Tuesday, February 18

Special Session: Systems with Multiple Electromagnetic Sensors

10:30 ***Wide-Slot Antenna for Breast Imaging Applications***

Sew Sun Tiang (Universiti Sains Malaysia, Malaysia); Mohammed S Hathal (University Sains Malaysia, Malaysia); Nik Syahrim Nik Anwar (Universiti Teknikal Malaysia Melaka, Malaysia); Mohd Ain (Universiti Sains Malaysia, Malaysia); Mohd Zaid Abdullah (Universiti Sains Malaysia & Engineering Campus, Malaysia)

A novel ultra wideband (UWB) antenna oriented for imaging cancerous cells in human breast is proposed. Fed by "50 Ω " microstrip line, the proposed design features a p-shaped wide-slot and printed on a substrate of size of 16 mm x 16 mm. Antenna measurements were performed from which a good agreement between measured and calculated values are obtained. Overall the bandwidth of the antenna averages at 83 % in the operating frequency 4.5¬¬–10.9 GHz. Meanwhile the image reconstruction is performed using the enhanced version of the delay and sum algorithm, from which the cross-sectional image depicting the permittivity distributions in heterogeneous breast is produced.

10:50 ***Measurement Uncertainties in Differential Radar Applied to Breast Imaging***

Emily Porter (McGill Universtiy, Canada); Adam Santorelli (McGill University, Canada); Milica Popović (McGill University, Canada)

In this work, we evaluate the measurement uncertainty and its consequences on a time-domain microwave breast imaging system. Our radar system contains a 16-element multistatic sensor array, and is used to generate microwave images of the breast using a differential method. We examine, for the first time with such a system, uncertainty due to sources of horizontal and vertical noise individually and together to determine their impact on image quality and tumor detection. It is found that for a time-domain radar system using differential imaging, horizontal noise is significantly more detrimental than vertical noise, and must be compensated for in order to have successful imaging of breast tumors. We show an example of a reconstructed breast image before and after compensation for both types of noise and highlight the necessity of such compensation.

11:10 ***Contactless Determination of Gas Concentration and Pressure based on a low Jitter mmWave FMCW Radar***

Christoph Baer (Ruhr-Universität Bochum & Institute of Electronic Circuits, Germany); Timo Jaeschke (Ruhr-University Bochum, Germany); Nils Pohl (Fraunhofer FHR, Germany); Thomas Musch (Ruhr-Universität Bochum, Germany)

In this contribution a novel approach on the determination of gas concentration and pressure is presented. Dielectric mixing equations are shown that explain the relation of permittivity and gas concentration. By means of the mixing equation's edge case, an approximation for dielectric behavior of pure gas pressures is affiliated. A test container and a highly precise, low jitter mmWave radar system

enable the establishment of a fast and precise time domain measurement, named pseudo transmission measurement, for gas measuring tasks. Measurements that were performed on the test setup prove the suggested dielectric gas mixing theory and are discussed in detail.

11:30 ***Simple linear inversion of soil electromagnetic properties from analytical model of electromagnetic induction sensor***

Darko Vasić (University of Zagreb, Croatia); Davorin Ambruš (University of Zagreb, Croatia); Vedran Bilas (University of Zagreb, Croatia)

We present an analytical model of electromagnetic induction sensor with several receiver coils placed horizontally above a soil consisting of arbitrary number of conductive and magnetic layers. The modeled region is truncated far from the transmitter coil and the solution for its vector magnetic potential is given as a series. We linearize the model with respect to the soil electrical conductivity and magnetic susceptibility of each layer, and calculate the total contribution of all layers by superposition. We evaluate the validity of the linear approximation. Finally, we postulate the inverse problem of determination of the electromagnetic properties of the soil layers using single excitation frequency and illustrate the inversion procedure on a synthetic data set. The linear model and the inversion procedure are suitable for field deployable instrument.

11:50 ***A water content sensor for baked products***

Ian M Woodhead (Lincoln, New Zealand); John Christie (Lincoln Agritech Ltd, New Zealand); Richard Fenton (Automation Design Ltd, New Zealand); Kenji Irie (Lincoln Ventures Limited, New Zealand)

The water content of baked products such as bread, cake and biscuits, affect the texture, colour, keeping qualities and consumer acceptance. Currently, moisture content is controlled by ensuring a uniform set of ingredients, mixing and baking, but inevitably variation arises from, for example, variation in ingredient characteristics, position within ovens and ambient temperature and relative humidity. A water content sensor that can measure on-line moisture after baking and adjust oven temperature distribution or just the mean oven temperature, will lead to more consistent products. This paper outlines requirements of a sensor for on-line measurement of moisture content, describes a microwave sensor concept that meets these requirements, and then presents the results from experimental work that determined typical permittivity values of bread, one of the target baked products.

Nondestructive Evaluation and Remote Sensing

10:30 ***Structural Health Monitoring of Bridges Using Cost-Effective 1-axis Accelerometers***

Chih-Hsing Lin (NARLabs, National Chip Implementation Center, Taiwan); Ssu-Ying Chen (National Chip Implementation Center, Taiwan); Chih-Chyau Yang (National Chip Implementation Center, Taiwan); Chien-Ming Wu (National Chip Implementation Center, Taiwan); Chun-Ming Huang (National Chip Implementation Center, Taiwan); Chih-Ting Kuo (National Chip Implementation Center, Taiwan)

This paper proposes a structure health monitoring device (HMD) with using three 1-axis accelerometers, microprocessor,analog to digital converter (ADC), and data logger for long span bridge. The proposed monitoring system achieves the features of low cost and data synchronization of three 1-axis accelerometers. Furthermore, we develop a packet acquisition program to receive the sensed data and then classify it based on time and date. Compared with 3-axis accelerometer, our proposed 1-axis accelerometers based device achieves 64.3% cost saving. Besides, the optimal sensor number can be verified by our proposed equation with only 0.37% error in terms of sample rate. Therefore, with using the proposed device,the real-time diagnosis system for bridge damage monitoring can be conducted effectively.

