

Multisensor Data Fusion From Algorithms And Architectural Design To Applications Devices Circuits And Systems

The emerging technology of multisensor data fusion has a wide range of applications, both in Department of Defense (DoD) areas and in the civilian arena. The techniques of multisensor data fusion draw from an equally broad range of disciplines, including artificial intelligence, pattern recognition, and statistical estimation. With the rapid evolution of this technology, this textbook provides a comprehensive introduction to the concepts and idea of multisensor data fusion. It is an extensively revised second edition of the author's successful book: "Multi-Sensor Data Fusion: An Introduction" which was originally published by Springer-Verlag in 2007. The main changes in the new book are: New Material: Apart from one new chapter there are approximately 30 new sections, 50 new examples and 100 new references. At the same time, material which is out-of-date has been eliminated and the remaining text has been rewritten for added clarity. Altogether, the new book is nearly 70 pages longer than the original book. Matlab code: Where appropriate we have given details of Matlab code which may be downloaded from the worldwide web. In a few places, where such code is not readily available, we have included Matlab code in the body of the text. Layout. The layout and typography has

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been revised. Examples and Matlab code now appear on a gray background for easy identification and advanced material is marked with an asterisk. The book is intended to be self-contained. No previous knowledge of multi-sensor data fusion is assumed, although some familiarity with the basic tools of linear algebra, calculus and simple probability is recommended. Although conceptually simple, the study of multi-sensor data fusion presents challenges that are unique within the education of the electrical engineer or computer scientist. To become competent in the field the student must become familiar with tools taken from a wide range of diverse subjects including: neural networks, signal processing, statistical estimation, tracking algorithms, computer vision and control theory. All too often, the student views multi-sensor data fusion as a miscellaneous assortment of different processes which bear no relationship to each other. In contrast, in this book the processes are unified by using a common statistical framework. As a consequence, the underlying pattern of relationships that exists between the different methodologies is made evident. The book is illustrated with many real-life examples taken from a diverse range of applications and contains an extensive list of modern references.

This book addresses a key technology for digital information processing: Kalman filtering, which is generally considered to be one of the greatest discoveries of the 20th century. It introduces readers to issues concerning various uncertainties in a single plant, and to corresponding solutions based on adaptive estimation. Further, it

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discusses in detail the issues that arise when Kalman filtering technology is applied in multi-sensor systems and/or multi-agent systems, especially when various sensors are used in systems like intelligent robots, autonomous cars, smart homes, smart buildings, etc., requiring multi-sensor information fusion techniques. Furthermore, when multiple agents (subsystems) interact with one another, it produces coupling uncertainties, a challenging issue that is addressed here with the aid of novel decentralized adaptive filtering techniques. Overall, the book's goal is to provide readers with a comprehensive investigation into the challenging problem of making Kalman filtering work well in the presence of various uncertainties and/or for multiple sensors/components. State-of-art techniques are introduced, together with a wealth of novel findings. As such, it can be a good reference book for researchers whose work involves filtering and applications; yet it can also serve as a postgraduate textbook for students in mathematics, engineering, automation, and related fields. To read this book, only a basic grasp of linear algebra and probability theory is needed, though experience with least squares, navigation, robotics, etc. would definitely be a plus.

This book provides an introductory treatment of the fundamentals of decision-making in a distributed framework. Classical detection theory assumes that complete observations are available at a central processor for decision-making. More recently, many applications have been identified in which observations are processed in a distributed manner and decisions are made at the distributed processors, or processed

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data (compressed observations) are conveyed to a fusion center that makes the global decision. Conventional detection theory has been extended so that it can deal with such distributed detection problems. A unified treatment of recent advances in this new branch of statistical decision theory is presented. Distributed detection under different formulations and for a variety of detection network topologies is discussed. This material is not available in any other book and has appeared relatively recently in technical journals. The level of presentation is such that the book can be used as a graduate-level textbook. Numerous examples are presented throughout the book. It is assumed that the reader has been exposed to detection theory. The book will also serve as a useful reference for practicing engineers and researchers. I have actively pursued research on distributed detection and data fusion over the last decade, which ultimately interested me in writing this book. Many individuals have played a key role in the completion of this book.

