Real Time Environmental Monitoring Sensors And Systems

The Handbook of Chemical and Biological Sensors focuses on the development of sensors to recognize substances rather than physical quantities. This fully inclusive book examines devices that use a biological sensing element to detect and measure chemical and biological species as well as those that use a synthetic element to achieve a similar result. A first port of call for anyone with a specific interest, question, or problem relating to this area, this comprehensive source of reference serves as a guide for practicing scientists and as a text for many graduate courses. It presents relevant physics to chemists, chemistry to materials scientists, materials science to electronic engineers, and fabrication technology to all of the above. In addition, the handbook is useful both to newcomers and to experienced researchers who wish to broaden their knowledge of the constituent disciplines of this wide-ranging field.

Environmental pollution has been one of the most challenging problems in modern society and more and more health issues are now linked to environmental pollution and especially, air pollution. Certain sensitive group like patients with asthma are highly influenced by the environmental air quality and knowledge of the daily air pollution exposure is of great importance for the management and prevention of asthma attack. Hence small form factor, real time, accurate, sensitive and easy to use portable devices for environmental monitoring are of great value. Three novel image-based methods for quantitative real time environmental monitoring were introduced and the sensing principle, sensor performances were evaluated through simulation and field tests. The first sensing principle uses surface plasmon resonance (SPR) image and home-made molecular sieve (MS) column to realize real time chemical separation and detection. SPR is sensitive and non-specific, which makes it a desirable optical method for sensitive biological and chemical sensing, the miniaturized MS column provides small area footprint and makes it possible for SPR to record images of the whole column area. The innovative and system level integration approach provide a new way for simultaneous chemical separation and detection. The second sensor uses scattered laser light, Complementary metal-oxide-semiconductor (CMOS) imager and image processing to realize real-time particulate matter (PM) sensing. Complex but low latency algorithm was developed to obtain real time information for PM including PM number, size and size distribution. The third sensor uses gradient based colorimetric sensor, absorbance light signal and image processing to realize real-time Ozone sensing and achieved high sensitivity and substantially longer lifetime compared to conventional colorimetric sensors. The platform provides potential for multi-analyte integration and large-scale consumer use as wearable device. The three projects provide novel, state-of-the-art and sensitive solutions for environmental and personal exposure monitoring. Moreover, the sensing platforms also provide tools for clinicians and epidemiologists to conduct large scale clinical studies on the adverse health effects of pollutants on various kinds of diseases.

A two-tier wireless data communication system was developed to remotely monitor sediment concentration in streams in real time. The system used wireless motes and other devices to form a wireless sensor network to acquire data from multiple sensors. The

system also used a Stargate, a single-board computer, as a gateway to manage and control data flow and wireless data transfer. The sensor signals were transmitted from an AirCard on the Stargate to an Internet server through the General Packet Radio Service (GPRS) provided by a commercial GSM cellular carrier. Various types of antennas were used to boost the signal level in a radio-hostile environment. Both short- and long-distance wireless data communications were achieved. Power supplies for the motes, Stargate, and AirCard were improved for reliable and robust field applications. The application software was developed using Java, C, nesC, LabView, and SQL to ensure seamless data transfer and enable both on-site and remote monitoring. Remote field tests were carried out at different locations with different GPRS signal strengths and a variety of landscapes. A three-tier wireless sensor network was then developed and deployed at three military installations around the country--Fort Riley in Kansas, Fort Benning in Georgia, and Aberdeen Proving Ground in Maryland - to remotely monitor sediment concentration and movement in real time. Sensor nodes, gateway stations, repeater stations, and central stations were strategically deployed to insure reliable signal transmissions. Radio signal strength was tested to analyze effects of distance, vegetation, and topographical barriers. Omni- and Yagi-directional antennas with different gains were tested to achieve robust, long-range communication in a wireless-hostile environment. Sampling times of sensor nodes within a local sensor network were synchronized at the gateway station. Error detection algorithms were developed to detect errors caused by interference and other impairments of the transmission path. GSM and CDMA cellular modems were used at different locations based on cellular coverage. Data were analyzed to verify the effectiveness and reliability of the three-tier WSN.