10:50 ***Development of a Frequency-Shifted Feedback Fiber Laser at 777.5 nm for Range Sensing Applications***

Michael Hofbauer (Vienna University of Technology, Austria); Johannes Seiter (Vienna University of Technology, Austria); Horst Zimmermann (Vienna University of Technology, Austria)

A frequency shifted feedback (FSF) laser in combination with an interferometer is a very accurate range sensing tool. In this paper, a FSF fiber laser with an output spectrum in the 777.5 nm range is presented. The cavity of the laser works in the 1555 nm range, enabling the use of cheap standard telecom products. Since 1555 nm are not detectable with silicon semiconductor devices the output of the laser is frequency doubled by a periodically poled lithium niobate (PPLN) crystal, which shifts the output spectrum from 1555 nm to 777.5 nm. It could be shown, that frequency doubling is a feasible way to shift the output spectrum of the laser to a range which is detectable by silicon, without destroying the special properties of the FSF laser.

11:10 ***Solar Panel Sensor Modeling and Fiscal Modeling***

Steven T. Griffin (University of Memphis, USA); Tom Wyatt (University of Memphis, USA)

A solar panel based sensor for automatic recording of practical insolation data at North Latitude 35.122196° and West Longitude -89.934553° has been developed. To implement this, a detailed, application oriented, solar panel model has been tested. This modeling has been divided into categories based on both technological characteristics such as cell and panel construction and disciple orientation such as thermal, electrical, optical, and mechanical. Emphasis has been on performance at maximum collection efficiency. This document addresses efficiency from the electrical output side rather than the optical input side. Emphasis is on effective coupling to load, balanced against collection efficiencies, so that sensor calibration constant is nearly constant. Partial obscuration and cost impacts are addressed.

11:30 ***2-D Vector Field Visualization of Corrosions in a Small-bore Piping System using Bobbin-type Integrated Hall and GMR Sensors Arrays***

Minhhuy Le (Chosun University, Korea); Jungmin Kim (Chosun University, Korea); Jinyi Lee (Chosun University, Korea)

This study proposes a 2-D bobbin-type magnetic field vector camera in nondestructive testing for inspection of corrosions in inner and outer diameter (ID and OD) of a small-bore piping system. 16.1 mm diameter bobbin probe was produced by integrated of 71 Hall sensors (BIHaS) and 71 Giant magnetoresistance sensors (BIGiS) in two circumferential lines at interval of 0.6 mm. The BIHaS and BIGiS could measure radial and axial components of alternating magnetic field. Thus ID and OD corrosions could be imaged in a 2-D magnetic field vector. Two small-bore copper (16.56 mm inner diameter, 1.27 mm thickness) and titanium (17.28 mm inner diameter, 0.86 mm thickness) pipes with ID and OD corrosions were inspected and presented in this paper. The measured signal of each sensor array was displayed in a single contour plot and combined 2-D vector plot in real-time during scan.

11:50 ***Non-Destructive Evaluation of Far-Side Corrosion around the Multi-Layered Rivet by using the Solid-State Hall Sensor Array***

Jinyi Lee (Chosun University, Korea); Minhhuy Le (Chosun University, Korea); Jungmin Kim (Chosun University, Korea)

Nondestructive evaluation of aircraft is a great importance from the viewpoint of the integrity and flight safety of an aircraft. In aircraft structures, damage is likely to be observed around the rivets that connect the skin to the frames. In the previous study, we proposed an automated inspection system to inspect far-side corrosion around rivets in the jet-engine air-inlet duct (intake) of the F-5 aircraft, which has a complicated geometry. The inspection system includes a linear integrated Hall sensor array, a C-type exciter in the sensor head, and an automated movement system to support the sensor probe to scan over the sectional inner surface of the intake. In this paper, we propose a method to identify far-side corrosions around rivets on the flat specimen with a probability of detection (POD) exceeding over 90%. We also analyse how the location of corrosion affects the POD of the measurement system is analyzed.

Special Session: Efficient Sensor Network Processing

13:20 ***Modelling, Quantification, Optimisation - Energy Efficiency in Distributed, Embedded Systems***

Matthias Vodel (Chemnitz University of Technology, Germany); Wolfram Hardt (Chemnitz University of Technology, Germany); René Bergelt (TU Chemnitz, Germany)

During the last decade, energy efficiency became one of the most challenging research fields in the IT domain. After optimising large-scaled hardware infrastructures, nowadays the focus has changed. Current projects deal with two major areas. On the one hand embedded, energy self-sufficient system architectures and on the other hand wireless communication technologies to enable mobile operation. Due to strongly limited energy resources within these platforms, the system runtime represents a critical parameter. Accordingly, optimisation strategies are necessary to prolong the runtime and to improve the communication behaviour. In this paper, we discuss energy efficiency in distributed, embedded systems with focus on the communication aspects. We introduce an easy to use estimation model as well as the respective cost functions for quantifying the energy efficiency. In this context, we evaluate several optimisation strategies on different abstraction layers regarding their energy efficiency and their impact on the communication behaviour. We analyse wake-up receiver technologies as well as

a modern data aggregation approach - PLANetary. The implemented real-world test scenario represents a wireless network topology with specific, wake-up receiver enabled hardware platforms. The results clarify, that if the configuration scheme fits to the environmental conditions, significant improvements of the energy efficiency are possible.

