Vincenzo Pesce, Andrea Colagrossi, and Stefano Silvestrini



ISBN: 978-0-323-90916-7 PUB DATE: Nov 16, 2022 LIST PRICE: £200.00 / \$200.00 / €250.00 DISCOUNT: Reference FORMAT: Paperback TRIM: 6w x 9h PAGES: c. 1050 Approx. 400 illustrations (50 in full color) BIC CODES: TGMF1, TRP THEMA CLASSIFICATION: THEMAPHDF; THEMATRP; THEMATGMF



*Prices are subject to change without notice. All Rights Reserved.



Modern Spacecraft Guidance, Navigation, and Control

From System Modeling to AI and Innovative Applications

Edited by: **Vincenzo Pesce**, GNC Engineer, Airbus D&S Advanced Studies Department, Toulouse, France; **Andrea Colagrossi**, Assistant Professor, Aerospace Science and Technology Department, Politecnico di Milano, Italy; and **Stefano Silvestrini**, Post-doctoral Researcher, Aerospace Science and Technology Department, Politecnico di Milano, Italy.

Covers updated spacecraft GNC design and validation processes and explores the modern techniques based on AI.

KEY FEATURES

- Provides an overview of classical and modern GNC techniques, covering practical system modeling aspects and applicative cases.
- Presents the most important artificial intelligence algorithms applied to present and future spacecraft GNC.
- Describes classical and advanced techniques for GNC hardware and software verification and validation and GNC failure detection isolation and recovery (FDIR).

DESCRIPTION

Modern Spacecraft Guidance, Navigation, and Control: From System Modeling to Al and Innovative Applications provides a comprehensive foundation of theory and applications of spacecraft GNC, from fundamentals to advanced concepts, including modern AI-based architectures with focus on hardware and software practical applications. Divided into four parts, this book begins with an introduction to spacecraft GNC, before discussing the basic tools for GNC applications. These include an overview of the main reference systems and planetary models, a description of the space environment, an introduction to orbital and attitude dynamics, and a survey on spacecraft sensors and actuators, with details of their modeling principles. Part 2 covers guidance, navigation, and control, including both on-board and ground-based methods. It also discusses classical and novel control techniques, failure detection isolation and recovery (FDIR) methodologies, GNC verification, validation, and on-board implementation. The final part 3 discusses AI and modern applications featuring different applicative scenarios, with particular attention on artificial intelligence and the possible benefits when applied to spacecraft GNC. In this part, GNC for small satellites and CubeSats is also discussed.

Modern Spacecraft Guidance, Navigation, and Control: From System Modeling to AI and Innovative Applications is a valuable resource for aerospace engineers, GNC/AOCS engineers, avionic developers, and AIV/AIT technicians.

ENGINEERING Automotive & Aeronautical www.virtuale.elsevier.com, www.elsevier.com

Table of Contents

Part 0 – Introduction

1. Introduction

Part 1 – Fundamental GNC Tools

- Reference systems and planetary models
 The space environment
 Orbital dynamics
 Attitude dynamics

- 6. Sensors
- 7. Actuators

Part 2 – Spacecraft GNC

- 8. Guidance
 9. Navigation
- 10. Control
- 11. FDIR development approaches in space systems
- 12. GNC verification and validation
- 13. On-board implementation

Part 3 – AI and Modern Applications

- 14. Applicative GNC cases and examples
- 15. Modern spacecraft GNC
- 16. Mathematical and geometrical rules
- 17. Dynamical systems theory
- 18. Autocoding best practices