This book provides an overview of modern sensing technologies and reflects the remarkable advances that have been made in the field of intelligent and smart sensors, environmental monitoring, health monitoring, and many other sensing and monitoring contexts in today’s world. It addresses a broad range of aspects, from human health monitoring to the monitoring of environmental conditions, from wireless sensor networks and the Internet of Things to structural health monitoring. Given its breadth of scope, the book will benefit researchers, practitioners, technologists and graduate students involved in the monitoring of systems within the human body, functions and activities, healthcare technologies and services, the environment, etc.

The goal of the project was to develop a wireless communications system, including communications, command, and control software, to remotely monitor the environmental state of a process or facility. Proof of performance would be tested and evaluated with a prototype demonstration in a functioning facility. AR Designs' participation provided access to software resources and products that enable network communications for real-time embedded systems to access remote workstation services such as Graphical User Interface (GUI), file I/O, Events, Video, Audio, etc. in a standardized manner. This industrial partner further provided knowledge and links with applications and current industry practices. FM and T's responsibility was primarily in hardware development in areas such as advanced sensors, wireless radios, communication interfaces, and monitoring and analysis of sensor data. This role included a capability to design, fabricate, and test prototypes and to provide a demonstration environment to test a proposed remote sensing system. A summary of technical accomplishments is given.

This book offers an up-to-date overview of the concepts, modeling, technical and technological details and practical applications of different types of sensors, and discusses the trends of next generation of sensors and systems for environmental and food engineering. This book is aimed at researchers, graduate students, academics and industry professionals working in the field of environmental and food engineering, environmental monitoring, precision agriculture and food quality control.
Nanotechnology is a diverse science that has brought about new applications in fields such as colloidal science, device physics and supra molecular chemistry. Environmental pollution treatment by nanomaterials is an emerging application of nanotechnology. It is gaining importance because of the increased environmental challenges due to the impact of modern industrial activities. Industrial activity involves the production and use of various toxic organic and inorganic chemicals which pollute nearby water streams, indirectly influencing aquatic and human life. Thus, there is a need to protect the environment through the development of new technologies and by enacting awareness drives for environmental sustainability. This volume summarizes cutting-edge research on nanomaterial utilization for environmental challenges. Chapters introduce readers to the concepts of environmental protection, sustainability and monitoring. Readers will also learn about technologies used for keeping the environment safer, including ion exchangers, metallic oxide complexes, nanocomposite materials, porous membranes and nanocatalysts. This volume is intended to be an introductory reference for students and researchers undertaking advanced courses in materials science, environmental science and engineering, giving readers a glimpse into the fascinating world of nanotechnology.
Real-time and reliable detection of molecular compounds and bacteria is essential in modern environmental monitoring. For rapid analyses, biosensing devices combining high selectivity of biomolecular recognition and sensitivity of modern signal-detection technologies offer a promising platform. Biosensors allow rapid on-site detection of pollutants and provide potential for better understanding of the environmental processes, including the fate and transport of contaminants.This book, including 12 chapters from 37 authors, introduces different biosensor-based technologies applied for environmental analyses.
Windows based mobile application for m-health and environmental monitoring sensor devices were developed and tested. With the number of smartphone users exponentially increasing, the applications developed for m-health and environmental monitoring devices are easy to reach the general public, if the applications are simple, user-friendly and personalized. The sensing device uses Bluetooth to communicate with the smartphone, providing mobility to the user. Since the device is small and hand-held, the user can put his smartphone in his pocket, connected to the device in his hand and can move anywhere with it. The data processing performed in the applications is verified against standard off the shelf software, the results of the tests are discussed in this document. The user-interface is very simple and doesn't require many inputs from the user other than during the initial setting when they have to enter their personal information for the records. The m-health application can be used by doctors as well as by patients. The response of the application is very quick and hence the patients need not wait for a long time to see the results. The environmental monitoring device has a real-time plot displayed on the screen of the smartphone showing concentrations of total volatile organic compounds and airborne particle count in the environment at the location of the device. The programming was

done with Microsoft Visual Studio and was written on VB.NET platform. On the applications, the smartphone receives data as raw binary bytes from the device via Bluetooth and this data is processed to obtain the final result. The final result is the concentration of Nitric Oxide in ppb in the Asthma Analyzer device. In the environmental monitoring device, the final result is the concentration of total Volatile Organic Compounds and the count of airborne Particles.

