# Handbook Of Multisensor Data Fusion Theory And Practice Second Edition Electrical Engineering Applied Signal Processing Series

Data compression is one of the main contributing factors in the explosive growth in information technology. Without it, a number of consumer and commercial products, such as DVD, videophone, digital camera, MP3, video-streaming and wireless PCS, would have been virtually impossible. Transforming the data to a frequency or other domain enables even more efficient compression. By illustrating this intimate link, The Transform and Data Compression Handbook serves as a much-needed handbook for a wide range of researchers and engineers. The authors describe various discrete transforms and their applications in different disciplines. They cover techniques, such as adaptive quantization and entropy coding, that result in significant reduction in bit rates when applied to the transform coefficients. With clear and concise presentations of the ideas and concepts, as well as detailed descriptions of the algorithms, the authors provide important insight into the applications and their limitations. Data compression is an essential step towards the efficient storage and transmission of information. The Transform and Data Compression Handbook provides a wealth of information regarding different discrete transforms and demonstrates their power and practicality in data compression.

Handbook of Multisensor Data FusionTheory and Practice, Second EditionCRC Press
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 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 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 evolut
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.

These proceedings address the latest developments in information communication and technologies for geo-engineering. The 3rd International Conference on Information Technology in Geo-Engineering (ICITG 2019), held in Guimarães, Portugal, follows the previous successful installments of this conference series in Durham (2014) and Shanghai (2010). The respective chapters cover the following: Use of information and communications technologies Big data and databases Data mining and data science Imaging technologies Building information modelling applied to geo-structures Artificial intelligence Smart geomaterials and intelligent construction Sensors and monitoring Asset management Case studies on design, construction and maintenance Given its broad range of coverage, the book will benefit students, educators, researchers and professional practitioners alike, encouraging these readers to help take the geo-engineering community into the digital age

The sheer quantity of widely diverse data which now results from multiple sources presents a problem for decision-makers and analysts, who are finding it impossible to cope with the ever-increasing flow of material. This has potentially serious consequences for the quality of decisions and operational processes in areas such as counterterrorism and security. This book presents the papers delivered at the NATO Advanced Research Workshop (ARW) 'Meeting Security Challenges through Data Analytics and Decision Support', held in Aghveran, Armenia, in June 2015. The aim of the conference was to promote and enhance cooperation and dialogue between NATO and Partner countries on the subject of effective decision support for security applications. The attendance of many leading scientists from a variety of backgrounds and disciplines provided the opportunity to improve mutual understanding, as well as cognizance of the specific requirements and issues of Cyber Physical Social Systems (CPPS) and the technical advances pertinent to all collaborative human-centric information support systems in a variety of applications. The book is divided into 3 sections: counter terrorism: methodology and applications; maritime and border security; and cyber security, and will be of interest to all those involved in decision-making processes based on the analysis of big data.

There has been an increasing interest in multi-disciplinary research on multisensor attitude estimation technology driven by its versatility and diverse areas of application, such as sensor networks, robotics, navigation, video, biomedicine, etc. Attitude estimation consists of the determination of rigid bodies' orientation in 3D space. This research area is a multilevel, multifaceted process handling the automatic association, correlation, estimation, and combination of data and information from several sources. Data fusion for attitude estimation is motivated by several issues and problems, such as data imperfection, data multi-modality, data dimensionality, processing framework, etc. While many of these problems have been identified and heavily investigated, no single data fusion algorithm is capable of addressing all the aforementioned challenges. The

variety of methods in the literature focus on a subset of these issues to solve, which would be determined based on the application in hand. Historically, the problem of attitude estimation has been introduced by Grace Wahba in 1965 within the estimate of satellite attitude and aerospace applications. This book intends to provide the reader with both a generic and comprehensive view of contemporary data fusion methodologies for attitude estimation, as well as the most recent researches and novel advances on multisensor attitude estimation task. It explores the design of algorithms and architectures, benefits, and challenging aspects, as well as a broad array of disciplines, including: navigation, robotics, biomedicine, motion analysis, etc. A number of issues that make data fusion for attitude estimation a challenging task, and which will be discussed through the different chapters of the book, are related to: 1) The nature of sensors and information sources (accelerometer, gyroscope, magnetometer, GPS, inclinometer, etc.); 2) The computational ability at the sensors; 3) The theoretical developments and convergence proofs; 4) The system architecture, computational resources, fusion level.

