

# **Industrial Wireless Sensor Networks**

APPLICATIONS, PROTOCOLS, AND STANDARDS



E D I T E D   B Y

**V. Çağrı Güngör and Gerhard P. Hancke**



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# Industrial Wireless Sensor Networks Applications Protocols And Standards Industrial Electronics

**Guillaume Favre**

A decorative graphic element consisting of a light blue horizontal bar with a rounded right end, and a red circular gradient shape partially visible behind it.

## **Industrial Wireless Sensor Networks Applications Protocols And Standards Industrial Electronics:**

Industrial Wireless Sensor Networks V. Çağrı Güngör, Gerhard P. Hancke, 2017-12-19 The collaborative nature of industrial wireless sensor networks IWSNs brings several advantages over traditional wired industrial monitoring and control systems including self organization rapid deployment flexibility and inherent intelligent processing In this regard IWSNs play a vital role in creating more reliable efficient and productive industrial systems thus improving companies competitiveness in the marketplace *Industrial Wireless Sensor Networks Applications Protocols and Standards* examines the current state of the art in industrial wireless sensor networks and outlines future directions for research *What Are the Main Challenges in Developing IWSN Systems* Featuring contributions by researchers around the world this book explores the software and hardware platforms protocols and standards that are needed to address the unique challenges posed by IWSN systems It offers an in depth review of emerging and already deployed IWSN applications and technologies and outlines technical issues and design objectives In particular the book covers radio technologies energy harvesting techniques and network and resource management It also discusses issues critical to industrial applications such as latency fault tolerance synchronization real time constraints network security and cross layer design A chapter on standards highlights the need for specific wireless communication standards for industrial applications *A Starting Point for Further Research* Delving into wireless sensor networks from an industrial perspective this comprehensive work provides readers with a better understanding of the potential advantages and research challenges of IWSN applications A contemporary reference for anyone working at the cutting edge of industrial automation communication systems and networks it will inspire further exploration in this promising research area

**Industrial Wireless Sensor Networks** Seong-eun Yoo, Taehong Kim, 2020-12-07 Wireless sensor networks are penetrating our daily lives and they are starting to be deployed even in an industrial environment The research on such industrial wireless sensor networks IWSNs considers more stringent requirements of robustness reliability and timeliness in each network layer This Special Issue presents the recent research result on industrial wireless sensor networks Each paper in this Special Issue has unique contributions in the advancements of industrial wireless sensor network research and we expect each paper to promote the relevant research and the deployment of IWSNs

*Multilevel Converters for Industrial Applications* Sergio Alberto Gonzalez, Santiago Andres Verne, Maria Ines Valla, 2017-07-12 Modern semiconductor devices have reached high current and voltage levels and their power handling limits can be extended if they are used in multilevel converter configurations To create high performance and reliable control designs however engineers need in depth understanding of the characteristics and operation of these topologies *Multilevel Converters for Industrial Applications* presents a thorough and comprehensive analysis of multilevel converters with a common DC voltage source The book offers a novel perspective to help readers understand the principles of the operation of voltage source multilevel converters as power processors and their capabilities and limitations The book

begins with an overview of medium voltage power converters and their applications. It then analyzes the topological characteristics of the diode clamped multilevel converter, the flying capacitor multilevel converter, and the asymmetric cascaded multilevel converter. For each topology, the authors highlight particular control issues and design trade-offs. They also develop relevant modulation and control strategies. Numerous graphical representations aid in the analysis of the topologies and are useful for beginning the analysis of new multilevel converter topologies. The last two chapters of the book explore two case studies that analyze the behavior of the cascade asymmetric multilevel converter as a distribution static compensator and shunt active power filter, and the behavior of the diode clamped topology configured as a back-to-back converter. These case studies demonstrate how to address the associated control problems with advanced control and modulation schemes. Examining recent advances, this book provides deep insight on the design of high power multilevel converters and their applications. It is a valuable reference for anyone interested in medium voltage power conversion, which is increasingly being used in industry and in renewable energy and distributed generation systems to improve efficiency and operation flexibility.