The Aegis system at Lawrence Livermore National Laboratory (LLNL) is being developed to provide a real-time emergency response management capability for a diverse range of environmental monitoring applications. The Aegis system is designed to integrate a variety of environmental, emergency, and process monitoring sensor systems using a flexible, modular architecture that can be readily configured for any number of industrial, commercial, or government sites. Several unique LLNL technologies are being integrated via this effort that will provide tracking of environmental contaminants, real-time identification of potentially unacceptable conditions, and facilitation of emergency or measured response management operations. Potential areas of application include: monitoring-surface/ground water, air, radiation; waste effluent & storm/drain line; water quality (water storage, treatment, and distribution); fixed processes, safety systems; critical facilities; hazardous spill management; rapid environmental monitoring deployment; watershed protection; ecosystem management and restoration; enforcement and compliance.

Recent advances in technology and manufacturing have made it possible to create small, powerful, energy-efficient, cost-effective sensor nodes for specialized telecommunication applications—nodes "smart" enough to be capable of adaptation, self-awareness, and self-organization. Sensor Networks for Sustainable Development examines sensor network technologies that increase the quality of human life and encourage societal progress with minimal effect on the earth’s natural resources and environment. Organized as a collection of articles authored by leading experts in the field, this valuable reference captures the current state of the art and explores applications where sensor networks are used for sustainable development in: Agriculture Environment Energy Healthcare Transportation Disaster management Beneficial to designers and planners of emerging telecommunication networks, researchers in related industries, and students and academia seeking to learn about the impact of sensor networks on sustainable development, Sensor Networks for Sustainable Development provides scientific tutorials and technical information about smart sensor networks and their use in everything from remote patient monitoring to improving safety on the roadways and beyond.

Basic and applied research is being conducted to develop simple to use chemical and biological sensor chips utilizing bio-chemo-mechanics for real-time, in-situ, detection of technetium, mercury, uranium, copper, and lead for deactivation and decommissioning applications. The bio-chemo-opto-mechanical (Bio-COM) chip involves properly fashioned arrays of micromachined silicon cantilevers containing embedded deformable diffraction gratings functionalized with chemically selective coatings. Adsorption of specific molecules on the cantilever array leads to bending, which changes the diffraction of light from the array. The biochemo- opto-mechanical (BioCOM) chips will be designed to contain an array of pixels, with each pixel containing an array of microcantilever springs in which one surface is derivatized with either an antibody coating or a self-assembled monolayer (SAM) coating for detecting Hg(II), Hg(0), Cu(II), Pb(II), U(VI), or TcO4-. The BioCOM sensor platform also offers the advantage of

