Preface

The constantly changing landscape of Robotics challenges experts and practitioners to stay apprized of the field’s most up-to-date research. That is why Information Science Reference is pleased to offer this three-volume reference collection that will empower students, researchers, and academicians with a strong understanding of critical issues within Robotics by providing both broad and detailed perspectives on cutting-edge theories and developments in the field. This collection is designed to act as a single reference source on conceptual, methodological, technical, and organizational issues, as well as provide insight into emerging trends and future opportunities within the discipline.

Robotics: Concepts, Methodologies, Tools, and Applications is organized into six distinct sections that provide comprehensive coverage of important topics. The sections are (1) Fundamental Concepts and Theories, (2) Development and Design Methodologies, (3) Tools and Technologies, (4) Utilization and Application, (5) Organizational and Social Implications, and (6) Emerging Trends. The following paragraphs provide a summary of what readers may expect from this invaluable reference tool.

Section 1, “Fundamental Concepts and Theories,” provides an overview of the subject by exploring several key topics and applications in the field of Robotics. The section begins with History of Service Robots by Zielinska Teresa, a chapter that brings together the current state of robotic assistive technologies with future trends in the field. In addition to service robotics, chapters in this section discuss computer vision technologies and applications (3D Scene Capture and Analysis for Intelligent Robotics by Ray Jarvis), artificial intelligence (A Framework for Prototyping of Autonomous Multi-Robot Systems for Search, Rescue, and Reconnaissance by Sedat Dogru, Sebahattin Topal, Aydan M. Erkmen, and Ismet Erkmen), and applications for education (Educational Robotics Theories and Practice by Amy Eguchi) and public libraries (The Inevitability of Library Automation by Edward Iglesias). In all, this section introduces the reader to some of the important ideas and current considerations in the research and development of robotic systems, concepts that will be explored in greater depth throughout the remaining sections.

Section 2, “Development and Design Methodologies,” explores some of the fundamental properties of Robotics systems. The first few chapters build on the service applications described in Section One to include learning and reasoning tools, such as Mission Planning of Mobile Robots and Manipulators for Service Applications by Elias K. Xidias, Nikos A. Aspragathos, and Philip N. Azariadis and Gesture Learning by Imitation Architecture for a Social Robot by J. P. Bandera, J. A. Rodríguez, and A. Bandera. Subsequently, the section addresses the concept of swarm intelligence and interactions between robots in Self Control and Server-Supervisory Control for Multiple Mobile Robots, and its Applicability to Intelligent DNC System by F. Nagata, T. Yamashiro, N. Kitahara, A. Otsuka, K. Watanabe, and Maki K. Habib, as well as several other central chapters. Finally, the section concludes with two chapters on the

Section 3, “Tools and Technologies,” bridges the gap between theory and practice with a discussion of recent development in tangible Robotics technologies. The opening chapters continue from the previous section by describing various robotic limbs and manipulators, such as Portable Haptic Arm Exoskeleton by Pierre Letier and André Preumont and Medical Manipulators for Surgical Applications by Xing-guang Duan, Xing-tao Wang, and Qiang Huang. Next, the section explores some potential applications for these technologies, with chapters such as Agile Wheeled Mobile Robots for Service in Natural Environment by Jean-Christophe Fauroux, Belhassen-Chedli Bouzgarrou, Nicolas Bouton, Philippe Vaslin, Roland Lenain, and Frédéric Chapelle and Needle Insertion Force Modeling using Genetic Programming Polynomial Higher Order Neural Network by Mehdi Fallahnezhad and Hashem Yousefi, among others. The closing chapters focus on robotic vision technologies, ending with Visual Control of an Autonomous Indoor Robotic Blimp by L. M. Alkurdi and R. B. Fisher, a chapter that transitions nicely into the next section and its discussion of robotic applications in indoor environments.

