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This book constitutes the refereed proceedings of the 17th Annual Conference on Towards Autonomous Robotics, TAROS 2016, held in Sheffield UK, in June/July 2016. The 23 revised full papers presented together with 15 short papers were carefully

reviewed and selected from 56 submissions. The overall program covers various aspects of robotics, including navigation, planning, sensing and perception, flying and swarm robots, ethics, humanoid robotics, human-robot interaction, and social robotics. Providing a guided tour of the pioneering work and major technical issues, Multiagent Robotic Systems addresses learning and adaptation in decentralized autonomous robots. Its systematic examination demonstrates the interrelationships between the autonomy of individual robots and the emerged global behavior properties of a group performing a cooperative task. The author also includes descriptions of the essential building blocks of the architecture of autonomous mobile robots with respect to their requirement on local behavioral conditioning and group behavioral evolution. After reading this book you will be able to fully appreciate the strengths and usefulness of various approaches in the development and application of multiagent robotic systems. It covers: Why and how to develop and experimentally test the computational mechanisms for learning and evolving sensory-motor control behaviors in autonomous robots How to design and develop evolutionary algorithm-based group behavioral learning mechanisms for the optimal emergence of group behaviors How to enable group robots to converge to a finite number of desirable task states through group learning What are the effects of the local learning mechanisms on the emergent global

behaviors How to use decentralized, self-organizing autonomous robots to perform cooperative tasks in an unknown environment Earlier works have focused primarily on how to navigate in a spatially unknown environment, given certain predefined motion behaviors. What is missing, however, is an in-depth look at the important issues on how to effectively obtain such behaviors in group robots and how to enable behavioral learning and adaptation at the group level. Multiagent Robotic Systems examines the key methodological issues and gives you an understanding of the underlying computational models and techniques for multiagent systems. This volume of the SPAR series brings the proceedings of the fourteen edition of the DARS symposium on Distributed Autonomous Robotic Systems, whose proceedings have been published within SPAR since the past edition. This symposium took place in Boulder, CO from October 15th to 17th, 2018. The volume edited by Nikolaus Correll and Mac Schwager contains 36 scientific contributions cutting across planning, control, design, perception, networking, and optimization, all united through the common thread of distributed robotic systems. This book constitutes the refereed proceedings of the 19th Annual Conference on Towards Autonomous Robotics, TAROS 2018, held in Bristol, UK, in July 2018. The 38 full papers presented together with 14 short papers were carefully reviewed and selected from 68 submissions. The papers focus on presentation and

discussion of the latest results and methods in autonomous robotics research and applications. The conference offers a friendly environment for robotics researchers and industry to take stock and plan future progress. The volume LNAI 12228 constitute the refereed proceedings of the 21th Annual Conference "Towards Autonomous Robotics," TAROS 20120, held in Nottingham, UK, in September 2020.* The 30 full papers and 11 short papers presented were carefully reviewed and selected from 63 submissions. The papers present and discuss significant findings and advances in autonomous robotics research and applications. They are organized in the following topical sections: soft and compliant robots; mobile robots; learning, mapping and planning; human-robot interaction; and robotic systems and applications. * The conference was held virtually due to the COVID-19 pandemic. Distributed robotics is a rapidly growing and maturing interdisciplinary research area lying at the intersection of computer science, network science, control theory, and electrical and mechanical engineering. The goal of the Symposium on Distributed Autonomous Robotic Systems (DARS) is to exchange and stimulate research ideas to realize advanced distributed robotic systems. This volume of proceedings includes 31 original contributions presented at the 2012 International Symposium on Distributed Autonomous Robotic Systems (DARS 2012) held in November 2012 at the Johns Hopkins University in