Signal Processing is one of the large specializations in electrical engineering, mechanical engineering and computer sciences. It derives input from physics, mathematics and is an indispensable feature of all natural- and life sciences in research and in application. The new series "Advanced Issues on Signals, Systems and Devices" presents original publications mainly from speakers on the International Conferences on Signal Systems and Devices but also from other international authors. The Conference is a forum for researchers and specialists in different fields covering all

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types of sensors and measurement systems as for example: Biomedical and Environmental Measurements & Instrumentation; Optical, Chemical and Biomedical Sensors; Mechanical and Thermal Sensors; Micro-Sensors and MEMS-Technology; Nano Sensors, Nano Systems and Nano Technology; Spectroscopy Methods; Signal Processing and Modelling; Multi Sensor Data Fusion; Data Acquisition & Distributed Measurements; Medical and Environmental Applications; Circuit Test, Device Characterization and Modelling; Custom and Semi-Custom Circuits; Analog Circuit Design; Low-Voltage, Low-Power VLSI Design; Hardware Implementation; Materials, Devices and Interconnects; Packaging and Reliability; Battery Monitoring; Impedance Spectroscopy for Measurement and Sensor Solutions; Energy Harvesting and Wireless power Transfer Systems; Wireless Sensor Networks in Industrial Plants This first volume of the new series mainly devotes to the most recent research and implementation of sensors-, circuit systems in signal processing, energy harvesting, nano- and molecular electronics.

Multisensor data fusion combines data from multiple sensor systems to achieve improved performance and provide more inferences than could be achieved using a single sensor system. One of the most important aspects of data fusion is data association. This dissertation develops new algorithms for data association, including measurement to track association, track to track association and track fusion, in distributed multisensor multitarget environment with overlapping sensor coverage. The

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performance of the proposed algorithms is compared to that of existing techniques. Computational complexity analysis is also presented. Numerical results based on Monte Carlo simulations and real data collected from the United States Coast Guard Vessel Traffic Services system are presented. The results show that the proposed algorithms reduce the computational complexity and achieve considerable performance improvement over those previously reported in the literature.

Combining different perspectives from materials science, engineering, and computer science, this reference provides a unified view of the various aspects necessary for the successful realization of intelligent systems. The editors and authors are from academia and research institutions with close ties to industry, and are thus able to offer first-hand information here. They adopt a unique, three-tiered approach such that readers can gain basic, intermediate, and advanced topical knowledge. The technology section of the book is divided into chapters covering the basics of sensor integration in materials, the challenges associated with this approach, data processing, evaluation, and validation, as well as methods for achieving an autonomous energy supply. The applications part then goes on to showcase typical scenarios where material-integrated intelligent systems are already in use, such as for structural health monitoring and smart textiles.

Fills the Existing Gap of Mathematics for Data Fusion Data fusion (DF) combines large amounts of information from a variety of sources and fuses this data algorithmically,

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logically and, if required intelligently, using artificial intelligence (AI). Also, known as sensor data fusion (SDF), the DF fusion system is an important component for use in various applications that include the monitoring of vehicles, aerospace systems, large-scale structures, and large industrial automation plants. Data Fusion Mathematics: Theory and Practice offers a comprehensive overview of data fusion, and provides a proper and adequate understanding of the basic mathematics directly related to DF. The material covered can be used for evaluation of the performances of any designed and developed DF systems. It tries to answer whether unified data fusion mathematics can evolve from various disparate mathematical concepts, and highlights mathematics that can add credibility to the data fusion process. Focuses on Mathematical Tools That Use Data Fusion This text explores the use of statistical/probabilistic signal/image processing, filtering, component analysis, image algebra, decision making, and neuro-FL-GA paradigms in studying, developing and validating data fusion processes (DFP). It covers major mathematical expressions, and formulae and equations as well as, where feasible, their derivations. It also discusses SDF concepts, DF models and architectures, aspects and methods of type 1 and 2 fuzzy logics, and related practical applications. In addition, the author covers soft computing paradigms that are finding increasing applications in multisensory DF approaches and applications. This book: Explores the use of interval type 2 fuzzy logic and ANFIS in DF Covers the mathematical treatment of many types of filtering algorithms, target-tracking methods,

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and kinematic DF methods Presents single and multi-sensor tracking and fusion mathematics Considers specific DF architectures in the context of decentralized systems Discusses information filtering, Bayesian approaches, several DF rules, image algebra and image fusion, decision fusion, and wireless sensor network (WSN) multimodality fusion Data Fusion Mathematics: Theory and Practice incorporates concepts, processes, methods, and approaches in data fusion that can help you with integrating DF mathematics and achieving higher levels of fusion activity, and clarity of performance. This text is geared toward researchers, scientists, teachers and practicing engineers interested and working in the multisensor data fusion area.