simultaneous measurement of many analytes using a single chip. The readout mechanism can be a reflected laser beam, producing a diffraction pattern, or in an ideal case the diffraction of daylight resulting in a change of color. In the latter case the proposed sensors would not require any external power, external or on-board electronics, or fluorescent dyes and associated optics, which will keep its fabrication and operation costs low while making it simple to use for realtime environmental monitoring. There is presently an urgent need for rugged, low cost sensing systems for real-time, in situ chemical sensors for characterization and monitoring of ground water, contaminated soil and process streams. Recent advances in designing and fabricating microcantilever beams capable of detecting extremely small forces, mechanical stress and mass additions offer the promising prospect of environmental sensing with unprecedented sensitivity and dynamic range. The resonance frequency of a cantilever beam varies sensitively as a function of molecular adsorption. In addition, when the adsorption is confined to one side of the cantilever, the cantilever undergoes deflection due to adsorption-induced variation in surface free energy. Chemical selectivity can be achieved by coating the cantilevers with selective molecules. We have detected a number of ions such as Cs, Cr, Cu, Hg and methyl Hg in ground water with very high sensitivity. Recent results from nanocantilever sensor arrays will be presented.
Sensing and Monitoring Technologies for Mines and Hazardous Areas: Monitoring and Prediction Technologies presents the fundamentals of mining related geotechnical risk and how the latest advances in sensing and data communication can be used both to prevent accidents and provide early warnings. Opencast mining operations involve huge quantities of overburden removal, dumping, and backfilling in excavated areas. Substantial increases in the rate of accumulation of waste dumps in recent years has resulted in greater height of dumps and also has given rise to the danger of dump failures as steeper open pit slopes are prone to failure. These failures lead to loss of valuable human lives and damage to mining machinery. This book presents the most recent advances in gas sensors, methane detectors, and power cut-off systems. It also introduces monitoring of the gas strata and environment, and an overview of the use of Internet of Things and cloud computing for mining sensing and surveillance purposes. Targeted at geotechnical and mining engineers, this volume covers the latest findings and technology to prevent mining accidents and mitigate the inherent risk of the activity. Presents complete details of a real-time slope stability monitoring system using wireless sensor networking and prediction technique based on multivariate statistical analysis of various parameters and analytical hierarchy process methods Discusses innovative ideas and new concepts of sensing technologies, mine transport surveillance, digital mining, and cloud computing to improve safety and productivity in mining industry Includes slope stability prediction software, downloadable through a companion website, which can be used for monitoring, analyzing, and storing different sensors and providing audio-visual, SMS, and email alerts Covers the latest findings and technology to prevent mining accidents and mitigate the inherent risk
Recent architectural trends have included exploring open space and the extensive use of glass as building material. While the details of these large, light-exposed, open-air environments can be modeled as thermal fluid systems in CFD simulations, the use of dense sensor networks can provide real-time monitoring of a building's airflow and thermal

management systems without the need for computationally-intensive theoretical models, and can use this data to inform and advance these models. Sensor networks can provide an accurate picture of the actual conditions of a building and how those conditions can change over time, due to deterioration or external influences. The information gathered from such networks will be critical in determining the energy efficiency of a building. To do this, a sensor network made of two types of sensors, temperature-humidity and airflow, was deployed in the large, glass-enclosed atrium of the recently-completed MIT Media Lab Extension (E14) in late March 2010. Their performance was calibrated, monitored, and the preliminary results analyzed in conjunction with the external weather conditions in the Boston metropolitan area. The results show that while the use of the sensors in monitoring temperature and humidity is successful, the airflow sensors currently require a different solution to solve both the need for low-power consumption and resolution, range, and stability in its measurements.

The principle of energy harvesting, i. e. gleaning of extremely small amounts of energy from the environment, has been around for a long time. For technical reasons, the idea of operating a wireless link, commercially, with energy from the environment was to date only possible with solar cells, and outdoors where there is sufficient light. EnOcean is the first company to offer commercial solutions for operating wireless links in low-light indoor surroundings, or by energy sources that are an alternate to light. In this paper we will discuss two application scenarios for energy-autonomous sensor/actor networks with partly contrary requirements. The first application scenario is typical for e.g. building automation or environmental monitoring, where the wirelessly operated sensors are distributed over a widespread area and only a few measurement values are generated in a moderate time interval. Modern fabrication facilities with highly flexible manufacturing cells or highly dynamic processes in the military environment, where clusters of sensors and actuators have to be read-out and controlled in a limited space under stringent real-time limitations stand for the second application scenario. We will describe the current status of technology, show measurement results, tell about experiences already made in the field and give a prospective view of possible future developments. Although primarily developed for new application scenarios in building systems engineering, household, logistics, environmental protection and production automation wireless sensor/actor networks based on EnOcean technology can also be tailored to military needs for future air, ground and naval vehicle capabilities.