Baltimore, MD USA. The selected papers in this volume are authored by leading researchers from Asia, Europa, and the Americas, thereby providing a broad coverage and perspective of the state-of-the-art technologies, algorithms, system architectures, and applications in distributed robotic systems. The book is organized into five parts, representative of critical long-term and emerging research thrusts in the multi-robot community: Coordination for Perception, Coverage, and Tracking; Task Allocation and Coordination Strategies; Modular Robots and Novel Mechanisms and Sensors; Formation Control and Planning for Robot Teams; and Learning, Adaptation, and Cognition for Robot Teams. This book constitutes the refereed proceedings of the 14th Conference on Advances in Autonomous Robotics, TAROS 2013, held in Oxford, UK, in August 2013. The 36 revised full papers presented together with 25 extended abstracts were carefully reviewed and selected from 89 submissions. The papers cover various topics such as artificial intelligence, bio-inspired and aerial robotics, computer vision, control, humanoid and robotic arm, swarm robotics, verification and ethics. This research book contains a sample of most recent research in the area of intelligent autonomous systems. The contributions include: General aspects of intelligent autonomous systems Design of intelligent autonomous robots Biped robots Robot for stair-case navigation Ensemble learning for multi-source information fusion Intelligent

autonomous systems in psychiatry Condition monitoring of internal combustion engine Security management of an enterprise network High dimensional neural nets and applications This book is directed to engineers, scientists, professor and the undergraduate/postgraduate students who wish to explore this field further. This book presents the state of the art in distributed autonomous systems composed of multiple robots, robotic modules, or robotic agents. Swarms in nature can not only adapt to their environments, but can also construct suitable habitats to their own advantage. Distributed autonomous robotic systems can do many things that its individuals cannot do alone. As the global pandemic was still ongoing, the 15th International Symposium on Distributed Autonomous Robotic Systems (DARS2021) was held on June 1–4, 2021, as an online meeting. The scope of DARS201 was to create a bridge between biologists and engineers interested in the distributed intelligence of living things and to establish a new academic field by integrating knowledge from both disciplines. Topics of DARS2021 were swarm intelligence, swarm robotics, multi-agent system, modular robotics, decentralized control, distributed system, etc. The papers in this book provide a very good overview of the state of the art in distributed autonomous robotic systems (DARS). They reflect current research themes in DARS with important contributions. We hope that this book helps to sustain the interest in DARS and triggers new research.

The second edition of a comprehensive introduction to all aspects of mobile robotics, from algorithms to mechanisms. Mobile robots range from the Mars Pathfinder mission's teleoperated Sojourner to the cleaning robots in the Paris Metro. This text offers students and other interested readers an introduction to the fundamentals of mobile robotics, spanning the mechanical, motor, sensory, perceptual, and cognitive layers the field comprises. The text focuses on mobility itself, offering an overview of the mechanisms that allow a mobile robot to move through a real world environment to perform its tasks, including locomotion, sensing, localization, and motion planning. It synthesizes material from such fields as kinematics, control theory, signal analysis, computer vision, information theory, artificial intelligence, and probability theory. The book presents the techniques and technology that enable mobility in a series of interacting modules. Each chapter treats a different aspect of mobility, as the book moves from low-level to high-level details. It covers all aspects of mobile robotics, including software and hardware design considerations, related technologies, and algorithmic techniques. This second edition has been revised and updated throughout, with 130 pages of new material on such topics as locomotion, perception, localization, and planning and navigation. Problem sets have been added at the end of each chapter. Bringing together all aspects of mobile robotics into one volume, Introduction to

Autonomous Mobile Robots can serve as a textbook or a working tool for beginning practitioners. Curriculum developed by Dr. Robert King, Colorado School of Mines, and Dr. James Conrad, University of North Carolina-Charlotte, to accompany the National Instruments LabVIEW Robotics Starter Kit, are available. Included are 13 (6 by Dr. King and 7 by Dr. Conrad) laboratory exercises for using the LabVIEW Robotics Starter Kit to teach mobile robotics concepts. This book introduces concepts in mobile, autonomous robotics to 3rd-4th year students in Computer Science or a related discipline. The book covers principles of robot motion, forward and inverse kinematics of robotic arms and simple wheeled platforms, perception, error propagation, localization and simultaneous localization and mapping. The cover picture shows a wind-up toy that is smart enough to not fall off a table just using intelligent mechanism design and illustrate the importance of the mechanism in designing intelligent, autonomous systems. This book is open source, open to contributions, and released under a creative common license. It has long been the goal of engineers to develop tools that enhance our ability to do work, increase our quality of life, or perform tasks that are either beyond our ability, too hazardous, or too tedious to be left to human efforts. Autonomous mobile robots are the culmination of decades of research and development, and their potential is seemingly unlimited. Roadmap to the