The field of multi-sensor fusion and integration is growing into significance as our society is in transition into ubiquitous computing environments with robotics services everywhere under ambient intelligence. What surround us are to be the networks of sensors and actuators that monitor our environment, health, security and safety, as well as the service robots, intelligent vehicles, and autonomous systems of ever heightened autonomy and dependability with integrated heterogeneous sensors and actuators. The field of multi-sensor fusion and integration plays key role for making the above transition possible by providing fundamental theories and tools for implementation. This volume is an edition of the papers selected from the 7th IEEE International Conference on Multi-Sensor Integration and Fusion, IEEE MFI'08, held in Seoul, Korea, August 20–22, 2008. Only 32 papers out of the 122 papers accepted for IEEE MFI'08 were chosen and requested for revision and extension to be included in this volume. The 32 contributions to this volume are organized into three parts: Part I is dedicated to the

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Theories in Data and Information Fusion, Part II to the Multi-Sensor Fusion and Integration in Robotics and Vision, and Part III to the Applications to Sensor Networks and Ubiquitous Computing Environments. To help readers understand better, a part summary is included in each part as an introduction. The summaries of Parts I, II, and III are prepared respectively by Prof. Hanseok Ko, Prof. Sukhan Lee and Prof. Hernsoo Hahn.

This report presents a two-year LDRD research effort into multisensor data fusion. We approached the problem by addressing the available types of data, preprocessing that data, and developing fusion algorithms using that data. The report reflects these three distinct areas. First, the possible data sets for fusion are identified. Second, automated registration techniques for imagery data are analyzed. Third, two fusion techniques are presented. The first fusion algorithm is based on the two-dimensional discrete wavelet transform. Using test images, the wavelet algorithm is compared against intensity modulation and intensity-hue-saturation image fusion algorithms that are available in commercial software. The wavelet approach outperforms the other two fusion techniques by preserving spectral/spatial information more precisely. The wavelet fusion algorithm was also applied to Landsat Thematic Mapper and SPOT panchromatic imagery data. The second algorithm is based on a linear-regression technique. We analyzed the technique using the same Landsat and SPOT data. Using MATLAB® examples wherever possible, Multi-Sensor Data Fusion with MATLAB explores the three levels of multi-sensor data fusion (MSDF): kinematic-level fusion, including the theory of DF; fuzzy logic and decision fusion; and pixel- and feature-level image fusion. The authors elucidate DF strategies, algorithms, and performance evaluation mainly for aerospace applications, although the methods can also be applied to systems in other areas,

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such as biomedicine, military defense, and environmental engineering. After presenting several useful strategies and algorithms for DF and tracking performance, the book evaluates DF algorithms, software, and systems. It next covers fuzzy logic, fuzzy sets and their properties, fuzzy logic operators, fuzzy propositions/rule-based systems, an inference engine, and defuzzification methods. It develops a new MATLAB graphical user interface for evaluating fuzzy implication functions, before using fuzzy logic to estimate the unknown states of a dynamic system by processing sensor data. The book then employs principal component analysis, spatial frequency, and wavelet-based image fusion algorithms for the fusion of image data from sensors. It also presents procedures for combining tracks obtained from imaging sensor and ground-based radar. The final chapters discuss how DF is applied to mobile intelligent autonomous systems and intelligent monitoring systems. Fusing sensors' data can lead to numerous benefits in a system's performance. Through real-world examples and the evaluation of algorithmic results, this detailed book provides an understanding of MSDF concepts and methods from a practical point of view. Select MATLAB programs are available for download on www.crcpress.com