This book presents the proceedings and the outcomes of the NATO Advanced Research Workshop (ARW) on Integrated Technologies for Environmental Monitoring and Information Production, which was held in Marmaris, Turkey, between September 10- 14, 200 I. With the contribution of 45 experts from 20 different countries, the ARW has provided the opportunity to resolve the basic conflicts that tend to arise between different disciplines associated with environmental

data management and to promote understanding between experts on an international and multidisciplinary basis. The prevailing universal problem in environmental data management (EDM) systems is the significant incoherence between data collection procedures and the retrieval of information required by the users. This indicates the presence of problems still encountered in the realization of; (1) delineation of objectives, constraints, institutional aspects of EDM; (2) design of data collection networks; (3) statistical sampling; (4) physical sampling and presentation of data; (5) data processing and environmental databases; (6) reliability of data; (7) data analysis and transfer of data into information; and (8) data accessibility and data exchange at local, regional and global scales. Further problems stem from the lack of coherence between different disciplines involved in EDM, lack of coordination between responsible agencies on a country basis, and lack of coordination on an international level regarding the basic problems and relevant solutions that should be sought.
With the increasing worldwide trend in population migration into urban centers, we are beginning to see the emergence of the kinds of mega-cities which were once the stuff of science fiction. It is clear to most urban planners and developers that accommodating the needs of the tens of millions of inhabitants of those megalopolises in an orderly and uninterrupted manner will require the seamless integration of and real-time monitoring and response services for public utilities and transportation systems. Part speculative look into the future of the world’s urban centers, part technical blueprint, this visionary book helps lay the groundwork for the communication networks and services on which tomorrow’s “smart cities” will run. Written by a uniquely well-qualified author team, this book provides detailed insights into the technical requirements for the wireless sensor and actuator networks required to make smart cities a reality.
Developing environmental sensing and monitoring technologies become essential especially for industries that may cause severe contamination. Intelligent environmental sensing uses novel sensor techniques, intelligent signal and data processing algorithms, and wireless sensor networks to enhance environmental sensing and monitoring. It finds applications in many environmental problems such as oil and gas, water quality, and agriculture. This book addresses issues related to three main approaches to intelligent environmental sensing and discusses their latest technological developments. Key contents of the book include: Agricultural monitoring Classification, detection, and estimation Data fusion Geological monitoring Motor monitoring Multi-sensor systems Oil reservoirs monitoring Sensor motes Water quality monitoring Wireless sensor network protocol.
Satellite imagery is a valuable tool for environmental monitoring of natural and man-made events. Analysis of imagery within a few hours is vital if these data are to be used to respond to rapidly changing conditions. Since April of 1982 Landsat imagery from the Quick-Look Project at the Geophysical Institute has been available for real-time applications. The system provides near real-time Landsat MSS imagery for applications including monitoring flood hazards, sea ice

motion, forest fires and agricultural development. As we move into the 1990s additional satellites with new sensors are being launched which will provide more opportunities for near real-time use. To take advantage of the sensors, additional facilities are needed to receive, process and deliver the data in a timely fashion. Candidate sensors and spacecraft include Enhanced Thematic Mapper (ETM) on Landsat-6; Advanced Very High Resolution Radiometer (AVHRR) on the NOAA polar orbiting satellites; SPOT; Japan's Meteorological Observation Satellite (MOS); OPS (Optical Sensor) on the Japanese Earth Resources Satellite-1 (JERS-1) and the Advanced Earth Observing Satellite (ADEOS). Ongoing projects, such as the Alaska SAR Facility, can provide some components of a multiple satellite receiving system. Such a capability will provide a valuable source of data to study global change in the Arctic. We will describe the capabilities required to use satellite data for environmental monitoring.

Real-Time Environmental MonitoringSensors and SystemsNovel Image-based Methods for Quantitative Real Time Environmental Monitoring