Expert coverage of the design and implementation of stateestimation algorithms for tracking and navigation Estimation with Applications to Tracking and Navigationtreats the estimation of various quantities from inherentlyinaccurate remote observations. It explains state estimator designusing a balanced combination of linear systems, probability, andstatistics. The authors provide a review of the necessary backgroundmathematical techniques and offer an overview of the basic conceptsin estimation. They then provide detailed treatments of all themajor issues in estimation with a focus on applying thesetechniques to real systems. Other features include: Problems that apply theoretical material to real-worldapplications In-depth coverage of the Interacting Multiple Model (IMM)estimator Companion DynaEst(TM) software for MATLAB(TM) implementation ofKalman filters and IMM estimators Design guidelines for tracking filters Suitable for graduate engineering students and engineers workingin remote sensors and tracking, Estimation with Applications toTracking and Navigation provides expert coverage of thisimportant area.

With the recent proliferation of service-oriented architectures (SOA), cloud computing technologies, and distributed-interconnected systems, distributed fusion is taking on a larger role in a variety of applications—from environmental monitoring and crisis management to intelligent buildings and defense. Drawing on the work of leading experts around the world, Distributed Data Fusion for Network-Centric Operations examines the state of the art of data fusion in a distributed sensing, communications, and computing environment. Get Insight into Designing and Implementing Data Fusion in a Distributed Network Addressing the entirety of information fusion, the contributors cover everything from signal and image processing, through estimation, to situation awareness. In particular, the work offers a timely look at the issues and solutions involving fusion within a distributed network enterprise. These include critical design problems, such as how to maintain a pedigree of agents or nodes that receive information, provide their contribution to the dataset, and pass to other network

components. The book also tackles dynamic data sharing within a network-centric enterprise, distributed fusion effects on state estimation, graph-theoretic methods to optimize fusion performance, human engineering factors, and computer ontologies for higher levels of situation assessment. A comprehensive introduction to this emerging field and its challenges, the book explores how data fusion can be used within grid, distributed, and cloud computing architectures. Bringing together both theoretical and applied research perspectives, this is a valuable reference for fusion researchers and practitioners. It offers guidance and insight for those working on the complex issues of designing and implementing distributed, decentralized information fusion.

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 computers and the maturation of data fusion technology, the door to using data fusion in everyday applications is now wide open and presenting great opportunities. The Handbook of Multisensor Data Fusion provides a unique, comprehensive, and up-to-date resource for data fusion systems designers and researchers. Divided into five parts, it: offers a thorough introduction to data fusion terminology and models describes advanced techniques for data association, target tracking, and identification presents practical information on system development, including requirements analysis, systems engineering, algorithm selection, database design, human-computer interfaces, and performance assessment introduces applications from the DoD, NASA, DARPA, and condition-based monitoring of complex machinery supplies data fusion resources and Web sites The contributing authors are all recognized leaders in data fusion and have collaborated to provide what promises to be the definitive reference for this rapidly developing field. Whether you are a researcher, system designer, implementer, or student, in the Handbook of Multisensor Data Fusion you'll find everything you need, from a basic introduction and survey of data fusion technology to advanced mathematics and theory, including very practical advice on data fusion system development and implementation.

This volume contains the papers presented at the International Workshop "Information Fusion and Geographic Information Systems" (IF&GIS'09) held in St. Petersburg, Russia in May 2009. The workshop was organized by the St. Petersburg Institute for Informatics and Automation of the Russian Academy of Sciences (SPIIRAS). The workshop continues a series organised biannually, and attracts academics and industrials from a wide range of disciplines including computer science, geography, statistics, mathematics, hydrography, geomorphology, and environmental sciences. The objective of this workshop is to provide a forum for innovative research oriented towards Geographic Information Science and tech- logies and Corporate Information Systems whose close