*Enabling 5G Communication Systems to Support Vertical Industries* Muhammad Ali Imran, Yusuf Abdulrahman Sambo, Qammer H. Abbasi, 2019-06-19

How 5G technology can support the demands of multiple vertical industries. Recent advances in technology have created new vertical industries that are highly dependent on the availability and reliability of data between multiple locations. The 5G system, unlike previous generations, will be entirely data driven, addressing latency, resilience, connection density, coverage area, and other vertical industry criteria. *Enabling 5G Communication Systems to Support Vertical Industries* demonstrates how 5G communication systems can meet the needs unique to vertical industries for efficient, cost-effective delivery of service. Covering both theory and practice, this book explores solutions to problems in specific industrial sectors, including smart transportation, smart agriculture, smart grid, environmental monitoring, and disaster management. The 5G communication system will have to provide customized solutions to accommodate each vertical industry's specific requirements. Whether an industry practitioner designing the next generation of wireless communications or a researcher needing to identify open issues and classify their research, this timely book covers the much-discussed topics of supporting multiple vertical industries and new ICT challenges. It addresses emerging issues and real-world problems surrounding 5G technology in wireless communication and networking. It explores a comprehensive array of essential topics such as connected health, smart transport, smart manufacturing, and more. It presents important topics in a clear, concise style suitable for new learners and professionals alike. It includes contributions from experts and industry leaders, system diagrams, charts, tables, and examples. *Enabling 5G Communication Systems to Support Vertical Industries* is a valuable resource for telecom engineers, industry professionals, researchers, professors, doctorate and postgraduate students requiring up-to-date information on supporting vertical industries with 5G technology systems.

*Wireless Automation as an Enabler for the Next Industrial Revolution* Muhammad Ali Imran, Sajjad Hussain, Qammer H.

Abbasi,2020-02-25 Presents the components challenges and solutions of wireless automation as enablers for industry 4 0 This timely book introduces the state of the art in industrial automation techniques concentrating on wireless methods for a variety of applications ranging from simple smart homes to heavy duty complex industrial setting with robotics accessibility It covers a wide range of topics including the industrial revolution enablers applications challenges their possible solutions and future directions Wireless Automation as an Enabler for the Next Industrial Revolution opens with an introduction to wireless sensor networks and their applications in various domains emphasizing industrial wireless networks and their future uses It then takes a look at life span extension for sensor networks in the industry followed by a chapter on multiple access and resource sharing for low latency critical industrial networks Industrial automation is covered next as is the subject of ultra reliable low latency communications Other topics include self healing in wireless networks cost efficiency optimization for industrial automation a non event based approach for non intrusive load monitoring wireless networked control and caching at the edge in low latency wireless networks The book finishes with a chapter on the application of terahertz sensing at nano scale for precision agriculture Introduces the future evolving dimension in industrial automation and discusses the enablers of the industrial revolution Places particular emphasis on wireless communication techniques which make industrial automation reliable efficient and cost effective Covers many of the associated topics and concepts like robotics AI internet of things telesurgery and remote manufacturing Of great interest to researchers from academia and industry who are looking at the industrial development from various perspectives Wireless Automation as an Enabler for the Next Industrial Revolution is an excellent book for telecom engineers IoT experts and industry professionals It would also greatly benefit researchers professors and doctorate and postgraduate students involved in automation and industry 4 0      **Protocols and**

**Applications for the Industrial Internet of Things** González García, Cristian,García-Díaz, Vicente,García-Bustelo, B.

Cristina Pelayo,Lovelle, Juan Manuel Cueva,2018-04-13 The Internet of Things IoT has become a major influence on the development of new technologies and innovations When utilized properly these applications can enhance business functions and make them easier to perform Protocols and Applications for the Industrial Internet of Things discusses and addresses the difficulties challenges and applications of IoT in industrial processes and production and work life Featuring coverage on a broad range of topics such as industrial process control machine learning and data mining this book is geared toward academicians computer engineers students researchers and professionals seeking current and relevant research on applications of the IoT      Granular Computing Witold Pedrycz,2018-09-03 Information granules as encountered in natural

language are implicit in nature To make them fully operational so they can be effectively used to analyze and design intelligent systems information granules need to be made explicit An emerging discipline granular computing focuses on formalizing information granules and unifying them to create a coherent methodological and developmental environment for intelligent system design and analysis Granular Computing Analysis and Design of Intelligent Systems presents the unified

principles of granular computing along with its comprehensive algorithmic framework and design practices Introduces the concepts of information granules information granularity and granular computing Presents the key formalisms of information granules Builds on the concepts of information granules with discussion of higher order and higher type information granules Discusses the operational concept of information granulation and degranulation by highlighting the essence of this tandem and its quantification in terms of the associated reconstruction error Examines the principle of justifiable granularity Stresses the need to look at information granularity as an important design asset that helps construct more realistic models of real world systems or facilitate collaborative pursuits of system modeling Highlights the concepts architectures and design algorithms of granular models Explores application domains where granular computing and granular models play a visible role including pattern recognition time series and decision making Written by an internationally renowned authority in the field this innovative book introduces readers to granular computing as a new paradigm for the analysis and synthesis of intelligent systems It is a valuable resource for those engaged in research and practical developments in computer electrical industrial manufacturing and biomedical engineering Building from fundamentals the book is also suitable for readers from nontechnical disciplines where information granules assume a visible position