Recent progress in data processing, communications and electronics miniaturisation is now enabling the development of emerging Wireless Sensor Networks (WSN), consisting of spatially distributed autonomous sensor modules that collaborate to monitor reSal-time environmental conditions within a large system. Recent and future applications of this technology range from quality control to environmental modelling and failure analysis. In order to fabricate these promising low-cost, low-power, reliable monitoring platforms, it is necessary to improve the level of sensor integration available today: existing solutions only offer a limited number of large, expensive environmental sensors. In order to satisfy these needs and offer more flexibility for present and future WSN modules, the development of a miniaturised CMOS compatible multisensor platform comprising different MEMS structures is described in this thesis. An existing fabrication process has been modified and extended to manufacture temperature, relative humidity, corrosion, gas detection, and gas flow velocity sensors on a single silicon substrate and to offer good sensitivity with limited power consumption. All devices can be easily simulated prior to their fabrication and may then be designed and dimensioned according to application-specific requirements. Final characterisation after fabrication has proven to be in good agreement with analytical models. Finally, a dedicated conditioning circuit layer has been built around this fabricated MEMS multisensor die for integration on an existing WSN module, for which an additional memory layer has been developed as well. The final multisensor unit enables accurate readings and cross-sensitivity compensation thanks to a combination of simultaneous readings from multiple sensors. Real-time communication of all sensed data to the outside world is ensured via radiofrequency protocols, and data collection in a serial memory is also made possible for future use or diagnostics applications. All significant advantages of the miniaturised multisensor platform described here may offer

good opportunities for further development or commercial use.

This chapter looks into the technical features of state-of-the-art wireless sensors networks for environmental monitoring. Technology advances in low-power and wireless devices have made the deployment of those networks more and more affordable. In addition, wireless sensor networks have become more flexible and adaptable to a wide range of situations. Hence, a framework for their correct implementation will be provided. Then, one specific application about real-time environmental monitoring in support of a model-based predictive control system installed in a metro station will be described. In these applications, filtering, resampling, and post-processing functions must be developed, in order to convert raw data into a dataset arranged in the right format, so that it can inform the algorithms of the control system about the current state of the domain under control. Finally, the whole architecture of the model-based predictive control and its final performances will be reported.

Sensor Technologies: Healthcare, Wellness and Environmental Applications explores the key aspects of sensor technologies, covering wired, wireless, and discrete sensors for the specific application domains of healthcare, wellness and environmental sensing. It discusses the social, regulatory, and design considerations specific to these domains. The book provides an application-based approach using real-world examples to illustrate the application of sensor technologies in a practical and experiential manner. The book guides the reader from the formulation of the research question, through the design and validation process, to the deployment and management phase of sensor applications. The processes and examples used in the book are primarily based on research carried out by Intel or joint academic research programs. “Sensor Technologies: Healthcare, Wellness and Environmental Applications provides an extensive overview of sensing technologies and their applications in healthcare, wellness, and environmental monitoring. From sensor hardware to system applications and case studies, this book gives readers an in-depth understanding of the technologies and how they can be applied. I would highly recommend it to students or researchers who are interested in wireless sensing technologies and the associated applications.” Dr. Benny Lo Lecturer, The Hamlyn Centre, Imperial College of London “This timely addition to the literature on sensors covers the broad complexity of sensing, sensor types, and the vast range of existing and emerging applications in a very clearly written and accessible manner. It is particularly good at capturing the exciting possibilities that will occur as sensor networks merge with cloud-based ‘big data’ analytics to provide a host of new applications that will impact directly on the individual in ways we cannot fully predict at present. It really brings this home through the use of carefully chosen case studies that bring the overwhelming concept of 'big data' down to the personal level of individual life and health.” Dermot Diamond Director, National Centre for Sensor Research, Principal Investigator, CLARITY Centre for Sensor Web Technologies, Dublin City University "Sensor Technologies:

Healthcare, Wellness and Environmental Applications takes the reader on an end-to-end journey of sensor technologies, covering the fundamentals from an engineering perspective, introducing how the data gleaned can be both processed and visualized, in addition to offering exemplar case studies in a number of application domains. It is a must-read for those studying any undergraduate course that involves sensor technologies. It also provides a thorough foundation for those involved in the research and development of applied sensor systems. I highly recommend it to any engineer who wishes to broaden their knowledge in this area!" Chris Nugent Professor of Biomedical Engineering, University of Ulster

The field of plasmonics has shown extraordinary capabilities in realizing highly sensitive and accurate sensors for environmental monitoring and measurement of biological analytes. The inherent potential of such devices has led to growing interest worldwide in commercial fiber optic chemical and biosensors. Optical Sensors for Biomedical Diagnostics and Environmental Monitoring is an essential resource for students, established researchers, and industry developers in need of a reference work on both the fundamentals and latest advances in optical fiber sensor technology in biomedical diagnostics and environmental monitoring. The book includes rigorous theory and experimental techniques of surface plasmon and lossy mode resonances, as well as real-time sensing applications of resonance techniques implemented over optical fiber substrate using bulk layer and/or nanostructures as transducer and sensing layers. In addition, discussion of various design options for real-time sensors in environmental monitoring and biomedical diagnostics make the book approachable to readers from multidisciplinary fields.