Future Serving as the first comprehensive reference on this interdisciplinary technology, Autonomous Mobile Robots: Sensing, Control, Decision Making, and Applications authoritatively addresses the theoretical, technical, and practical aspects of the field. The book examines in detail the key components that form an autonomous mobile robot, from sensors and sensor fusion to modeling and control, map building and path planning, and decision making and autonomy, and to the final integration of these components for diversified applications. Trusted Guidance A duo of accomplished experts leads a team of renowned international researchers and professionals who provide detailed technical reviews and the latest solutions to a variety of important problems. They share hard-won insight into the practical implementation and integration issues involved in developing autonomous and open robotic systems, along with in-depth examples, current and future applications, and extensive illustrations. For anyone involved in researching, designing, or deploying autonomous robotic systems, Autonomous Mobile Robots is the perfect resource. The two volumes LNAI 11649 and LNAI 11650 constitute the refereed proceedings of the 20th Annual Conference "Towards Autonomous Robotics", TAROS 2019, held in London, UK, in July 2019. The 74 full papers and 12 short papers presented were carefully reviewed and selected from 101 submissions. The papers present and discuss

significant findings and advances in autonomous robotics research and applications. They are organized in the following topical sections: robotic grippers and manipulation; soft robotics, sensing and mobile robots; robotic learning, mapping and planning; human-robot interaction; and robotic systems and applications. This book presents the state of the art in distributed autonomous systems composed of multiple robots, robotic modules, or robotic agents. Swarms in nature can not only adapt to their environments, but can also construct suitable habitats to their own advantage. Distributed autonomous robotic systems can do many things that its individuals cannot do alone. As the global pandemic was still ongoing, the 15th International Symposium on Distributed Autonomous Robotic Systems (DARS2021) was held on June 1–4, 2021, as an online meeting. The scope of DARS201 was to create a bridge between biologists and engineers interested in the distributed intelligence of living things and to establish a new academic field by integrating knowledge from both disciplines. Topics of DARS2021 were swarm intelligence, swarm robotics, multi-agent system, modular robotics, decentralized control, distributed system, etc. The papers in this book provide a very good overview of the state of the art in distributed autonomous robotic systems (DARS). They reflect current research themes in DARS with important contributions. We hope that this book helps to sustain the interest in DARS and triggers new research.

The volume LNAI 13546 constitutes the refereed proceedings of the 23rd Annual Conference Towards Autonomous Robotic Systems, TAROS 2022, held in Culham, UK, in September 2022. The 14 full papers and 10 short papers were carefully reviewed and selected from 38 submissions. Organized in the topical sections "Algorithms" and "Systems", they discuss significant findings and advances in the following areas: Robotic Grippers and Manipulation; Soft Robotics, Sensing and Mobile Robots; Robotic Learning, Mapping and Planning; Robotic Systems and Applications. This book constitutes the presentations made at the Advanced Research Workshop on Autonomous Robotic Systems, which was held at the University of Coimbra, Portugal, June 1997. The aim of the meeting was to bring together leading researchers in the area of autonomous systems for mobility and manipulation, and the aim of this book is to share the presentations with the reader. The book presents the most recent developments in the field. Topics include sensors and navigation in mobile robots, robot co-operation, telerobotics, legged robots, climbing robots and applications. Existing and emerging applications of autonomous syst ems are described in great detail, including applications in forestry, cleaning, mining, tertiary buildings, assistance to the elderly and handicapped, and surgery. The chapters are written in a structured and advanced tutorial style by leading specialists from Europe, Australia,

Japan and USA. The style will allow the reader to grasp the state-of-the-art and research directions in the area of autonomous systems. This book constitutes the refereed proceedings of the 18th Annual Conference on Towards Autonomous Robotics, TAROS 2017, held in Guildford, UK, in July 2017. The 43 revised full papers presented together with 13 short papers were carefully reviewed and selected from 66 submissions. The papers discuss robotics research drawn from a wide and diverse range of topics, such as swarm and multi-robotic systems; human-robot interaction; robotic learning and imitation; robot navigation, planning and safety; humanoid and bio-inspired robots; mobile robots and vehicles; robot testing and design; detection and recognition; learning and adaptive behaviours; interaction; soft and reconfigurable robots; and service and industrial robots. Expounding on the results of the author’s work with the US Army Research Office, DARPA, the Office of Naval Research, and various defense industry contractors, Governing Lethal Behavior in Autonomous Robots explores how to produce an "artificial conscience" in a new class of robots, humane-oids, which are robots that can potentially perform more ethically than humans in the battlefield. The author examines the philosophical basis, motivation, theory, and design recommendations for the implementation of an ethical control and reasoning system in autonomous robot systems, taking into account the