13:36 ***Energy efficient handling of big data in embedded, wireless sensor networks***

René Bergelt (TU Chemnitz, Germany); Matthias Vodel (Chemnitz University of Technology, Germany); Wolfram Hardt (Chemnitz University of Technology, Germany)

The development of wireless sensor networks has reached a point where each individual node of a network may store and deliver a massive amount of (sensor-based) information at once or over time. In the future massively connected, highly dynamic wireless sensor networks such as vehicle-2-vehicle communication scenarios may hold an even greater information potential. Mostly due to the increase in node complexity. Consequently, data volumes will become a problem for traditional data aggregation strategies traffic-wise as well as with regard to energy efficiency. Therefore in this paper we suggest to call such scenarios big data scenarios as they pose similar questions and problems as traditional big data scenarios. Although these focus mostly focusing on business intelligence problems. We then propose an aggregation strategy tied to technological prerequisites which enables the efficient use of energy and the handling of large data volumes. In the end we demonstrate the energy conservation potential based on experiments with actual sensor platforms.

13:52 ***FPGA-based Approach for Runway Boundary Detection in High-resolution Colour Images***

Stephan Blokzyl (Technische Universitaet Chemnitz, Germany); Matthias Vodel (Chemnitz University of Technology, Germany); Wolfram Hardt (Chemnitz University of Technology, Germany)

Systems for aerial vehicles have to face tight constraints on weight, space, and energy consumption due to limited payload and energy resources of aircrafts. This leads to the use of optimised, application-specific components. In exploration and surveillance scenarios, electro-optical (EO) sensors in combination with embedded systems are very suitable to contribute to various perception tasks. EO sensors are lightweight, affordable and provide a high-quality representation of vehicle's environment. Embedded systems are energy-efficient, space-saving and provide powerful computing capabilities. But processing of high-resolution images is challenging, especially in the context of embedded computing and real-time data exploitation. Considering these conditions, the article introduces a novel FPGA-based approach for runway boundary recognition. The source image is scanned line-by-line to identify colour variations. Locations with strong colour discontinuity are grouped to lines which are used for runway pattern extraction in image. The classifier-less approach is independent from runway colour, brightness and contrast and doesn't require additional markers. The final detection is evaluated by a confidence value indicating its trustiness. The determinability of the worst case execution time and the robustness over a wide dynamic range demonstrate the certifiability of the implementation. It will be tested on an unmanned aerial vehicle for automated landing.

14:08 ***Distributed Detection in Neural Network based Multihop Wireless Sensor Network***

Jabal Raval (TCS Innovation Labs, Tata Consultancy Services Ltd., India); Bhushan Gurmukhdas Jagyasi (TCS Innovation Labs Mumbai & Indian Institute of Technology Bombay, India)

In this paper, a Neural Network back-propagation based data aggregation approach to detect binary events in a Multi hop Wireless Sensor Network has been proposed. We envision every node in a network as a unit of neuron which gets trained by using the neural network based back propagation algorithm. As compared to the LMS based Adaptive Weighted Aggregation scheme for tree network, the proposed Neural Network based wireless sensor network approach leads to significantly better detection accuracy. We also observe that no significant amount of energy losses due to communication and computation overhead has been incurred. We also compare the detection accuracy of the proposed Neural Network based scheme with that of the non-adaptive Bayesian approach which requires apriori knowledge of the sensor's performance indices.

14:24 ***Investigation into the Impact of Protocol Design on Energy Consumption of Low Power Wireless Sensors***

Debraj Basu (Massey University, New Zealand); Gourab Sen Gupta (Massey University, New Zealand); Giovanni Moretti (Massey University, New Zealand); Xiang Gui (Massey University, New Zealand)

This paper proposes a modified communication protocol that uses the knowledge of channel states to transmit packets. It shuts off the energy expensive acknowledgement operation during good channel state while uses all its retransmission attempts in bad channel state to deliver the packets through the channel. The impact of this protocol has been directly studied on the coin cell batteries that are used to power wireless sensors by emulating the loads for the battery and radio channel conditions. The radio channel is modeled as two state Markov chain with FAVOURABLE and NON-FAVOURABLE states. Three different channel conditions - good, bad and uncertain - are considered based on how often they transit between the FAVOURABLE and NON-FAVOURABLE states. The results have been compared with a classical communication protocol where communication between nodes takes place on send-acknowledge basis with a fixed number of retransmission attempts when error occurs. Our proposed protocol shows promising improvement in battery lifetime when dealing with good channel and found to be more effective in the other two channel conditions when the receive operation time is high. Analytical results are also used to substantiate our observations.

