

Preface

Nanoscale communication has emerged as a new research topic in communications engineering. The term “nano” typically refers to the dimensions from a nanometer to hundred nanometers, and nanoscale communication is loosely defined as communication that may occur in that range. Communication engineers have started to investigate two distinct forms of nanoscale communication: molecular communication and electromagnetic-based nanoscale communication. In molecular communication, chemical signals are used for communication among nano- or microscale devices, while in EM-based nanoscale communication, electromagnetic waves are used. As nanoscale communication further develops, it may enable new applications in medicine, environment, and industry. It may also enable the integration of nano- or microscale devices into currently available communication networks to form future communication networks.

The research area of nanoscale communication is rapidly growing as evidenced by an increasing number of papers that have been published in recent years. In editing this book, our goal was to collect, from leading experts of nanoscale communication, comprehensive summary articles with recent research results on nanoscale communication. Toward this goal, this book consists of 24 articles collectively covering

- **Fundamentals of Molecular Communication** (Chapters “[Concentration-Encoded Molecular Communication in Nanonetworks. Part 1: Fundamentals, Issues, and Challenges](#)”–“[An Architecture of Calcium Signaling for Molecular Communication Based Nano Network](#)”), in which signal processing, communication theory, architectures, and protocols for molecular communication are presented,
- **Molecular Communication in Biology** (Chapters “[On Regulation of Neurospike Communication for Healthy Brain](#)”–“[Quantifying Robustness in Biological Networks Using NS-2](#)”), in which signal propagation in the brain, inter-molecule interactions, gene regulatory networks, and cell communication are studied,

- **Electromagnetic–Based Nano-scale Communication** (Chapters “Fundamentals of Graphene-Enabled Wireless On-Chip Networking”–“Nanoscale Communications Based on Fluorescence Resonance Energy Transfer (FRET)”), in which system design and methods of electromagnetic-based nanoscale communication are presented,
- **Nanomaterial and Nanostructure** (Chapters “Ultrasonics—An Effective Non-invasive Tool to Characterize Nanofluids”–“Reliable Design for Crossbar Nano-architectures”), in which nanotechnology for applied purposes such as security and computing is discussed,
- **Medical Applications of Nanoscale Communication** (Chapters “Effect of Aging, Disease Versus Health Conditions in the Design of Nano-communications in Blood Vessels”–“Computational Biosensors: Molecules, Algorithms, and Detection Platforms”), in which disease diagnosis, drug delivery, and biomolecular sensing are presented.

We believe this book serves as a point of references for students and researchers who are interested in this emerging area of nanoscale communication as well as those who are working in the area. Finally, we thank all chapters’ authors and reviewers who made this book possible.

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Modeling, Methodologies and Tools for Molecular and
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Modeling, Methodologies and Tools

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