Laws of War and Rules of Engagement. The book presents robot architectural design recommendations for Post facto suppression of unethical behavior, Behavioral design that incorporates ethical constraints from the onset, The use of affective functions as an adaptive component in the event of unethical action, and A mechanism that identifies and advises operators regarding their ultimate responsibility for the deployment of autonomous systems. It also examines why soldiers fail in battle regarding ethical decisions; discusses the opinions of the public, researchers, policymakers, and military personnel on the use of lethality by autonomous systems; provides examples that illustrate autonomous systems' ethical use of force; and includes relevant Laws of War. Helping ensure that warfare is conducted justly with the advent of autonomous robots, this book shows that the first steps toward creating robots that not only conform to international law but outperform human soldiers in their ethical capacity are within reach in the future. It supplies the motivation, philosophy, formalisms, representational requirements, architectural design criteria, recommendations, and test scenarios to design and construct an autonomous robotic system capable of ethically using lethal force. Ron Arkin was quoted in a November 2010 New York Times article about robots in the military. Rapid technological advances in the field of robotics and autonomous systems (RAS) are transforming the international security environment

and the conduct of contemporary conflict. Bringing together leading experts from across the globe, this book provides timely analysis on the current and future challenges associated with greater utilization of RAS by states, their militaries, and a host of non-state actors. Technologically driven change in the international security environment can come about through the development of one significant technology, such as the atomic bomb. At other times, it results from several technologies maturing at roughly the same pace. This second image better reflects the rapid technological change that is taking us into the robotics age. Many of the chapters in this edited volume explore unresolved ethical, legal, and operational challenges that are only likely to become more complex as RAS technology matures. Though the precise ways in which the impact of autonomous systems – both physical and non-physical – will be felt in the long-run is hidden from us, attempting to anticipate the direction of travel remains an important undertaking and one that this book makes a critical effort to contend with. The chapters in this book were originally published as a special issue of the journal Small Wars & Insurgencies. Distributed robotics is a rapidly growing, interdisciplinary research area lying at the intersection of computer science, communication and control systems, and electrical and mechanical engineering. The goal of the Symposium on Distributed Autonomous Robotic Systems (DARS) is to

exchange and stimulate research ideas to realize advanced distributed robotic systems. This volume of proceedings includes 43 original contributions presented at the Tenth International Symposium on Distributed Autonomous Robotic Systems (DARS 2010), which was held in November 2010 at the École Polytechnique Fédérale de Lausanne (EPFL), Switzerland. The selected papers in this volume are authored by leading researchers from Asia, Europa, and the Americas, thereby providing a broad coverage and perspective of the state-of-the-art technologies, algorithms, system architectures, and applications in distributed robotic systems. The book is organized into four parts, each representing one critical and long-term research thrust in the multi-robot community: distributed sensing (Part I); localization, navigation, and formations (Part II); coordination algorithms and formal methods (Part III); modularity, distributed manipulation, and platforms (Part IV). The 6th International Symposium on Distributed Autonomous Robotic Systems (DARS 2002) was held in June 2002 in Fukuoka, Japan, a decade after the first DARS symposium was convened. This book, containing the proceedings of the symposium, provides broad coverage of the technical issues in the current state of the art in distributed autonomous systems composed of multiple robots, robotic modules, or robotic agents. DARS 2002 dealt with new strategies for realizing complex, modular, robust, and fault-tolerant robotic systems, and this volume covers