### **Power Electronics and Control**

**Techniques for Maximum Energy Harvesting in Photovoltaic Systems** Nicola Femia, 2017-07-12 Incentives provided by European governments have resulted in the rapid growth of the photovoltaic PV market Many PV modules are now commercially available and there are a number of power electronic systems for processing the electrical power produced by PV systems especially for grid connected applications Filling a gap in the literature Power Electronics and Control Techniques for Maximum Energy Harvesting in Photovoltaic Systems brings together research on control circuits systems and techniques dedicated to the maximization of the electrical power produced by a photovoltaic PV source Tools to Help You Improve the Efficiency of Photovoltaic Systems The book supplies an overview of recent improvements in connecting PV systems to the grid and highlights various solutions that can be used as a starting point for further research and development It begins with a review of methods for modeling a PV array working in uniform and mismatched conditions The book then discusses several ways to achieve the best maximum power point tracking MPPT performance A chapter focuses on MPPT efficiency examining the design of the parameters that affect algorithm performance The authors also address the maximization of the energy harvested in mismatched conditions in terms of both power architecture and control algorithms and discuss the distributed MPPT approach The final chapter details the design of DC DC converters which usually perform the MPPT function with special emphasis on their energy efficiency Get Insights from the Experts on How to Effectively Implement MPPT Written by well known researchers in the field of photovoltaic systems this book tackles state of the art issues related to how to extract the maximum electrical power from photovoltaic arrays under any weather condition Featuring a wealth of examples and illustrations it offers practical guidance for researchers and industry professionals who

want to implement MPPT in photovoltaic systems      Handbook of Research on Innovations and Applications of AI, IoT, and Cognitive Technologies Zhao, Jingyuan, Kumar, V. Vinoth, 2021-06-25 Recently artificial intelligence AI the internet of things IoT and cognitive technologies have successfully been applied to various research domains including computer vision natural language processing voice recognition and more In addition AI with IoT has made a significant breakthrough and a shift in technical direction to achieve high efficiency and adaptability in a variety of new applications On the other hand network design and optimization for AI applications addresses a complementary topic namely the support of AI based systems through novel networking techniques including new architectures as well as performance models for IoT systems IoT has paved the way to a plethora of new application domains at the same time posing several challenges as a multitude of devices protocols communication channels architectures and middleware exist Big data generated by these devices calls for advanced learning and data mining techniques to effectively understand learn and reason with this volume of information such as cognitive technologies Cognitive technologies play a major role in developing successful cognitive systems which mimic cognitive functions associated with human intelligence such as learning and problem solving Thus there is a continuing demand for recent research in these two linked fields The Handbook of Research on Innovations and Applications of AI IoT and Cognitive Technologies discusses the latest innovations and applications of AI IoT and cognitive based smart systems The chapters cover the intersection of these three fields in emerging and developed economies in terms of their respective development situation public policies technologies and intellectual capital innovation systems competition and strategies marketing and growth capability and governance and relegation models These applications span areas such as healthcare security and privacy industrial systems multidisciplinary sciences and more This book is ideal for technologists IT specialists policymakers government officials academics students and practitioners interested in the experiences of innovations and applications of AI IoT and cognitive technologies      Industrial Wireless Sensor Networks R Budampati, S Kolavennu, 2015-10-23 Industrial Wireless Sensor Networks Monitoring Control and Automation explores the explosive growth that has occurred in the use of wireless sensor networks in a variety of applications during the last few years As wireless technology can reduce costs increase productivity and ease maintenance the book looks at the progress in standardization efforts regarding reliability security performance power consumption and integration Early sections of the book discuss issues such as media access control MAC antenna design and site survey energy harvesting and explosion proof design Subsequent sections present WSN standards including ISA100 ZigBee™ Wi-Fi™ WirelessHART™ and 6LoWPAN and the applications of WSNs in the oil and gas chemical food and nuclear power industries Reviews technologies and standards for industrial wireless sensor networks Considers particular applications for the technology and their ability to reduce costs increase productivity and ease maintenance Focuses on industry needs and standardization efforts regarding reliability security performance power consumption and integration      **The Industrial Electronics Handbook - Five Volume Set** Bogdan M. Wilamowski, J.