association highlight novel theoretical and practical challenges. The papers selected by the International Program Committee cover a wide range of innovative areas including ontological and semantic approaches for the representation of geographical data, geographical data monitoring, situation management and forecast, to emerging applications oriented to the maritime environment, disaster management and security threats. While traditional topics of GIS conferences are well represented and still being advanced, several new domains appear and stress the need for the development of versatile monitoring systems and decision making systems. While GIS already have a de facto standard for geographical monitoring and analysis, the papers accepted in this volume also illustrate several novel directions of application whose objective is more closely oriented to process modeling and decision making, and where the nature of the objects represented is revisited using ontological and semantic approaches.

The second edition of this handbook provides a state-of-the-art overview 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 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/

Data Fusion and Data Mining for Power System Monitoring provides a

comprehensive treatment of advanced data fusion and data mining techniques for power system monitoring with focus on use of synchronized phasor networks. Relevant statistical data mining techniques are given, and efficient methods to cluster and visualize data collected from multiple sensors are discussed. Both linear and nonlinear data-driven mining and fusion techniques are reviewed, with emphasis on the analysis and visualization of massive distributed data sets. Challenges involved in realistic monitoring, visualization, and analysis of observation data from actual events are also emphasized, supported by examples of relevant applications. Features Focuses on systematic illustration of data mining and fusion in power systems Covers issues of standards used in the power industry for data mining and data analytics Applications to a wide range of power networks are provided including distribution and transmission networks Provides holistic approach to the problem of data mining and data fusion using cutting-edge methodologies and technologies Includes applications to massive spatiotemporal data from simulations and actual events

The implementation of wireless sensor networks has wide-ranging applications for monitoring various physical and environmental settings. However, certain limitations with these technologies must be addressed in order to effectively utilize them. The Handbook of Research on Advanced Wireless Sensor Network Applications, Protocols, and Architectures is a pivotal reference source for the latest research on recent innovations and developments in the field of wireless sensors. Examining the advantages and challenges presented by the application of these networks in various areas, this book is ideally designed for academics, researchers, students, and IT developers.

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-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.

Using the same strategy for the needs of image processing and pattern recognition, scientists and researchers have turned to computational intelligence for better research throughputs and end results applied towards engineering, science, business and financial applications. Handbook of Research on Computational Intelligence for Engineering, Science, and Business discusses the computation intelligence approaches, initiatives and applications in the engineering, science and business fields. This reference aims to highlight computational intelligence as no longer limited to computing-related disciplines and can be applied to any effort which handles complex and meaningful information. The Industrial Information Technology Handbook focuses on existing and emerging industrial

applications of IT, and on evolving trends that are driven by the needs of companies and by industry-led consortia and organizations. Emphasizing fast growing areas that have major impacts on industrial automation and enterprise integration, the Handbook covers topics such as industrial communication technology, sensors, and embedded systems. The book is organized into two parts. Part 1 presents material covering new and quickly evolving aspects of IT. Part 2 introduces cutting-edge areas of industrial IT. The Handbook presents material in the form of tutorials, surveys, and technology overviews, combining fundamentals and advanced issues, with articles grouped into sections for a cohesive and comprehensive presentation. The text contains 112 contributed reports by industry experts from government, companies at the forefront of development, and some of the most renowned academic and research institutions worldwide. Several of the reports on recent developments, actual deployments, and trends cover subject matter presented to the public for the first time.

Improvements in process control, such as defined-accuracy instrumentation structures and computationally intelligent process modeling, enable advanced capabilities such as molecular manufacturing. High Performance Instrumentation and Automation demonstrates how systematizing the design of instrumentation and automation leads to higher performance through more homogeneous systems, which are frequently assisted by rule-based, fuzzy logic, and neural network process descriptions. Incorporate Advanced Performance Enhancements into Your Automation Enterprise The book illustrates generic common core process-to-control concurrent engineering linkages applied to a variety of laboratory and industry automation systems. It outlines: Product properties translated into realizable process variables Axiomatic decoupling of subprocess variables for improved robustness Production planner model-driven goal state execution In situ sensor and control structures for attenuating process disorder Apparatus tolerance design for minimizing process variabilities Production planner remodeling based on product features measurement for quality advancement Coverage also includes multisensor data fusion, high-performance computer I/O design guided by comprehensive error modeling, multiple sensor algorithmic error propagation, robotic axes volumetric accuracy, quantitative video digitization and reconstruction evaluation, and in situ process measurement methods. High Performance Instrumentation and Automation reflects the experience of engineer and author Patrick Garrett, including his role as co-principal investigator for an Air Force intelligent manufacturing initiative. You can download Analysis Suite.xls,, computer-aided design instrumentation software, available in the book's description on the CRC Press website.