the technical areas of system design, modeling, simulation, operation, sensing, planning, and control. The papers that are included here were contributed by leading researchers from Asia, Oceania, Europe, and the Americas, and make up an invaluable resource for researchers and students in the field of distributed autonomous robotic systems. Distributed robotics is an interdisciplinary and rapidly growing area, combining research in computer science, communication and control systems, and electrical and mechanical engineering. Distributed robotic systems can autonomously solve complex problems while operating in highly unstructured real-world environments. They are expected to play a major role in addressing future societal needs, for example, by improving environmental impact assessment, food supply, transportation, manufacturing, security, and emergency and rescue services. The goal of the International Symposium on Distributed Autonomous Robotic Systems (DARS) is to provide a forum for scientific advances in the theory and practice of distributed autonomous robotic systems. This volume of proceedings include 47 original contributions presented at the 13th International Symposium on Distributed Autonomous Robotic Systems (DARS 2016), which was held at the Natural History Museum in London, UK, from November 7th to 9th, 2016. The selected papers in this volume are authored by leading researchers from around the world, thereby providing a

broad coverage and perspective of the state-of-the-art technologies, algorithms, system architectures, and applications in distributed robotic systems. The book is organized into seven parts, representative of critical long-term and emerging research thrusts in the multi-robot community: Distributed Coverage and Exploration; Multi-Robot Control; Multi-Robot Estimation; Multi-Robot Planning; Modular Robots and Smart Materials; Swarm Robotics; and Multi-Robot Systems in Applications. This book contains an edited collection of eighteen contributions on soft and hard computing techniques and their applications to autonomous robotic systems. Each contribution has been exclusively written for this volume by a leading researcher. The volume demonstrates the various ways that the soft computing and hard computing techniques can be used in different integrated manners to better develop autonomous robotic systems that can perform various tasks of vision, perception, cognition, thinking, pattern recognition, decision-making, and reasoning and control, amongst others. Each chapter of the book is self-contained and points out the future direction of research. "It is a must reading for students and researchers interested in exploring the potentials of the fascinating field that will form the basis for the design of the intelligent machines of the future" (Madan M. Gupta) Through expanded intelligence, the use of robotics has fundamentally transformed a variety of fields, including manufacturing, aerospace,

medicine, social services, and agriculture. Continued research on robotic design is critical to solving various dynamic obstacles individuals, enterprises, and humanity at large face on a daily basis. Robotic Systems: Concepts, Methodologies, Tools, and Applications is a vital reference source that delves into the current issues, methodologies, and trends relating to advanced robotic technology in the modern world. Highlighting a range of topics such as mechatronics, cybernetics, and human-computer interaction, this multi-volume book is ideally designed for robotics engineers, mechanical engineers, robotics technicians, operators, software engineers, designers, programmers, industry professionals, researchers, students, academicians, and computer practitioners seeking current research on developing innovative ideas for intelligent and autonomous robotics systems. As a new strategy to realize the goal of flexible, robust, fault-tolerant robotic systems, the distributed autonomous approach has quickly established itself as one of the fastest growing fields in robotics. This book is one of the first to devote itself solely to this exciting area of research, covering such topics as self-organization, communication and coordination, multi-robot manipulation and control, distributed system design, distributed sensing, intelligent manufacturing systems, and group behavior. The fundamental technologies and system architectures of distributed autonomous robotic systems are expounded in detail, along with the

latest research findings. This book should prove indispensable not only to those involved with robotic engineering but also to those in the fields of artificial intelligence, self-organizing systems, and coordinated control. Offers a theoretical and practical guide to the communication and navigation of autonomous mobile robots and multi-robot systems This book covers the methods and algorithms for the navigation, motion planning, and control of mobile robots acting individually and in groups. It addresses methods of positioning in global and local coordinates systems, off-line and on-line path-planning, sensing and sensors fusion, algorithms of obstacle avoidance, swarming techniques and cooperative behavior. The book includes ready-to-use algorithms, numerical examples and simulations, which can be directly implemented in both simple and advanced mobile robots, and is accompanied by a website hosting codes, videos, and PowerPoint slides Autonomous Mobile Robots and Multi-Robot Systems: Motion-Planning, Communication and Swarming consists of four main parts. The first looks at the models and algorithms of navigation and motion planning in global coordinates systems with complete information about the robot’s location and velocity. The second part considers the motion of the robots in the potential field, which is defined by the environmental states of the robot's expectations and knowledge. The robot's motion in the unknown environments and the corresponding tasks of