Sensors in Biomedical Applications

13:20 ***A Compact Back-Plaster Sensor Node for Dementia and Alzheimer Patient Care***

André Schwarzmeier (University of Erlangen-Nuremberg & Institute for Electronics Engineering, Germany); Jürgen Besser (International DiaLog College and Research Institute, Germany); Robert Weigel (University of Erlangen-Nuremberg, Germany); Georg Fischer (University of Erlangen-Nuremberg & Eesy-id, Germany); Dietmar Kissinger (University of Erlangen-Nuremberg, Germany)

This paper presents a compact and highly integrated back-plaster sensor node equipped with seamless localization (in-door and out-door) based on assisted GPS and Bluetooth localization, activity

classification and fall detection as well as a GSM module providing a GPRS connection to a server infrastructure for supporting dementia and Alzheimer patients in their daily life. The innovative and durable design as a hermetically rubber-sealed, waterproof and sanitizable back-plaster ensures optimum wearing comfort for the patient as well as reliable fall detection. In addition, combined with an internet server infrastructure the described plaster sensor node allows informing relatives or professional care in case of an emergency and help to enhance the quality of life by increasing patient's feeling of security.

13:40 ***High Inductance Coil Embedded On On-chip Magnetic Sensor for Biomagnetism Measurements***

HyunJune Lyu (Kyungpook National University, Korea); Yun Sik Bae (Kyungpook National University, Korea); Vijith Vijayakumaran Nair (Kyungpook National University, Korea); Jun-rim Choi (Kyungpook University, Korea)

Magnetic sensor chip for measuring bio-magnetism is implemented in 0.18μm CMOS technology. The magnetic sensor chip consists of a small-sized high inductance coil sensor and an instrumentation amplifier (IA). The embedded high-inductance coil sensor contains suitable sensitivity and bandwidth for biomagnetic measurements, and is designed via electromagnetic field simulation. A low-gm operational transconductance amplifier is also implemented on the chip to reduce the transconductance value. The output signal sensitivity of the magnetic sensor chip is 3.25 fT/μV, and the output reference noise is 21.1 fT/√Hz. The instrumentation amplifier is designed to minimize the magnetic signal noise using current feedback and a band-pass filter with a bandwidth between 0.5 kHz and 5 kHz. The common-mode rejection ratio is measured at 117.5 dB by the Multi-Project Chip test. The proposed magnetic sensor chip is designed such that the input reference noise is maintained below 0.87 μV.

14:00 ***Acquisition and Elaboration of Cardiac Signal in Android Smartphone Devices***

Angelo Vezzoli (University of Brescia, Italy); Chiara Maria De Dominicis (University of Brescia, Italy); Alessandro Depari (University of Brescia, Italy); Alessandra Flammini (University of Brescia, Italy); Stefano Rinaldi (University of Brescia, Italy); Emiliano Sisinni (University of Brescia, Italy)

Today, Smartphones diffusion has determined a wide availability of software applications for numerous purposes. Smartphones are now needful devices for every day life, not just advanced mobile phone terminals. The presence of powerful processing devices, embedded sensors and the availability of standard communication interfaces has recently interested the scientific community. Several projects based on Smartphones have been proposed in different fields and many more application scenarios are being explored. A critical aspect is the possibility of acquiring external information, such as data from other sensors. Being consumer devices, Smartphones provide digital and high level communication interfaces, such as USB. Sensor interface is possible if a suitable front-end able to digitalize sensor data and to handle the communication. To lower the complexity and the cost of the front-end and to reduce its power consumption, an effective method for the acquisition of external sensor signals through the Smartphone audio input is proposed. As a proof of concept, a sensor system composed by a photoplethysmographic sensor and a pair of electrodes for tissue impedance estimation has been used.

Specific software routines for Android operating system have been developed to process the acquired sensor signals and thus demonstrating the feasibility of the proposed approach.

14:20 ***Real-time remote vital sign detection using a portable Doppler sensor system***

Wei Hu (University of Science and Technology of China & Institute of Microelectronics of CAS, P.R. China); Zhangyan Zhao (Institute of Microelectronics of CAS, P.R. China); Yunfeng Wang (Institute of Microelectronics of CAS, P.R. China); Xize Wang (Institute of Microelectronics of CAS, P.R. China); Haiying Zhang (University of Science and Technology of China, P.R. China)

A portable sensor system with signal processing techniques are developed in this paper, aiming to provide remote monitoring of vital signs of human subject. The designed sensor based on microwave Doppler radar enables accurate reconstruction of subject's motion caused by cardiopulmonary activities and other movement in the field of view of the radar front-end. The developed algorithm enables real-time estimation of respiration, heart rate in real world conditions. The sensor system was designed to be a compact detector which can be integrated into portable device for personal healthcare applications. The described sensor system was successfully tested on both simulated target and human subject. The working range was from 3 cm to 250 cm, the mean square error of extracted heart rate is 0.46 compared with ECG results.

14:40 ***Patch Type Integrated Sensor System for Measuring Electrical and Mechanical Cardiac Activities***

Eeunjae Hyun (Seoul National University, Korea); SeugnWoo Noh (Seoul National, Korea); Chiyul Yoon (Seoul National University, Korea); Hee-Chan Kim (Seoul National University\, Korea)

The ElectroMechanical Film (EMFi), a thin and flexible piezoelectric material, has been widely used as a mechanical sensor or actuator. Especially in Biomedical Engineering field, many researchers have used EMFi for measuring ballistocardiogram (BCG) which is a mechanical signal caused by blood ejected from heart. However, previous methods required special equipments installed on a chair or a bed to measure BCG. In this preliminary study, we designed a flexible patch type sensor that can measure electrical and mechanical signal simultaneously on a single unit. The Ballistocardiogram-Electrocardiogram patch (BEpatch), integrated with a flexible circuit and attached to chest, can successfully measure fine electrocardiogram (ECG) and BCG signals simultaneously. The result shows that the BEpatch can be used for continuous monitoring of bio-signals in a simple and comfortable manner, thereby, advantageous as a wearable health care device