Information is always required by organizations of coastal states about the movements, identities and intentions of vessels sailing in the waters of interest to them, which may be coastal waters, straits, inland waterways, rivers, lakes or open seas. This interest may stem from defense requirements or from needs for the protection of off-shore resources, enhanced search and rescue services, deterrence of smuggling, drug trafficking and other illegal activities and/or for providing vessel traffic services for safe and efficient navigation and protection of the environment. To meet these needs it is necessary to have a well designed maritime

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surveillance and control system capable of tracking ships and providing other types of information required by a variety of user groups ranging from port authorities, shipping companies, marine exchanges to governments and the military. Principles of Integrated Maritime Surveillance Systems will be of vital interest to anyone responsible for the design, implementation or provision of a well designed maritime surveillance and control system capable of tracking ships and providing navigational and other types of information required for safe navigation and efficient commercial operation. Principles of Integrated Maritime Surveillance Systems is therefore essential to a variety of user groups ranging from port authorities to shipping companies and marine exchanges as well as civil governments and the military.

The limitations of satellites create a large gap in assistive directional technologies, especially indoors. The methods and advances in alternate directional technologies is allowing for new systems to fill the gaps caused by the limitations of GPS systems. Positioning and Navigation in Complex Environments is a critical scholarly resource that examines the methodologies and advances in technologies that allow for indoor navigation. Featuring insight on a broad scope of topics, such as multipath mitigation, Global Navigation Satellite System (GNSS), and multi-sensor integration, this book is directed toward data scientists, engineers, government agencies, researchers, and graduate-level students.

Since the publication of the first edition of this book, advances in algorithms, logic and software tools have transformed the field of data fusion. The latest edition covers these areas as well as smart agents, human computer interaction, cognitive aides to analysis and data system fusion control. data fusion system, this book guides you through the process of determining the trade-

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offs among competing data fusion algorithms, selecting commercial off-the-shelf (COTS) tools, and understanding when data fusion improves systems processing. Completely new chapters in this second edition explain data fusion system control, DARPA's recently developed TRIP model, and the latest applications of data fusion in data warehousing and medical equipment, as well as defence systems.

For some time, all branches of the military have used a wide range of sensors to provide data for many purposes, including surveillance, reconnoitring, target detection and battle damage assessment. Many nations have also attempted to utilise these sensors for civilian applications, such as crop monitoring, agricultural disease tracking, environmental diagnostics, cartography, ocean temperature profiling, urban planning, and the characterisation of the Ozone Hole above Antarctica. The recent convergence of several important technologies has made possible new, advanced, high performance, sensor based applications relying on the near-simultaneous fusion of data from an ensemble of different types of sensors. The book examines the underlying principles of sensor operation and data fusion, the techniques and technologies that enable the process, including the operation of 'fusion engines'. Fundamental theory and the enabling technologies of data fusion are presented in a systematic and accessible manner. Applications are discussed in the areas of medicine, meteorology, BDA and targeting, transportation, cartography, the environment, agriculture, and manufacturing and process control.

This textbook provides a comprehensive introduction to the theories and techniques of multi-sensor data fusion. It is aimed at advanced undergraduate and first-year graduate students in electrical engineering and computer science, as well as researchers and professional

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engineers. The book is intended to be self-contained. No previous knowledge of multi-sensor data fusion is assumed, although some familiarity with the basic tools of linear algebra, calculus and simple probability theory is recommended.

This book establishes the fundamentals (particularly definitions and architectures) in data fusion. The second part of the book is devoted to methods for the fusion of images. It offers an in-depth presentation of standard and advanced methods for the fusion of multi-modality images.

Multisensor Data Fusion From Algorithms and Architectural Design to Applications
CRC Press

Combining versatile data sets from multiple satellite sensors with advanced thematic information retrieval is a powerful way for studying complex earth systems. The book Multisensor Data Fusion and Machine Learning for Environmental Remote Sensing offers complete understanding of the basic scientific principles needed to perform image processing, gap filling, data merging, data fusion, machine learning, and feature extraction. Written by two experts in remote sensing, the book presents the required basic concepts, tools, algorithms, platforms, and technology hubs toward advanced integration. By merging and fusing data sets collected from different satellite sensors with common features, we are enabled to utilize the strength of each satellite sensor to the maximum extent. The inclusion of machine learning or data mining techniques to aid in feature extraction after gap filling, data merging and/or data fusion further

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empowers earth observation, leading to confirm the whole is greater than the sum of its parts. Contemporary applications discussed in this book make all essential knowledge seamlessly integrated by an interdisciplinary manner. These case-based engineering practices uniquely illustrate how to improve such an emerging field of importance to cope with the most challenging real-world environmental monitoring issues.