David Irwin, 2011-03-04 Industrial electronics systems govern so many different functions that vary in complexity from the operation of relatively simple applications such as electric motors to that of more complicated machines and systems including robots and entire fabrication processes The Industrial Electronics Handbook Second Edition combines traditional and new Extreme Environment Electronics John D. Cressler, H. Alan Mantooth, 2017-12-19 Unfriendly to conventional electronic devices circuits and systems extreme environments represent a serious challenge to designers and mission architects The first truly comprehensive guide to this specialized field Extreme Environment Electronics explains the essential aspects of designing and using devices circuits and electronic systems intended to operate in extreme environments including across wide temperature ranges and in radiation intense scenarios such as space The Definitive Guide to Extreme Environment Electronics Featuring contributions by some of the world's foremost experts in extreme environment electronics the book provides in depth information on a wide array of topics It begins by describing the extreme conditions and then delves into a description of suitable semiconductor technologies and the modeling of devices within those technologies It also discusses reliability issues and failure mechanisms that readers need to be aware of as well as best practices for the design of these electronics Continuing beyond just the paper design of building blocks the book rounds out coverage of the design realization process with verification techniques and chapters on electronic packaging for extreme environments The final set of chapters describes actual chip level designs for applications in energy and space exploration Requiring only a basic background in electronics the book combines theoretical and practical aspects in each self contained chapter Appendices supply additional background material With its broad coverage and depth and the expertise of the contributing authors this is an invaluable reference for engineers scientists and technical managers as well as researchers and graduate students A hands on resource it explores what is required to successfully operate electronics in the most demanding conditions

Security Designs for the Cloud, IoT, and Social Networking Dac-Nhuong Le, Chintan Bhatt, Mani Madhukar, 2019-10-08 Security concerns around the rapid growth and variety of devices that are controlled and managed over the Internet is an immediate potential threat to all who own or use them This book examines the issues surrounding these problems vulnerabilities what can be done to solve the problems investigating the roots of the problems and how programming and attention to good security practice can combat the threats today that are a result of lax security processes on the Internet of Things cloud computing and social media Renewable Energy Systems Fang Lin Luo, Ye Hong, 2017-12-19 Energy conversion techniques are key in power electronics and even more so in renewable energy source systems which require a large number of converters Renewable Energy Systems Advanced Conversion Technologies and Applications describes advanced conversion technologies and provides design examples of converters and inverters for renewable energy systems including wind turbine and solar panel energy systems Learn Cutting Edge Techniques for Converters and Inverters Setting the scene the book begins with a review of the basics of astronomy and Earth physics It then systematically introduces more



than 200 topologies of advanced converters originally developed by the authors including 150 updated circuits on modern conversion technologies It also discusses recently published topologies and thoroughly analyzes new converter circuits Novel approaches include split capacitor and split inductor techniques that can be applied in super lift and other converters Resolve Historic Problems in Conversion Technologies Along with offering many cutting edge techniques the authors resolve some historic problems such as the accurate determination of the conduction angle of single phase rectifiers and power factor correction They also describe a new series ladder multilevel inverters that uses few devices to produce more levels overcoming the drawbacks of the pulse width modulation PWM inverter and providing great scope for industrial applications Tap the Knowledge of Pioneers in the Field This book is written by pioneers in advanced conversion technology who have created a large number of converters including the world renowned DC DC Luo converters and super lift Luo converters Featuring numerous examples and diagrams it guides readers in designing advanced converters for use in renewable energy systems

**Key Technologies of Internet of Things and Smart Grid** Xianwu Zeng, Shuping Bao, 2023-12-20 This book focuses on the key technology applied Internet of things and smart grid which include some novel ICT technologies such as big data edge computing 5G and wide area wireless communication technology The mutual penetration deep integration and wide application of smart grid and IoT effectively integrate communication infrastructure resources and power system infrastructure resources further realize energy conservation and emission reduction improve the level of grid informatization automation and interaction and improve grid operation capacity and quality of service These key technologies are presented and studied in detail which help readers deeply understand those key technologies to apply IoT and grid The book benefits researchers engineers and graduate students in the fields of IoT and energy systems etc