This book is a printed edition of the Special Issue "UAV Sensors for Environmental Monitoring" that was published in Sensors

Monitoring of user-defined constraints on time-varying data is a fundamental functionality in various sensor-based real-time applications such as environmental monitoring, process control, location-based surveillance, etc. In general, these applications track real-world objects and constantly evaluate the constraints over the object trace to take a timely reaction upon their violation or satisfaction. While it is ideal that all the constraints are evaluated accurately in real-time, data streams often contain incomplete and delayed information, rendering the evaluation results of the constraints uncertain to some degree. In this dissertation, we provide a comprehensive approach to the problem of monitoring constraint-based queries over data streams for which the data or timestamp values are inherently uncertain. First, we propose a generic framework, namely Ptmon, for monitoring timing constraints and detecting their violation early, based on the notion of probabilistic violation time. In doing so, we provide a systemic approach for deriving a set of necessary timing constraints at compilation time. Our work is innovative in that the framework is formulated to be modular with respect to the probability distributions on timestamp values. We demonstrate the applicability of the framework for different timestamp

models. Second, we present a probabilistic timing join operator, namely Ptjoin, as an extended functionality of Ptmon, which performs stream join operations based on temporal proximity as well as temporal uncertainty. To efficiently check the Ptjoin condition upon event arrivals, we introduce the stream-partitioning technique that delimits the probing range tightly. Third, we address the problem of monitoring value-based constraints that are in the form of range predicates on uncertain data values with confidence thresholds. A new monitoring scheme Spmon that can reduce the amount of data transmission and thus expedite the processing of uncertain data streams is introduced. The similarity concept that was originally intended for real-time databases is extended for our probabilistic data stream model where each data value is given by a probability distribution. In particular, for uniform and gaussian distributions, we show how we derive a set of constraints on distribution parameters as a metric of similarity distances, exploiting the semantics of probabilistic queries being monitored. The derived constraints enable us to formulate the probabilistic similarity region that suppresses unnecessary data transmission in a monitoring system.

Wireless sensor networks (WSNs) utilize fast, cheap, and effective applications to imitate the human intelligence capability of sensing on a wider distributed scale. But acquiring data from the deployment area of a WSN is not always easy and multiple issues arise, including the limited resources of sensor devices run with one-time batteries. Additi

Advanced materials and nanotechnology is a promising, emerging field involving the use of nanoparticles to facilitate the detection of various physical and chemical parameters, including temperature, humidity, pH, metal ion, anion, small organic or inorganic molecules, gases, and biomolecules responsible for environmental issues that can lead to diseases like cancer, diabetes, osteoarthritis, bacterial infections, and brain, retinal, and cardiovascular diseases. By monitoring environmental samples and detecting these environmental issues, advanced nanotechnology in this type of sensory technology is able to improve daily quality of life. Although these sensors are commercially available for the detection of monovalent cations, anions, gases, volatile organic molecules, heavy metal ions, and toxic metal ions, many existing models require significant power and lack advanced technology for more quality selectivity and sensitivity. There is room in these sensors to optimize their selectivity, reversibility, on/off ratio, response time, and their environmental stability in real-world operating conditions. This book explores the methods for the development and design of environmentally-friendly, simple, reliable, and cost effective electrochemical nanosensors using powerful nanostructured materials. More specifically, it highlights the use of various electrochemical-based biosensor sensors involved in the detection of monovalent cations, anions, gases, volatile organic molecules, heavy metal ions, and toxic metal ions, with the ultimate goal of seeing these technologies reach market.