This thesis effort develops a data fusion process for laser radar and forward looking infrared sensors. The process contains an algorithm which segments man-made objects away from a variety of backgrounds. Importantly, the segmentation algorithm does not use pre-stored templates. Other algorithms within the process also enhance and extract target features from both laser radar and infrared images. The overall process provides target details which were not easily found in either one of the two sensors by themselves. Furthermore, key algorithms within the overall process have possible optical implementations.

The purpose of this book is to provide an overview of basic image fusion techniques and serve as an introduction to image fusion applications in variant fields. It is anticipated that it will be useful for research scientists to capture recent developments and to spark new ideas within the image fusion domain. With an emphasis on both the basic and advanced applications of image fusion, this 12-chapter book covers a number of unique concepts that have been graphically represented throughout to enhance readability, such as the wavelet-based image fusion introduced in chapter 2

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and the 3D fusion that is proposed in Chapter 5. The remainder of the book focuses on the area application-orientated image fusions, which cover the areas of medical applications, remote sensing and GIS, material analysis, face detection, and plant water stress analysis.

This volume contains revised papers based on contributions to the NATO Advanced Research Workshop on Multisensor Fusion for Computer Vision, held in Grenoble, France, in June 1989. The 24 papers presented here cover a broad range of topics, including the principles and issues in multisensor fusion, information fusion for navigation, multisensor fusion for object recognition, network approaches to multisensor fusion, computer architectures for multi sensor fusion, and applications of multisensor fusion. The participants met in the beautiful surroundings of Mont Belledonne in Grenoble to discuss their current work in a setting conducive to interaction and the exchange of ideas. Each participant is a recognized leader in his or her area in the academic, governmental, or industrial research community. The workshop focused on techniques for the fusion or integration of sensor information to achieve the optimum interpretation of a scene. Several participants presented novel points of view on the integration of information. The 24 papers presented in this volume are based on those collected by the editor after the workshop, and reflect various aspects of our discussions. The papers are organized into five parts, as follows.

This book is a printed edition of the Special Issue "Advances in Multi-Sensor

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Information Fusion: Theory and Applications 2017" that was published in Sensors This book illustrates the benefits of sensor fusion by considering the characteristics of infrared, microwave, and millimeter-wave sensors, including the influence of the atmosphere on their performance. Applications that benefit from this technology include: vehicular traffic management, remote sensing, target classification and tracking- weather forecasting- military and homeland defense. Covering data fusion algorithms in detail, Klein includes a summary of the information required to implement each of the algorithms discussed, and outlines system application scenarios that may limit sensor size but that require high resolution data.

This article discusses the elementary theory and method of condition monitoring and fault diagnosis in complex mechanical systems, using multisensor data fusion and integration technology. The basic concept of decision-layer multi-sensor data fusion, i.e., Dempster-Shafer evidence theory, is concisely described. The algorithms and implementation of decision-layer data fusion for condition monitoring and fault diagnosis, based on Dempster-Shafer evidence theory, are studied. We present an approach to diagnose multiple faults of a working diesel engine, based on the above algorithms. The analysis results show that this approach effectively improves the accuracy and reliability of fault diagnosis of the diesel engine.

In the years since the bestselling first edition, fusion research and applications have adapted to service-oriented architectures and pushed the boundaries of situational

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modeling in human behavior, expanding into fields such as chemical and biological sensing, crisis management, and intelligent buildings. Handbook of Multisensor Data Fusion: Theory and Practice, Second Edition represents the most current concepts and theory as information fusion expands into the realm of network-centric architectures. It reflects new developments in distributed and detection fusion, situation and impact awareness in complex applications, and human cognitive concepts. With contributions from the world's leading fusion experts, this second edition expands to 31 chapters covering the fundamental theory and cutting-edge developments that are driving this field. New to the Second Edition—

- Applications in electromagnetic systems and chemical and biological sensors
- Army command and combat identification techniques
- Techniques for automated reasoning
- Advances in Kalman filtering
- Fusion in a network centric environment
- Service-oriented architecture concepts
- Intelligent agents for improved decision making
- Commercial off-the-shelf (COTS) software tools