Sensors and Systems for Homeland Security

15:20 ***Probabilistic Method to Determine Human Subjects for Low-Resolution Thermal Imaging Sensor***

Yongwoo Jeong (Samsung S1 Corporation, Korea); Kwanwoo Yoon (Samsung S1 Corporation, Korea); KyoungHo Joung (Samsung S1 Corporation, Korea)

In this work, we present the method of determining the human subjects via a low-resolution thermal imaging sensor. Since the image quality of the low-resolution thermal imaging sensor could be suffering

from heat signatures and recognizable patterns of human subjects can't be determined due to resolution issue, it is recommended to employ the probabilistic method. This paper presents how human subjects can be expressed in terms of pixel size, standard deviation, label movement, vector tracking, label lifetime and a rewarding system based on those. And various pre and post-image processing methods will be covered including background collection, Gaussian filtering, segmentation, local/global adaptive threshold and background learning. Pre-processing and segmentation provide the base structure then probabilistic method calculates how the heat signature is close to be reported as a human subject. The calculated probability to be a human subject can be inherited as long as new segment's characteristics are considered as the connected one as the frame increases. Even though a human segment is disappeared, the proposed idea is able to track it with the local adaptive threshold. Also, the ambient heat sources like warm air circulation can be removed by using background learning.

15:40 ***Two-Frequency Surveillance Technique for Intrusion- Detection Sensor with Leaky Coaxial Cables***

Kenji Inomata (Mitsubishi Electric Corp. & Advanced R&D Centor, Japan); Wataru Tsujita (Mitsubishi Electric Corp., Japan); Takashi Hirai (Mitsubishi Electric Corp, Japan)

This paper presents a new design and realization of Leaky Coaxial Cable (LCX)-based intrusion sensing techniques. LCX radiates the microwave from slots milled on the outer conductor. This sensor can catch an intrusion object by measuring the variation of receiving signal. LCX has two types of emitting modes; the radiation mode and the surface mode. The microwave radiates to far field in the radiation mode. On the other hand, the microwave exists only around the LCX in the surface mode. Although the conventional LCX-based sensor operates the LCX in only one mode to detect and classify the object, this paper introduces the simultaneous sensing technique using these two modes. Comparing the signals in both modes, the classification of object can be estimated. The theory of the emitting modes of LCX and the developed sensor prototype are described. Experimental results are presented to show that the proposed sensing techniques are valid.

16:00 ***Emergency Management through Sensors of Enterprise Systems***

Deniz Gurkan (University of Houston, USA); Kiran Vemuri (University of Houston, USA); Parth Gala (University of Houston, USA); Anatoliy Malishevski (University of Houston, USA); Anand Daga (Dell, USA)

Emergency response has become a way of life. Safety and security are what many of us think about from day to day. Although, many of us hesitate to talk or think about what we would do in emergencies on a campus, we do expect that systems to be in place to respond quickly and intelligently. The main thesis of Emergency Management Gateway is to collect data from different sources of critical information and to aggregate it in a single place for the emergency management team to consider and make their decisions. In most cases, information and communications are the keys to the successful deployment of an emergency management program. In this paper, we propose an intelligent and efficient way to gather this type of critical data for the purpose of emergency management.

16:20 ***High-Resolution Measurement of Magnetic Field Generated from Cryptographic LSIs***

Nguyen Ngoc Mai-Khanh (University of Tokyo & VLSI Design and Education Center (VDEC), Japan); Tetsuya Iizuka (University of Tokyo, Japan); Akihiko Sasaki (Morita-Tech Co., Ltd, Japan); Makoto Yamada (Morita-Tech Co., Ltd, Japan); Osamu Morita (Morita-Tech Co., Ltd, Japan); Kunihiro Asada (University of Tokyo, Japan)

This paper presents a high-resolution magnetic measurement for detecting vulnerable and suspicious areas on cryptography LSI chips. A CMOS 3-stage low-noise amplifier is integrated with a magnetic pick-up coil to amplify the induced voltage of the coil. Moreover, the Si-substrate area underneath the coil is removed by applying a Focused-Ion-Beam technique to enhance the coil's performance. An automatic high resolution scanning system with in a shielded box implements magnetic sensing on both a micro-strip line and a cryptography LSI. By making a comparison with a commercial probe, this measurement holds the advantage that higher-resolution magnetic maps in multiple frequency bands and more revealed information can be achieved.

16:40 ***A Novel Cataluminescence (CTL) Sensor System Based on Two Sensing Units to Detect and Distinguish Ketone Vapors***

Ruiya Xing (Guangzhou University, P.R. China); Xiaoan Cao (University of Guangzhou, P.R. China); Ling Xu (Guangzhou University, P.R. China); Zhengni Wang (Guangzhou University, P.R. China); Yonghui Liu (Guangzhou University, P.R. China)

It has been reported that simple cataluminescence (CTL) sensors with one sensing unit generally cannot identify different gases, but that electronic noses can. However, the electronic nose is composed of several sensing units and is not conducive to instrumental stability. Here, a novel CTL sensor system based on two sensing units to detect and distinguish the vapors of different ketones has been developed. After each of the six ketone vapors passed through the surface of the nanosized MgO (or nanosized Y2O3) producing response signal IA (called the first-order reaction), the residual gases (exhausts) were considered to be a new reactant. It then passed through the surface of the nanosized MgO (or nanosized Y2O3; called the second-order reaction) producing the response signal IR. The study revealed that the IA/IR values on the given sensing unit were specific for one kind of ketone vapor, which are constants within a wide range of concentrations. Therefore, the method can be utilized to detect and distinguish different ketone vapors. By changing the flow direction of analyst gases, the sensor system obtained four IA/IR values for each of the six ketones to provide multidimensional information improving the ability of the sensors to detect and distinguish ketones.

