 2023.
- [62] Guangtai Tian and Guangren Duan, Robust model reference tracking for uncertain second-order nonlinear systems with application to robot manipulator , *International Journal of Robust and Nonlinear Control*, vol. 33, no. 3, pp. 1750-1771, 2023, doi: 10.1002/rnc.6450.
- [63] Xiubo Wang and Guangren Duan, Fully actuated system approaches: Predictive elimination control for discrete-time nonlinear time-varying systems with full state constraints and time-varying delays, *IEEE Transactions on Circuits and Systems I: Regular Papers*, 2023, early access, doi:10.1109/TCSI.2023.3323454.
- [64] Guangtai Tian, Bi Li, Qin Zhao, and Guangren Duan, High-precision trajectory tracking control for free-flying space manipulators with multiple constraints and system uncertainties, *IEEE Transactions on Aerospace and Electronic Systems*, 2023, early access, doi:10.1109/TAES.2023.3328797.

- [65] Yajun Gao, Guangren Duan, Robust model reference tracking control for **high-order** descriptor linear systems subject to parameter uncertainties, *IET Control Theory and Application*, 2023, doi:org/110.1049/cth2.12567.
- [66] Tianyi Zhao, Guangren Duan, Wanqing Xin, Observer-Based Control for High-Order **fully actuated** Systems, *IEEE Access*, vol. 11, pp. 132239-132253, 2023.
- [67] Kaxin Cui, Guangren Duan, Minzhe Hou, Discrete-Time Model Reference Tracking Control for A Class of Combined Spacecraft: A High-Order **fully actuated** System Approach, *IEEE Transactions on Automation Science and Engineering*, early access, 2023, DOI: 10.1109/TASE.2023.3335106.

Applications

- [68] Feng Zhang, Guangren Duan, Coupled Dynamics and Integrated Control for Position and Attitude Motions of Spacecraft: A Survey, *IEEE/CAA Journal of Automatica Sinica*, vol. 10, no. 12, 2023, pp. 2187-2208.
- [69] Ping Li and Guangren Duan, High-order **fully actuated** control approaches of flexible servo systems based on singular perturbation theory, *IEEE/ASME Transactions on Mechatronics*, 2023, doi: 10.1109/TMECH.2023.3267085.
- [70] Gaoqi Liu, Bin Li, and Guangren Duan, An optimal **FASA approach** for UAV trajectory tracking control, *Guidance, Navigation and Control*, 2023, early access, doi:10.1142/S2737480723500152.

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Theoretical Topics

- [71] Wenrui Shi, Mingzhe Hou, and Guang-Ren Duan Adaptive preassigned time stabilisation of uncertain second-order **sub-fully actuated** systems, *Journal of Systems Science & Complexity*, vol. 35, no. 2, pp. 703-713, Apr, 2022.
- [72] Guangtai Tian, and Guang-Ren Duan, Robust model reference tracking for uncertain second-order nonlinear systems with application to robot manipulator, *International Journal of Robust and Nonlinear Control*, vol. 33, no. 3, pp. 1750-1771, Feb, 2023.
- [73] Weizhen Liu, Guangren Duan, and Mingzhe Hou, High-order robust command filtered backstepping design for strict-feedback systems: A high-order **fully actuated** system approach, *International Journal of Robust and Nonlinear Control*, vol. 32, no. 18, pp. 10251-10270, Dec, 2022.
- [74] Bin Zhou and Guang-Ren Duan, On the role of zeros in the pole assignment of scalar high-order **fully actuated** linear systems, *Journal of Systems Science & Complexity*, vol. 35, no. 2, pp. 535-542, Apr, 2022.
- [75] Guang-Ren Duan and Bin Zhou, **Fully actuated** system approach for linear systems control: A frequency-domain solution, *Journal of Systems Science & Complexity*, vol. 35, no. 6, pp. 2046-2061, Dec, 2022.

Applications

- [76] Qin Zhao and Guang-Ren Duan, **Fully actuated** system approach for 6DOF spacecraft control based on extended state observer, *Journal of Systems Science & Complexity*, vol. 35, no. 2, pp. 604-622, Apr, 2022.
- [77] Tianyi Zhao and Guang-Ren Duan, **Fully actuated** system approach to attitude control of flexible spacecraft with nonlinear time-varying inertia, *Science China-Information Sciences*, vol. 65, no. 11, Nov, 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.

Prof. Guang-Ren Duan is the founder and the Director of the Center for Control Theory and Guidance Technology at Harbin Institute of Technology, and in 2021, he also established the Center for Control Science and Technology at the Southern University of Science and Technology. He visited the University of Hull, the University of Sheffield, and also the Queen's University of Belfast, UK, from December 1996 to October 2002, and has served as Member of the Science and Technology

Committee of the Chinese Ministry of Education, Chair of the Discipline Review Group, the State Council of China, Vice President of the Control Theory and Applications Committee, Chinese Association of Automation (CAA), etc. He is currently Academician of the Chinese Academy of Sciences, and Fellow of CAA, IEEE and IET. His main research interests include parametric control systems design, descriptor systems, spacecraft control and magnetic bearing control. Particularly, he established the fully actuated system approach for nonlinear control in 2021. In 2022, he established the TC on Fully Actuated System (FAS) Theory and Applications, CAA, and has been the president of this TC since then. Simultaneously, he set up the Annual Conference on Fully Actuated System Theory and Applications (FASTA), which has been held three times with FASTA 2024 having more than 610 participants. He is the author and co-author of 5 books and over 500 SCI-indexed publications, and has delivered plenary lectures at over 40 international conferences, including the IEEE ARM 2020, IEEE ICRA 2021, IEEE IECON 2023, SICE-ICASE 2006, SICE 2014, IFAC TDS 2021, CCC 2021, and CAC 2024.

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 since it is the first book in the world on the fully actuated system (FAS) approach. As a matter of fact, the FAS approach was only proposed in 2020-2021, by the author, as a general framework for control system analysis and design based on a newly discovered general type of FAS models for dynamical systems, but it has attracted a great deal of attention in the world control community ever since its emergence.

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, scientists and engineers; academic and corporate libraries; practitioners and professionals; postgraduates; undergraduates

2) Research area: control science, technology and engineering, aeronautical and astronautical engineering, electrical and mechanical engineering, applied mathematics, etc.

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

Systems and control, Nonlinear dynamical systems, Control system designs, Fully actuated system approaches, Spacecraft control, Mechanical systems control, Electrical systems control.

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

1) Provides, as the first book in the world on the fully actuated system (FAS) approach, written by the proposer of the general approach, a comprehensive elementary introduction to the FAS approach for analysis and control of nonlinear dynamical systems.

- 2) Presents a whole new framework parallel to the state-space approach, which unifies and generalizes several dominant existing techniques for nonlinear control, while proposing essential developments ranging from models, concepts to control techniques.
- 3) Demonstrates by both theoretical developments and practical examples such as, control of the PVTOL plane and quadrotors, and spacecraft rendezvous and attitude control, that the introduced FAS approach solves many problems that the state-space approach can not solve or does not solve well.

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 300 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)

Appendix A. Table of Contents for Volume I

Introduction to Fully Actuated System Approach for Control

Volume I. Global Fully Actuated Systems

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Introduction to Fully Actuated System Approach for Control

Volume II. Sub-fully Actuated Systems

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Introduction to Fully Actuated System Approach for Control

Volume III. Unidirectionally Connected FASs

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