From basic information to state-of-the-art theories, this second edition continues to be a unique, comprehensive, and up-to-date resource for data fusion systems designers. Image Fusion is an important branch of information fusion, and it is also an important technology for image understanding and computer vision. The fusion process is to merging different images into one to get more accurate description for the scene. The original images for image fusion are always obtained by several different image sensors, or the same sensor in different operating modes. The fused image can provide

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more effective information for further image processing, such as image segmentation, object detection and recognition. Image fusion is a new study field which combined with many different disciplines, such as sensors, signal processing, image processing, computer and artificial intelligence. In the past two decades, a large number of research literatures appear. This book is edited based on these research results, and many research scholars give a great help to this book.

Understand multi-sensor fusion--the most sophisticated way to deliver accurate real-world data to computer systems. Applications include aviation, medicine, military, manufacturing, and transportation. The Sensor Fusion Toolkit on disk contains C programs discussed in the book and supports each section.

Intelligent Data Mining and Fusion Systems in Agriculture presents methods of computational intelligence and data fusion that have applications in agriculture for the non-destructive testing of agricultural products and crop condition monitoring. Sections cover the combination of sensors with artificial intelligence architectures in precision agriculture, including algorithms, bio-inspired hierarchical neural maps, and novelty detection algorithms capable of detecting sudden changes in different conditions. This book offers advanced students and entry-level professionals in agricultural science and engineering, geography and geoinformation science an in-depth overview of the connection between decision-making in agricultural operations and the decision support features offered by advanced computational intelligence algorithms. Covers crop

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protection, automation in agriculture, artificial intelligence in agriculture, sensing and Internet of Things (IoT) in agriculture Addresses AI use in weed management, disease detection, yield prediction and crop production Utilizes case studies to provide real-world insights and direction

This book focuses on the basic theory and methods of multisensor data fusion state estimation and its application. It consists of four parts with 12 chapters. In Part I, the basic framework and methods of multisensor optimal estimation and the basic concepts of Kalman filtering are briefly and systematically introduced. In Part II, the data fusion state estimation algorithms under networked environment are introduced. Part III consists of three chapters, in which the fusion estimation algorithms under event-triggered mechanisms are introduced. Part IV consists of two chapters, in which fusion estimation for systems with non-Gaussian but heavy-tailed noises are introduced. The book is primarily intended for researchers and engineers in the field of data fusion and state estimation. It also benefits for both graduate and undergraduate students who are interested in target tracking, navigation, networked control, etc.

Probability as an Alternative to Boolean Logic While logic is the mathematical foundation of rational reasoning and the fundamental principle of computing, it is restricted to problems where information is both complete and certain. However, many real-world problems, from financial investments to email filtering, are incomplete or uncertain in nature

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Multisensor Data Fusion: From Algorithms and Architectural Design to Applications covers the contemporary theory and practice of multisensor data fusion, from fundamental concepts to cutting-edge techniques drawn from a broad array of disciplines. Featuring contributions from the world's leading data fusion researchers and academicians, this authoritative book: Presents state-of-the-art advances in the design of multisensor data fusion algorithms, addressing issues related to the nature, location, and computational ability of the sensors Describes new materials and achievements in optimal fusion and multisensor filters Discusses the advantages and challenges associated with multisensor data fusion, from extended spatial and temporal coverage to imperfection and diversity in sensor technologies Explores the topology, communication structure, computational resources, fusion level, goals, and optimization of multisensor data fusion system architectures Showcases applications of multisensor data fusion in fields such as medicine, transportation's traffic, defense, and navigation Multisensor Data Fusion: From Algorithms and Architectural Design to Applications is a robust collection of modern multisensor data fusion methodologies. The book instills a deeper understanding of the basics of multisensor data fusion as well as a practical knowledge of the problems that can be faced during its execution.

The security of the U.S. commercial aviation system has been a growing concern since the 1970's when the hijacking of aircraft became a serious problem. Over that period, federal aviation officials have been searching for more effective ways for non-invasive screening of

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passengers, luggage, and cargo to detect concealed explosives and weapons. To assist in this effort, the Transportation Security Administration (TSA) asked the NRC for a study of emerging screening technologies. This book - the fourth of four - focuses on data fusion as a means to significantly improve the ability of the existing suite of airport detection systems and access control systems to detect and prevent attacks. The book presents a discussion of the data fusion, an analysis of current data fusion efforts, and an assessment of data fusion opportunities for various airport security activities.