Sensor Array and Multisensor Data Fusion

15:20 ***Design and Implementation of Array Readout Integrated Circuit and Image System for Current Mode Sensors***

Jia-Hao Li (National Chi Nan University, Taiwan); Lai Li Kang (National Chi Nan University, Taiwan); Tai Ping Sun (National Chi Nan University, Taiwan); Hsiu-Li Shieh (National Chi Nan University, Taiwan); Yi Chuan Lu (National Chi Nan University, Taiwan); Teng-Yi Wang (National Chi Nan University, Taiwan)

This study discussed the design of a dual-band hybrid array readout circuit. The direct injection circuit structure was used in the unit pixel. The readout circuit chip adopted TSMC 0.35um 2P4M CMOS 5V to design a 16x12 array readout circuit. The experimental results show that the minimum input current is 1.9pA, the total power dissipation of the circuit is 18.01mW, and the measured and calculated noise RMS voltage is 0.68mV when the power supply is 5V, and chip dynamic range is 69dB when the voltage output signal is 2V. The tested chip was used to connect the detection system proxy board and digital signal board, and digital signal processing video. The readout circuit chip connected the signal proxy board for testing. The overall system resolution reached 10 bit.

15:40 ***Expansion of Sound Source Emphasis to Multiple Areas***

Marco Politakis (University of Canterbury, New Zealand); Yusuke Hioka (University of Canterbury, New Zealand)

An expansion is introduced to a technique for emphasising sound signals from one particular area that is surrounded by undesired noise sources. The proposed expansion allows sound signals to be extracted from areas located in different positions. The previous method uses multiple fixed beamformers to estimate the PSDs of two-dimensional areas and thus, calculate the necessary gain coefficients used to emphasise sources within the target region. The proposed expansion adjusts the beamformer directivity, in order to change the location of the target region. Validation was achieved by testing the performance within an anechoic chamber using two Kinect sensors equipped with microphone arrays. The expansion achieved noise attenuation performance equivalent to that of the previous method in different target regions.

16:00 ***Localisation of a Sound Source in Different Positions Using Kinect Sensors***

Jason Orchard (University of Canterbury, New Zealand); Yusuke Hioka (University of Canterbury, New Zealand)

A novel strategy using two Microsoft Kinect sensors to achieve localisation of a sound source is proposed. The key concept is to perform a two stage localisation method. A coarse grain location estimate is first made followed by a more accurate estimate of sound source location by estimating power spectra of a number of spatial regions. The paper outlines the sound source localisation strategy is able to localise a sound source within a series of predefined spatial regions. The results of testing the strategy indicate that the strategy is able to localise an active sound source and can maintain good localisation performance even when ambient noise is present.

16:20 ***Power Sensor Applications in a Load Management Network for a Residential Microgrid***

Philip Diefenderfer (Bucknell University, USA); Peter Mark Jansson (Rowan University, USA)

As we continue to push the limits of technology further, our power grid is struggling to keep up with the technological advances. This project is about the design and implementation of a residential microgrid which is the future of smart grid technology. By definition, a microgrid has generation resources and loads which will need to be balanced using power sensors and load management in order to ensure

stable operation. Using Power Line Communications, this project will implement a smart metering infrastructure to allow for remote observation of the sensors and controls. Combining the power sensor networking infrastructure with a PV array and a Natural Gas Generator will give this microgrid smart controls that can respond to both the RTP market and both changing power grid and environmental conditions based on user set parameters and system sensors. Finally, this system will be introduced to an existing home to aid the homeowner in the identification of large drains of power using the power sensors in the home, monitor environmental conditions in the home through environmental sensors, and control both electrical loads and generation resources to lower energy costs and waste while being able utilize excess energy to back feed the power grid.

16:40 ***An advanced tracking solution fully based on native sensing features of smartphone***

Bruno Andò (University of Catania, Italy); Salvatore Baglio (University of Catania, Italy); Cristian Orazio Lombardo (University of Catania, Italy); Vincenzo Marletta (University of Catania, Italy)

This paper deals with an advanced multi-sensor approach for the implementation of tracking systems exploiting sensing and processing features embedded in smartphone devices. In particular, a methodology based on advanced data fusion paradigms assuring an efficient heading estimation has been developed. Main advantages of the solution proposed reside in the possibility to correctly perform heading estimation also in the presence of serious environmental influence due to permanent magnetic field distortion. Among possible application contexts, the proposed system would be particularly suitable for the development of mobility assistive systems for a safe and efficient exploration of educational/job environments by technological skilled weak people.

Wednesday, February 19

Special Session: Environmental and Agritech Related Sensors I

10:20 ***Free-Space Microwave Moisture Content Measurement of Moist Sand***

Sean Richards (Lincoln Agritech Limited, New Zealand); Adrian Tan (Lincoln Agritech Limited & Lincoln University, New Zealand); Ian G Platt (Lincoln Agritech Ltd, New Zealand); Ian M Woodhead (Lincoln, New Zealand)

Dielectric models are used with permittivity measurements of material for translation from permittivity to moisture content. A dielectric model for pure sand was developed based on fundamental physical properties such as the permittivity and geometry of the host material particles, and the frequency dependent processes that determine the permittivity of water. The measurement of sand using the short-circuited reflection method is discussed included associated pre-processing as is the processing of the measured data to extract permittivity values. A system is derived to automate the selection of appropriate solution equation, time-gate position and generation of initial values for numerical inversion. Measured data in the 1 - 6 GHz frequency range for sand with various volumetric moisture contents is compared with the dielectric model.