An unprecedented opportunity exists to introduce real-time physiological and environmental monitoring technology into future US Army dismounted forces for use in both training and combat situations. The motivation is to enhance the survivability of the individual warfighter and to provide increased situational awareness to both combat medics and commanders during the course of

a mission or field operation. The monitoring technology must be reliable, must be unobtrusive, and compelling in terms of value to both the lowest-echelon warfighters and their command chain. Realizing these objectives will require adapting and extending ambulatory medical monitoring technology well beyond the capabilities of current commercial devices and systems, and will place the US Army in a unique position with regard to real-time physiological status and health monitoring. This report identifies specific technology and system level issues that must be addressed to realize the objective system and proposes both a near-term and far-term system concept and development strategy. Technology developments critical to success include covert wireless personal area networking, physiological and environmental sensors hardened for the dynamic warfighter environment, and real-time data processing and fusion algorithms to extract the relevant physiological information and overall health status.

Basic and applied research is being conducted to develop simple to use chemical and biological sensor chips utilizing bio-chemo-mechanics for real-time, in-situ, detection of technetium, mercury, uranium, copper, and lead for deactivation and decommissioning applications. The bio-chemo-opto-mechanical (Bio-COM) chip involves properly fashioned arrays of micromachined silicon cantilevers containing embedded deformable diffraction gratings functionalized with chemically selective coatings. Adsorption of specific molecules on the cantilever array leads to bending, which changes the diffraction of light from the array. The biochemo- opto-mechanical (BioCOM) chips will be designed to contain an array of pixels, with each pixel containing an array of microcantilever springs in which one surface is derivatized with either an antibody coating or a self-assembled monolayer (SAM) coating for detecting Hg(II), Hg(0), Cu(II), Pb(II), U(VI), or TcO4 -. The BioCOM sensor platform also offers the advantage of simultaneous measurement of many analytes using a single chip. The readout mechanism can be a reflected laser beam, producing a diffraction pattern, or in an ideal case the diffraction of daylight resulting in a change of color. In the latter case the proposed sensors would not require any external power, external or on-board electronics, or fluorescent dyes and associated optics, which will keep its fabrication and operation costs low while making it simple to use for realtime environmental monitoring.

Buildings and environmental monitoring systems sense their surrounding conditions using various types of sensors. They process information and react to their environments in real time. The integrated cyberinfrastructure (CI) for the real-time data acquisition, real-time data processing and decision making is proposed, analyzed, implemented, and tested in this thesis. The open architecture solution is presented and implemented with open source software packages. Then, the CI is applied in two settings, the simulation and the real world. The smart building application uses the simulation environment, and the coral reef monitoring system uses the sensors deployed in the Pacific Ocean. This research is based on studies performed in Moorea. The use case scenarios and the configuration for detecting and responding to such scenarios are described for both applications.

This book constitutes the refereed proceedings of the Third Annual International Conference on Wireless Algorithms, Systems, and Applications, WASA 2008, held in Dallas, TX, USA, in October 2008. The 35 revised full papers presented together with 3 keynote talks and 15 invited lectures were carefully reviewed and selected from numerous submissions. Providing a forum for researchers and practitioners, from the academic, industrial and governmental sectors, the papers address current research and

development efforts of various issues in the area of algorithms, systems and applications for current and next generation infrastructure and infrastructureless wireless networks.

Although there are many books available on WSNs, most are low-level, introductory books. The few available for advanced readers fail to convey the breadth of knowledge required for those aiming to develop next-generation solutions for WSNs.Filling this void, Wireless Sensor Networks: From Theory to Applications supplies comprehensive coverage of WS

"Environmental Monitoring" is a book designed by InTech - Open Access Publisher in collaboration with scientists and researchers from all over the world. The book is designed to present recent research advances and developments in the field of environmental monitoring to a global audience of scientists, researchers, environmental educators, administrators, managers, technicians, students, environmental enthusiasts and the general public. The book consists of a series of sections and chapters addressing topics like the monitoring of heavy metal contaminants in varied environments, biolgical monitoring/ecotoxicological studies; and the use of wireless sensor networks/Geosensor webs in environmental monitoring.