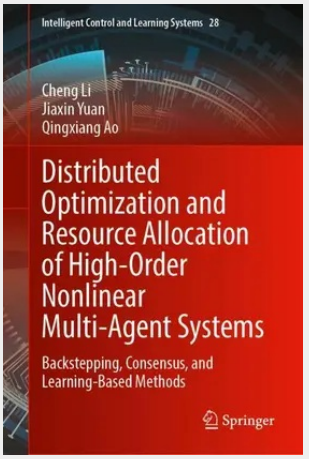
Li / Yuan / Ao

Distributed Optimization and Resource Allocation of High-Order Nonlinear Multi-Agent Systems

Backstepping, Consensus, and Learning-Based Methods



This book provides a unified and practical framework for solving distributed optimization and resource allocation problems in nonlinear multi-agent systems under complex dynamic environments. It enables readers to design control strategies that achieve fast convergence, robustness against disturbances, and resilience to communication and security constraints. The book presents a series of advanced methodologies, including finite-time, fixed-time, and predefined-time optimization control, disturbance rejection via observer-based techniques, and learning-based approaches using adaptive dynamic programming (ADP). It also introduces event-triggered mechanisms to reduce communication burden and observer-driven strategies to address false data injection attacks. These topics are of particular interest as they bridge the gap between theoretical optimization and real-world control implementation. Special features of the book include a unified optimization–control perspective, systematic integration of multiple time-constrained control schemes, and application-oriented case studies such as quadrotor UAV swarm coordination. The presentation combines rigorous theoretical analysis with intuitive explanations, supported by illustrative figures, structured frameworks, and comparative simulations. Readers will gain both theoretical insight and practical tools for addressing optimization and control challenges in networked systems. This book is intended for researchers, graduate students, and engineers in control systems, multi-agent systems, robotics, and intelligent networked systems.

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