10:45 ***Antenna Design for a Proximal Soil Moisture Mapping Sensor***

Adrian Tan (Lincoln Agritech Limited & Lincoln University, New Zealand); Sean Richards (Lincoln Agritech Limited, New Zealand); Ian G Platt (Lincoln Agritech Ltd, New Zealand); Ian M Woodhead (Lincoln, New Zealand)

We present the design of an antenna array for a proximal soil moisture sensor that will be mounted on an irrigator. The sensor maps the soil moisture of the ground ahead and uses the information to modulate the water volume of the irrigator. The design objective of the antenna is to enable the sensor to map the ground surface at less than 1m2 resolutions. Applying radar analysis, it is determined that the antenna needs to maintain a directivity performance of 12 dBi over a bandwidth of 500 MHz. An array of four log-periodic dipole antennas is designed, constructed and measured. Measurement showed that the array exhibit a flat gain performance of 10.3 dBi over the frequency range of 400-1200 MHz. The dimensions of the antenna array are 0.35m×0.45m×0.55m. Based on the measured parameters, we computed that the sensor is capable of achieving a ground resolution of 0.62m2.

11:10 ***RFID Coordinate Registration for Agricultural Process Sensing***

Ian G Platt (Lincoln Agritech Ltd, New Zealand); Ian M Woodhead (Lincoln, New Zealand); Adrian Tan (Lincoln Agritech Limited & Lincoln University, New Zealand); Sean Richards (Lincoln Agritech Limited, New Zealand); Michael Hagedorn (LVL, New Zealand)

One of the key components in maintaining efficiency in Agricultural production is monitoring the "state" of the production cycle. To help achieve this, sensors that may be attached to mobile or relocatable components are becoming increasingly important and given their spatial diversity so is their communication and geographic positioning. Active RFID tags are becoming more prevalent for this type of operation since they are relatively low cost, robust, small and have ranges of several hundred metres. A major challenge with RFID tags is to obtain their coordinates in the cost effective manner that makes them so attractive in the first place. In this paper we develop a system to determine the location of RFID tags using RSS (Received Signal Strength) measurements between tags and the reader to estimate their position. Tag positioning with this system can be made with a single portable reader without the need for triangulation. The WSN (Wireless Sensor Network) is treated as an optimisation problem where relative positioning is found using a MCMC (Monte Carlo Markov Chain) technique. Results show that using this process it is possible to locate tags to within 2 - 3 metres at long ranges without major modification to currently available systems.

11:35 ***Moisture Content: What is it and how can it be measured?***

John Christie (Lincoln Agritech Ltd, New Zealand); Ian G Platt (Lincoln Agritech Ltd, New Zealand)

Dependence on water is pervasive in agriculture, affecting growth, harvesting, processing and storage of the products of the land. A great many sensors exist for measurement of water distribution, flow and quality, but I focus here on the water content of produce. Moisture content (M.C.) is a key parameter affecting the properties of commercially important products such as foods, cellulosics (e.g. wood products), textiles and a host of other miscellaneous materials. The common understanding of "moisture content" is the water content of a material, usually a solid such as wood or bread. But behind

this apparent simplicity lies surprising complexity. The question, "What is moisture content and what are our sensors measuring?" is not easily answered, and there exists a plethora of different, commonly incompatible, measurement methods. In this paper I examine the strengths and weaknesses of some common commercial and laboratory measurement methods and then focus on the prospects for a universal physical definition of moisture content so that sensors can be tailored to give results most pertinent to the produce being measured.

Micro and Nano-Sensors I

10:20 ***Anti-Phase Coupled Bistable Transducers: a review of recent progress***

Carlo Trigona (University of Catania, Italy); Salvatore Baglio (University of Catania, Italy); Bruno Andò (University of Catania, Italy); Felice Maiorca (University of Catania, Italy); F. Giusa (DIEEI, Italy); A. Noto (DIEEI, Italy)

The science of nonlinear systems and coupled oscillators in MEMS technology has recently undergone radical change, with the advent of new materials exploiting novel mechanisms fundamentally different from classical approaches (resonators). In this paper a review of recent progress on a novel nonlinear systems performed through two bi-stable beams coupled by using permanent magnets deposited at the tip of each cantilever is proposed. This mechanism, named anti phase bistable system, is based on two NdFeB permanent magnets, having the same direction of polarization, in order to impress a repulsive force on each beam. As consequence 180°of phase shift between the cantilevers will be induced. It is worst nothing that this configuration, that is suitable to be integrated as respect a "non-parallel magnetization", is useful as wide-band vibration energy harvester, but also as power converter, integrated signal conditioning circuits or filters. This family of devices has been presented/patented by the authors, here a brief overview will be conducted highlighting recent progress on methodology and some microscale prototypes based on PZT layers.

