

Jan Lunze

# Graph-Theoretical Methods in Systems Theory and Control

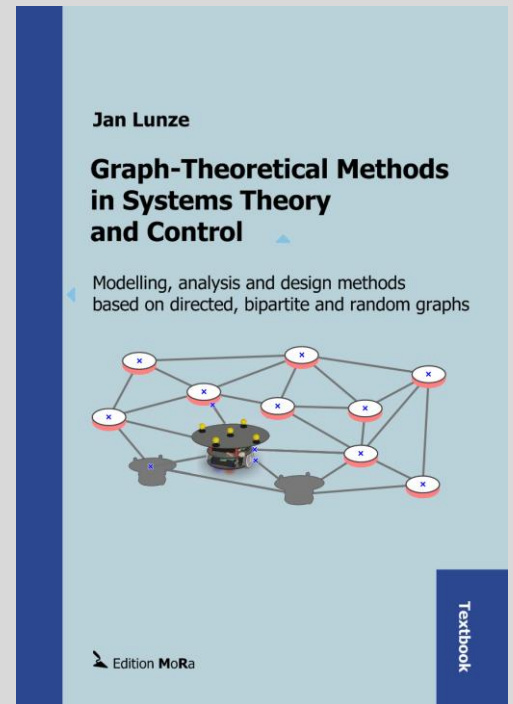
## Modelling, analysis and design methods based on directed, bipartite and random graphs

Many dynamical phenomena seem to be very complex, but have a simple structural cause, which can be discovered by graph-theoretical means. This textbook describes for numerous scenarios how to use the structural properties of a system to simplify modelling, analysis or design tasks. The readers learn to extract structure graphs from diverse information about a system and to solve problems of systems and control theory in a graph-theoretical way.

Numerous graph-theoretical representations of dynamical systems have been developed for different analysis and design problems:

- **Block diagrams** and coupling graphs for the decomposition of systems
- **Signal-flow graphs** for the analysis of interconnected linear systems
- **Bayesian networks** for dealing with probabilistic information
- **Inference graphs** for knowledge-based problem solving
- **Automaton graphs** for the analysis of discrete-event systems
- **Circuit graphs** for modelling electrical networks
- **Structure graphs** for the analysis of generic properties of linear systems
- **Flow networks** for the representation of transportation systems
- **Communication graphs** for the design of networked control systems
- **Bipartite structure graphs** for the decomposition of linear constraint sets
- **Bipartite graphs** for fault diagnosis
- **Random coupling graphs** to use the small-world property of large systems

**Prof. Dr.-Ing. Jan Lunze** is head of the Institute of Automation and Computer Control at Ruhr-University Bochum, Germany. He is the author of several textbooks on control theory, discrete-event systems and artificial intelligence. His experience with industrial applications has led to the numerous examples, exercises and application studies of this book that demonstrate structural properties of dynamical systems.



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