Taking another lesson from nature, the latest advances in image processing technology seek to combine image data from several diverse types of sensors in order to obtain a more accurate view of the scene: very much the same as we rely on our five senses. Multi-Sensor Image Fusion and Its Applications is the first text dedicated to the theory and practice of the registration and fusion of image data, covering such approaches as statistical methods, color-related techniques, model-based methods, and visual information display strategies. After a review of state-of-the-art image fusion techniques, the book provides an overview of fusion algorithms and fusion performance evaluation. The following chapters explore recent progress and practical applications of the proposed techniques to solving problems in such areas as medical diagnosis, surveillance and biometric systems, remote sensing, nondestructive evaluation, blurred image restoration, and image quality assessment. Recognized leaders from industry and academia contribute the chapters, reflecting the latest research trends and providing useful algorithms to aid implementation. Supplying a 28-page full-color insert, Multi-Sensor Image Fusion and Its Applications clearly demonstrates the benefits and possibilities of this revolutionary development. It provides a solid knowledge base for applying these cutting-

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edge techniques to new challenges and creating future advances.

The second edition of this handbook provides a state-of-the-art cover view on the various aspects in the rapidly developing field of robotics. Reaching for the human frontier, robotics is vigorously engaged in the growing challenges of new emerging domains. Interacting, exploring, and working with humans, the new generation of robots will increasingly touch people and their lives. The credible prospect of practical robots among humans is the result of the scientific endeavour of a half a century of robotic developments that established robotics as a modern scientific discipline. The ongoing vibrant expansion and strong growth of the field during the last decade has fueled this second edition of the Springer Handbook of Robotics. The first edition of the handbook soon became a landmark in robotics publishing and won the American Association of Publishers PROSE Award for Excellence in Physical Sciences & Mathematics as well as the organization's Award for Engineering & Technology. The second edition of the handbook, edited by two internationally renowned scientists with the support of an outstanding team of seven part editors and more than 200 authors, continues to be an authoritative reference for robotics researchers, newcomers to the field, and scholars from related disciplines. The contents have been restructured to achieve four main objectives: the enlargement of foundational topics for robotics, the enlightenment of design of various types of robotic systems, the extension of the treatment on robots moving in the environment, and the enrichment of advanced robotics applications. Further to an extensive update, fifteen new chapters have been introduced on emerging topics, and a new generation of authors have joined the handbook's team. A novel addition to the second edition is a comprehensive collection of multimedia references to more than 700 videos, which bring valuable insight into

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the contents. The videos can be viewed directly augmented into the text with a smartphone or tablet using a unique and specially designed app. Springer Handbook of Robotics Multimedia Extension Portal: <http://handbookofrobotics.org/>

The last decade has witnessed a rapid surge of interest in new sensing and monitoring devices for wellbeing and healthcare. One key development in this area is wireless, wearable and implantable in vivo monitoring and intervention. A myriad of platforms are now available from both academic institutions and commercial organisations. They permit the management of patients with both acute and chronic symptoms, including diabetes, cardiovascular diseases, treatment of epilepsy and other debilitating neurological disorders. Despite extensive developments in sensing technologies, there are significant research issues related to system integration, sensor miniaturisation, low-power sensor interface, wireless telemetry and signal processing. In the 2nd edition of this popular and authoritative reference on Body Sensor Networks (BSN), major topics related to the latest technological developments and potential clinical applications are discussed, with contents covering. Biosensor Design, Interfacing and Nanotechnology Wireless Communication and Network Topologies Communication Protocols and Standards Energy Harvesting and Power Delivery Ultra-low Power Bio-inspired Processing Multi-sensor Fusion and Context Aware Sensing Autonomic Sensing Wearable, Ingestible Sensor Integration and Exemplar Applications System Integration and Wireless Sensor Microsystems The book also provides a comprehensive review of the current wireless sensor development platforms and a step-by-step guide to developing your own BSN applications through the use of the BSN development kit.

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