**E-Business and Telecommunications** Mohammad S. Obaidat, 2017-10-26 This book constitutes the refereed proceedings of the 13th International Joint Conference on E Business and Telecommunications ICETE 2016 held in Lisbon Portugal in July 2016 ICETE is a joint international conference integrating four major areas of knowledge that are divided into six corresponding conferences International Conference on Data Communication Networking DCNET International Conference on E Business ICE B International Conference on Optical Communication Systems OPTICS International Conference on Security and Cryptography SECRIPT International Conference on Signal Processing and Multimedia SIGMAP International Conference on Wireless Information Systems WINSYS The 20 full papers presented together with an invited paper in this volume were carefully reviewed and selected from 241 submissions The papers cover the following key areas of e business and telecommunications data communication networking e business optical communication systems security and cryptography signal processing and multimedia applications wireless networks and mobile systems

**Intelligent Systems, Technologies and Applications** Marcin Paprzycki, Sabu M. Thampi, Sushmita Mitra, Ljiljana Trajkovic, El-Sayed M. El-Alfy, 2021-05-31 This book offers to readers a selection of refereed papers that were presented at the Sixth International

Symposium on Intelligent Systems Technologies and Applications ISTA 20 All submissions were evaluated on the basis of their significance novelty and technical quality This book consists of 28 papers 19 regular and 9 short papers that were virtually presented at the Symposium The papers cover different areas such as big data analytics security and privacy Internet of things machine and deep learning health informatics visual computing signal processing and natural language processing The book is directed to the researchers and scientists engaged in various fields of intelligent systems

*WirelessHARTTM* Tran Duc Chung, Rosdiazli Ibrahim, Vijanth Sagayan Asirvadam, Nordin Saad, Sabo Miya Hassan, 2017-11-22 This book presents a guideline for EWMA filter design for industrial wireless networked control system both theoretically and practically The filter's key advantages are simple effective low computational overhead This book also provides a guideline for practical implementation of EWMA filter for improving networked control performance of various process plants It further discusses not only the advantages of the filter but also the limitations and how to avoid them when implementing the filter from practical point of view ICCWCS 2019 Jamal Zbitou, Adil Echchelh, Mostafa Hefnawi, Ahmed Errkik, 2019 Today computer science engineering and telecommunications are two important areas linked and even inseparable This is obvious for the user who connects the modem of his computer on his mobile phone or telephone line to access via the global data network the information available on the servers The both domains are evolving rapidly and the development of new architectures of systems dedicated to telecommunications and computing becomes essential Especially wireless transmission systems with high data rate Two parts of these systems should be developed software and hardware Another area that is renewable energies becomes more attractive for researchers in order to develop new conversion systems with good performances and a good optimization of energy For example in wireless sensor systems we try to develop new protocols permitting to have a good autonomy in terms of energy

**Hybrid PID Based Predictive Control Strategies for WirelessHART Networked Control Systems** Sabo Miya Hassan, Rosdiazli Ibrahim, Nordin Saad, Kishore Bingi, Vijanth Sagayan Asirvadam, 2020-05-12 Recent advances in wireless technology have led to the emergence of industry standards such as WirelessHART These strategies minimise the need for cumbersome cabling thereby reducing costs However applying them involves the challenge of handling stochastic network delays which can degrade control performance To address this problem commonly used simple PID could be employed However PID suffers from gain range limitations when used in a delayed environment Furthermore model based controllers are complex and require exact models of the process and systematic system identification for implementation Therefore to address these issues the book proposes control strategies that retain the simplicity of PID in terms of ease of tuning and structure while improving on the performance of the closed loop system with regard to stochastic network delays and mismatches Concretely it proposes and discusses three strategies namely Setpoint Weighting SW Filtered Predictive PI FPPI and Optimal Fuzzy PID In order to optimise some of these controllers two novel hybrid optimisation algorithms combining the dynamism of the Bacterial Foraging Algorithm BFA and

advantages of both the Spiral Dynamic Algorithm SDA and the Accelerated Particle Swarm Optimisation APSO have been used. The strategies proposed here can also be applied in stochastic control scenarios not necessarily wireless characterised by uncertainties. This book will be useful to engineers and researchers in both industry and academia. In industry it will be particularly useful to research and development efforts where PID controllers and wireless sensor networks WSNs involving both short and long term stochastic network delay are employed. Thus it can be used for real time control design in these areas. In the academic setting the book will be useful for researchers, undergraduate and graduate students of instrumentation and control. It can also be used as reference material for teaching courses on predictive and adaptive controls and their application.

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