environment mapping using sensed information is covered in the third part. The fourth part deals with the multi-robot systems and swarm dynamics in two and three dimensions. Provides a self-contained, theoretical guide to understanding mobile robot control and navigation Features implementable algorithms, numerical examples, and simulations Includes coverage of models of motion in global and local coordinates systems with and without direct communication between the robots Supplemented by a companion website offering codes, videos, and PowerPoint slides Autonomous Mobile Robots and Multi-Robot Systems: Motion-Planning, Communication and Swarming is an excellent tool for researchers, lecturers, senior undergraduate and graduate students, and engineers dealing with mobile robots and related issues. The Fifth International Symposium on Distributed Autonomous Robotic Systems (DARS 2000) dealt with new strategies to realize complex, modular, robust, and fault-tolerant robotic systems. Technologies, algorithms, and system architectures for distributed autonomous robotic systems were presented and discussed during the meeting. DARS 2000 was truly an international event, with participants represent ing eleven countries from Europe, Asia, and the Americas. All of the papers in this volume were presented at DARS 2000, and were selected on the basis of peer re views to ensure quality and relevance. These papers have the common goal of con tributing solutions to realize robust and intelligent

multirobot systems. The topics of the symposium address a wide range of issues that are important in the development of decentralized robotic systems. These topics include architec tures, communication, biological inspirations, reconfigurable robots, localization, exploration and mapping, distributed sensing, multi robot motion coordination, tar get assignment and tracking, multirobot learning, and cooperative object transport. DARS clearly requires a broad area of interdisciplinary technologies related not only to robotics and computer engineering, but also to biology and psychology. The DARS symposium is the leading established conference on distributed au tonomous systems. The First, Second, and Third International Symposia on Distrib uted Autonomous Robotic Systems (DARS '92, DARS '94, and DARS '96) were held at the Institute of Physical and Chemical Research (RIKEN), Saitama, Japan. This volume of proceedings includes 32 original contributions presented at the 12th International Symposium on Distributed Autonomous Robotic Systems (DARS 2014), held in November 2014. The selected papers in this volume are authored by leading researchers from Asia, Australia, Europe, and the Americas, thereby providing a broad coverage and perspective of the state-of-the-art technologies, algorithms, system architectures, and applications in distributed robotic systems. Distributed autonomous robotic systems (DARS) are systems composed of multiple autonomous units such as

modules, cells, processors, agents, and robots. Combination or cooperative operation of multiple autonomous units is expected to lead to desirable features such as flexibility, fault tolerance, and efficiency. The DARS is the leading established conference on distributed autonomous systems. All papers have the common goal to contribute solutions to the very demanding task of designing distributed systems to realize robust and intelligent robotic systems. The Fifth International Symposium on Distributed Autonomous Robotic Systems (DARS 2000) dealt with new strategies to realize complex, modular, robust, and fault-tolerant robotic systems. Technologies, algorithms, and system architectures for distributed autonomous robotic systems were presented and discussed during the meeting. DARS 2000 was truly an international event, with participants represent ing eleven countries from Europe, Asia, and the Americas. All of the papers in this volume were presented at DARS 2000, and were selected on the basis of peer re views to ensure quality and relevance. These papers have the common goal of con tributing solutions to realize robust and intelligent multirobot systems. The topics of the symposium address a wide range of issues that are important in the development of decentralized robotic systems. These topics include architec tures, communication, biological inspirations, reconfigurable robots, localization, exploration and mapping, distributed sensing, multi robot motion coordination, tar get assignment

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will allow the reader to grasp the state-of-the-art and research directions in the area of autonomous systems. This collection of twenty-three timely contributions covers a well-selected repertory of topics within the autonomous systems field. The book discusses a range of design, construction, control, and operation problems along with a multiplicity of well-established and novel solutions. This book collects papers selected by an international program committee for presentation at the 8th International Symposium on Distributed Autonomous Robotic Systems. The papers present state of the art research advances in the field of distributed robotics. What makes this book distinctive is the emphasis on using multiple robots and on making them autonomous, as opposed to being teleoperated. Novel algorithms, system architectures, technologies, and numerous applications are covered. This book constitutes the refereed proceedings of the 12th Annual Conference Towards Autonomous Robotics Systems, TAROS 2011, held in Sheffield, UK, in August/September 2011. The 32 revised full papers presented together with 29 two-page abstracts were carefully reviewed and selected from 94 submissions. Among the topics addressed are robot navigation, robot learning, human-robot interaction, robot control, mobile robots, reinforcement learning, robot vehicles, swarm robotic systems, etc. This book constitutes the refereed proceedings of the 15th Conference on Advances in Autonomous Robotics, TAROS 2014, held in