Section 4, “Utilization and Application,” describes some of the various uses for the technologies presented in the first three sections, further demonstrating the applicability of Robotics to other diverse fields and endeavors. The section begins with applications in restricted environments, such as homes and industrial infrastructure. Notably, Study and Design of an Autonomous Mobile Robot Applied to Underwater Cleaning by Lafaete Creomar Lima Junior, Armando Carlos de Pina Filho, and Aloísio Carlos de Pina and Prototyping of Fully Autonomous Indoor Patrolling Mobile Robots by Xiaojun Wu, Bingbing Liu, Jun-Hong Lee, Vikas Reddy, and Xi Zheng explore two such applications. Next, the following chapters expand upon the swarm intelligence concepts illustrated in Section Two, including Safer and Faster Humanitarian Demining with Robots by Emin Faruk Kececi. Additional applications can be found in the energy (Mechatronics Technology for Solar Cells by H. Henry Zhang, Danny Rodriguez, and Qiong Li) and agricultural (Service Robots for Agriculture by Andrea Manuemento Bertetto) sectors, and the final chapters cover Medical Robotics, notably Surgical Robots by Tamás Haidegger and Wearable Power Assist Robot Driven with Pneumatic Rubber Artificial Muscles by Toshiro Noritsugu.

Section 5, “Organizational and Social Implications,” moves away from the physical aspects of Robotics to explore the impact that these technologies have on society and human interaction. The section begins with chapters on rehabilitation and assistive technologies, including Gait Rhythm of Parkinson’s Disease Patients and an Interpersonal Synchrony Emulation System Based on Cooperative Gait by Hirota Uchitomi, Kazuki Suzuki, Tatsunori Nishi, Michael J. Hove, Yoshihiro Miyake, Satoshi Oriomo, and Yoshiaki Wada and Interactive Games with Robotic and Augmented Reality Technology in Cognitive and Motor Rehabilitation by Ana Belén Naranjo-Saucedo, Cristina Suárez-Mejías, Carlos L. Parra-Calderón, Ester González-Aguado, Frida Böckel-Martínez, Antoni Yuste-Marco, Pablo Bustos, Luis Manso, Pilar Bachiller, Sergi Plana, Jose M. Diaz, Ricardo Boniche, and Adriá Marco. The majority of the chapters in this section cover human-machine interaction and how modern technologies affect human identity. In particular, Human-Friendly Mechatronics Systems with Functional Fluids and Elastomers by Takehiro Kikuchi evaluates safety concerns in human-machine coexistence, and Just Doesn’t Look Right by Julie Carpenter describes how the design and appearance of a robot can affect the way it is perceived by its human counterparts. The section concludes with two chapters on Robotics education, a crucial first step in the development of new Robotics technologies.
Section 6, “Emerging Trends,” completes this valuable reference source with insight into the most recent advances and future developments in Robotics technologies. The chapters in this section extrapolate on the concepts and applications discussed in previous sections, including robot vision (Self-Calibration of Eye-to-Hand and Workspace for Mobile Service Robot by Jwu-Sheng Hu and Yung-Jung Chang), navigation (Collaborative Exploration Based on Simultaneous Localization and Mapping by Domenec Puig), multi-robot systems (Ad Hoc Communications for Wireless Robots in Indoor Environments by Laura Victoria Escamilla Del Río and Juan Michel García Díaz), and human-computer interaction (Understanding the Human-Machine Interface in a Time of Change by Erica Orange), among others. The diverse natures of the chapters in this section are indicative of the variety of applications and benefits that Robotics technologies provide to enhance human lives. The final chapter, A Neurorobotics Approach to Investigating Word Learning Behaviors by Richard Veale effectively concludes this essential three-volume reference by exploring how a greater understanding of robots can help us to better understand ourselves and our environment.

As a comprehensive collection of research on current findings related to the development of interdisciplinary technologies, Robotics: Concepts, Methodologies, Tools, and Applications provides researchers, administrators, and all audiences with a complete understanding of the latest advances, applications, and concepts in Robotics. Although the primary organization of the contents in this multi-volume work is based on its six sections, offering a progression of coverage on the important concepts, methodologies, technologies, applications, social issues, and emerging trends, the reader can also identify specific content by utilizing the extensive indexing system found at the end of each volume. Given the vast number of issues concerning usage, successes and failures, policies, strategies, and applications of Robotics in countries around the world, Robotics: Concepts, Methodologies, Tools, and Applications addresses the demand for a resource that encompasses the most pertinent research on the technologies being employed to globally bolster the knowledge and implementation of Robotics.