This book is a printed edition of the Special Issue "Advances in Multi-Sensor Information Fusion: Theory and Applications 2017" that was published in Sensors

This IMA Volume in Mathematics and its Applications RANDOM SETS: THEORY AND APPLICATIONS is based on the proceedings of a very successful 1996 three-day Summer Program on "Application and Theory of Random Sets." We would like to thank the scientific organizers: John Goutsias (Johns Hopkins University), Ronald P.S. Mahler (Lockheed Martin), and Hung T. Nguyen (New Mexico State University) for their excellent work as organizers of the meeting and for editing the proceedings. We also take this opportunity to thank the Army Research Office (ARO), the Office ofNaval Research (0NR), and the Eagan, MinnesotaEngineering Center ofLockheed Martin Tactical Defense Systems, whose financial support made the summer program possible. Avner Friedman Robert Gulliver v PREFACE "Later generations will regard set theory as a disease from which one has recovered. " - Henri Poincare Random set theory was independently conceived by D.G. Kendall and G. Matheron in connection with stochastic geometry. It was however G.

With the science of robotics undergoing a major transformation just now, Springer's new, authoritative handbook on the subject couldn't have come at a better time. Having broken free from its origins in industry, robotics has been rapidly expanding into the challenging terrain of

unstructured environments. Unlike other handbooks that focus on industrial applications, the Springer Handbook of Robotics incorporates these new developments. Just like all Springer Handbooks, it is utterly comprehensive, edited by internationally renowned experts, and replete with contributions from leading researchers from around the world. The handbook is an ideal resource for robotics experts but also for people new to this expanding field.

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.

A rigorous introduction to the theory and applications of state estimation and association, an important area in aerospace, electronics, and defense industries. Applied state estimation and association is an important area for practicing engineers in aerospace, electronics, and defense industries, used in such tasks as signal processing, tracking, and navigation. This book offers a rigorous introduction to both theory and application of state estimation and association. It takes a unified approach to problem formulation and solution development that helps students and junior engineers build a sound theoretical foundation for their work and develop skills and tools for practical applications. Chapters 1 through 6 focus on solving the problem of estimation with a single sensor observing a single object, and cover such topics as parameter estimation, state estimation for linear and nonlinear systems, and multiple model estimation algorithms. Chapters 7 through 10 expand the discussion to consider multiple sensors and multiple objects. The book can be used in a first-year graduate course in control or system engineering or as a reference for professionals. Each chapter ends with problems that will help readers to develop derivation skills that can be applied to new problems and to build computer models that offer a useful set of tools for problem solving. Readers must be familiar with state-variable representation of systems and basic probability theory including random and stochastic processes.

Information fusion resulting from multi-source processing, often called multisensor data fusion when sensors are the main sources of information, is a relatively young (less than 20 years) technology domain. It provides techniques and methods for: Integrating data from multiple sources and using the complementarity of this data to derive maximum information about the phenomenon being observed; Analyzing and deriving the meaning of these observations; Selecting the best course of action; and Controlling the actions. Various sensors have been designed to detect some specific phenomena, but not others. Data fusion applications can combine synergically information from many sensors, including data provided by satellites and contextual and encyclopedic knowledge, to provide enhanced ability to detect and recognize anomalies in the environment, compared with conventional means. Data fusion is an integral part of multisensor processing, but it can also be applied to fuse non-sensor information (geopolitical, intelligence, etc.) to provide decision support for a timely and effective situation and threat assessment. One special field of application for data fusion is satellite imagery, which can provide extensive information over a wide area of the electromagnetic spectrum using several types of sensors (Visible, Infra-Red (IR), Thermal IR, Radar, Synthetic Aperture Radar (SAR), Polarimetric SAR (PolSAR), Hyperspectral...). Satellite imagery provides the coverage rate needed to identify and monitor human activities from agricultural practices (land use, crop types identification...) to defence-related surveillance (land/sea target detection and classification). By acquiring remotely sensed imagery over earth regions that land sensors cannot access, valuable information can be gathered for the defence against