Birmingham, UK, in September 2014. The 23 revised full papers presented together with 9 extended abstracts were carefully reviewed and selected from 48 submissions. The overall program covers various aspects of robotics, including navigation, planning, sensing and perception, flying and swarm robots, ethics, humanoid robotics, human-robot interaction, and social robotics. This book constitutes the refereed proceedings of the 16th Annual Conference on Towards Autonomous Robotics, TAROS 2015, held in Liverpool UK, in September 2015. The 16 revised full papers presented together with 18 short papers were carefully reviewed and selected from 59 submissions. The overall program covers various aspects of robotics, including navigation, planning, sensing and perception, flying and swarm robots, ethics, humanoid robotics, human-robot interaction, and social robotics. The International Symposia on Distributed Autonomous Robotic Systems (DARS) started at Riken, Japan in 1992. Since then, the DARS symposia have been held every two years: in 1994 and 1996 in Japan (Riken, Wako), in 1998 in Germany (Karlsruhe), in 2000 in the USA (Knoxville, TN), in 2002 in Japan (Fukuoka), in 2004 in France (Toulouse), and in 2006 in the USA (Minneapolis, MN). The 9th DARS symposium, which was held during November 17–19 in T- kuba, Japan, hosted 84 participants from 13 countries. The 48 papers presented there were selected through rigorous peer review with a 50% acceptance

ratio. Along with three invited talks, they addressed the spreading research fields of DARS, which are classifiable along two streams: theoretical and standard studies of DARS, and interdisciplinary studies using DARS concepts. The former stream includes multi-robot cooperation (task assignment methodology among multiple robots, multi-robot localization, etc.), swarm intelligence, and modular robots. The latter includes distributed sensing, mobiligence, ambient intelligence, and mul- agent systems interaction with human beings. This book not only offers readers the latest research results related to DARS from theoretical studies to application-oriented ones; it also describes the present trends of this field. With the diversity and depth revealed herein, we expect that DARS technologies will flourish soon. An introduction to the science and practice of autonomous robots that reviews over 300 current systems and examines the underlying technology. Autonomous robots are intelligent machines capable of performing tasks in the world by themselves, without explicit human control. Examples range from autonomous helicopters to Roomba, the robot vacuum cleaner. In this book, George Bekey offers an introduction to the science and practice of autonomous robots that can be used both in the classroom and as a reference for industry professionals. He surveys the hardware implementations of more than 300 current systems, reviews some of their application areas, and examines the underlying technology, including control,

architectures, learning, manipulation, grasping, navigation, and mapping. Living systems can be considered the prototypes of autonomous systems, and Bekey explores the biological inspiration that forms the basis of many recent developments in robotics. He also discusses robot control issues and the design of control architectures. After an overview of the field that introduces some of its fundamental concepts, the book presents background material on hardware, control (from both biological and engineering perspectives), software architecture, and robot intelligence. It then examines a broad range of implementations and applications, including locomotion (wheeled, legged, flying, swimming, and crawling robots), manipulation (both arms and hands), localization, navigation, and mapping. The many case studies and specific applications include robots built for research, industry, and the military, among them underwater robotic vehicles, walking machines with four, six, and eight legs, and the famous humanoid robots Cog, Kismet, ASIMO, and QRIO. The book concludes with reflections on the future of robotics—the potential benefits as well as the possible dangers that may arise from large numbers of increasingly intelligent and autonomous robots. Great interest is now focused on distributed autonomous robotic systems (DARS) as a new strategy for the realization of flexible, robust, and intelligent robots. Inspired by autonomous, decentralized, and self-organizing biological systems, the

field of DARS encompasses broad interdisciplinary technologies related not only to robotics and computer engineering but also to biology and psychology. The rapidly growing interest in this new area of research was manifest in the first volume of Distributed Autonomous Robotic Systems, published in 1994. This second volume in the series presents the most recent work by eminent researchers and includes such topics as multirobot control, distributed robotic systems design, self-organizing systems, and sensing and navigation for cooperative robots. Distributed Autonomous Robotic Systems 2 is a valuable source for those whose work involves robotics and will be of great interest to those in the fields of artificial intelligence, self-organizing systems, artificial life, and computer science.

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