terrorism. This books deals with the following research areas: Target recognition/classification and tracking; Sensor systems; Image processing; Remote sensing and remote control; Belief functions theory; and Situation assessment. 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, 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 combing 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 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 been revised. Examples and Matlab code now appear on a gray background for easy identification and advancd 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 familarity with the basic tools of linear algebra, calculus and simple probability is recommended. Although conceptually simple, the study of mult-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.

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.

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 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. Information fusion refers to the merging of information from disparate sources with differing conceptual, contextual and typographical representations. Rather than focusing on traditional data fusion applications which have been mainly concerned with physical military targets, this unique resource explores new human-centered trends, such as locations, identity, and interactions of individuals and groups (social networks). Moreover, the book discusses two new major sources of information: human observations and web-based information.This cutting-edge volume presents a new view of multi-sensor data fusion that seeks to address these new developments, explicitly considering the active role of a human user/analyst. Professionals become knowledgeable about the key inputs into this innovative information fusion process, including traditional sensing resources (S-space), dynamic communities of human observers (H-space), and resources such as archived sensor data, blogs, and dynamic news reports from citizen reporters via the Internet (I-space).

This book is concerned with important problems of robust (stable) statistical pat tern recognition when hypothetical model assumptions about experimental data are violated (disturbed). Pattern recognition theory is the field of applied mathematics in which prin ciples and methods are constructed for classification and identification of objects, phenomena, processes, situations, and signals, i. e. , of objects that can be specified

by a finite set of features, or properties characterizing the objects (Mathematical Encyclopedia (1984)). Two stages in development of the mathematical theory of pattern recognition may be observed. At the first stage, until the middle of the 1970s, pattern recogni tion theory was replenished mainly from adjacent mathematical disciplines: mathe matical statistics, functional analysis, discrete mathematics, and information theory. This development stage is characterized by successful solution of pattern recognition problems of different physical nature, but of the simplest form in the sense of used mathematical models. One of the main approaches to solve pattern recognition problems is the statisti cal approach, which uses stochastic models of feature variables. Under the statistical approach, the first stage of pattern recognition theory development is characterized by the assumption that the probability data model is known exactly or it is esti mated from a representative sample of large size with negligible estimation errors (Das Gupta, 1973, 1977), (Rey, 1978), (Vasiljev, 1983)).

In two editions spanning more than a decade, The Electrical Engineering Handbook stands as the definitive reference to the multidisciplinary field of electrical engineering. Our knowledge continues to grow, and so does the Handbook. For the third edition, it has expanded into a set of six books carefully focused on a specialized area or field of study. Each book represents a concise yet definitive collection of key concepts, models, and equations in its respective domain, thoughtfully gathered for convenient access. Sensors, Nanoscience, Biomedical Engineering, and Instruments provides thorough coverage of sensors, materials and nanoscience, instruments and measurements, and biomedical systems and devices, including all of the basic information required to thoroughly understand each area. It explores the emerging fields of sensors, nanotechnologies, and biological effects. Each article includes defining terms, references, and sources of further information. Encompassing the work of the world's foremost experts in their respective specialties, Sensors, Nanoscience, Biomedical Engineering, and Instruments features the latest developments, the broadest scope of coverage, and new material on multisensor data fusion and MEMS and NEMS. In the years since the bestselling first edition, fusion research and applications have adapted to service-oriented architectures and pushed the boundaries of situational 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. 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 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.

In the years since the bestselling first edition, fusion research and applications have adapted to service-oriented architectures and pushed the boundaries of situational 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. 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-edge techniques to new challenges and creating future advances.

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