10:40 ***Design and Simulation of Nano-mechanical Resonator for Virus Detection***

Anyaa Mittal (BITS, Pilani Dubai Campus, UAE); Krishna Singh (Birla Institute of Technology & Science, Dubai, UAE); Gaurav Chaudhary (BITS, UAE); Neeru Singh (Birla Institute of Technology & Science, Dubai, UAE)

In the present study, nano mechanical resonator is used to detect different viruses. Biosensors have been designed using single walled Boron Nitrite Nanotube (SWBNNT) as a sensing material in terms of nanowire and micro cantilever. Here we have considered two approaches for sensing the biomolecules. First one is to calculate the change in resonance frequency of nanowire and second one is to calculate the bending deformation of micro cantilever in the measurable range. Resonance frequency shift of nanowire with and without virus has been calculated.Mass sensitivities of Boron Nitride nanowires are found to be more with increase in frequency shift.

11:00 ***An easy-fabricated hydrogen gas sensor based on palladium-decorated polyurethane nanofibers***

Ran Chen (The State Key Lab of Fluid Power Transmission and Control, P.R. China); Weiting Liu (The State Key Lab of Fluid Power Transmission and Control, P.R. China); Xin Fu (The State Key Lab of Fluid Power Transmission and Control, P.R. China); Paolo Dario (Scuola Superiore Sant'Anna, Italy)

This paper reports a hydrogen gas sensor based on palladium-decorated polyurethane nanofibers which can be easily fabricated through electrospinning, sputtering and stretching. This sensor performs a good and fast response (with response time less than 5s and recovery time less than 10s) to hydrogen gas of low concentrations with a sensitive but narrow range of linearity (with max sensitivity about 0.32% per ppm in resistance and width less than 100ppm) and a very low limit-of-detection (which can be below 50ppm). Since measurement range can be adjusted by stretching fibers, both single sensor which works as hydrogen-activated switch and sensor arrays with extended measurement range can be applied in hydrogen gas leak detection and other situations.

11:20 ***Design and Simulation of a Micro Hotplate for MEMS Based Integrated Gas Sensing System***

Hardeep Kumar (Birla Institute of Technology & Science, Dubai, UAE); Anuj Kumar (Birla Institute of Technology & Science, Dubai, UAE); Krishna Singh (Birla Institute of Technology & Science, Dubai, UAE); Neeru Singh (Birla Institute of Technology & Science, Dubai, UAE); Ravi Kant Mittal (Director, BITS Pilani, Dubai Campus, UAE)

Micro Hotplate (MHP) is one of the main components in micro-sensors, especially in gas sensors. The metal oxide gas sensors utilize the properties of surface adsorption to detect changes in resistance as a function of varying concentration of different gases. To detect the resistive changes, the temperature must be in the requisite temperature range over the heater area. Hence, the sensitivity and response time of the sensor are dependent on the operating temperature of the MHP. Making proper design is of critical importance. In this paper, design and simulation of uniform temperature MHP has been investigated which is best suitable for sensing multiple gases by using array of MHP to get the better sensitivity and better selectivity and compared with meander type MHP. So, by improving sensor properties this system would be advanced one. If there is mixture of gases present at the same time then there is a need of this type of gas sensing system. The designing and simulations have been done using the COMSOL 4.2a Multiphysics. MHP also has been the subject of great interest owing to their extensive applications in Bio Sensors for detection of environmental mycobacteria, Toxin detection and other micro-systems.

11:40 ***An inkjet printed sensor for load measurement***

Bruno Andò (University of Catania, Italy); Salvatore Baglio (University of Catania, Italy); Cristian Orazio Lombardo (University of Catania, Italy); Vincenzo Marletta (University of Catania, Italy)

Low cost direct printing technologies are assuming a terrific role for the development of sensors, with particular regards to bendable and flexible sensors addressing many applications. In this paper the development of a capacitive load sensor realized by low cost inkjet printing process is discussed along with its experimental characterization. The load sensor is based on a InterDigitated (IDT) capacitive Transducer, printed on a PET substrate, covered by a dielectric layer. The sensing methodology

proposed as respect to traditional solutions based on resistive strain sensor is characterized by the absence of mechanics allowing the transduction between load and strain, which is usually implemented by cantilever architectures. Experimental results provide an estimated sensor resolution of 8,5•10-4 kg.

Special Session: Computer Vision and Machine Learning for Vision Based Applications, Organized by TC-32 (Fault-Tolerant Measurement Systems) of IEEE I&M Society

13:20 ***Fast and Robust Zebrafish Segmentation and Detection Algorithm under Different Spectrum Conditions***

Jei Shian Tan (Monash University Malaysia, Malaysia); Tak Kwin Chang (Monash University Malaysia, Malaysia); Melanie P-L. Ooi (Monash University, Malaysia); Ye Chow Kuang (Monash University Malaysia, Malaysia); Chee Pin Tan (Monash University Malaysia, Malaysia); Takashi Kitahashi (Monash University Malaysia, Australia)

Zebrafish is a vertebrate animal used for spectral neurobehavioural studies due to its robust endocrine system. Such studies generate large amounts of video data which is too time-consuming and exhausting for a human observer to manually log their behaviour. Thus, computer vision techniques must be applied. Unfortunately, current commercial software for this application were developed for analysis under normal incandescent lighting and sunlight, thus they fail to work for spectral studies whereby the incident light spectrum is changed. This research develops a fast and robust algorithm to detect and segment the fish under different lighting spectrum and benchmarks it against a state-of-art background extraction algorithm as well as an available commercial off-the-shelf software.

13:40 ***Detecting Spongiosis in Stained Histopathological Specimen using Multispectral Imaging and Machine Learning***

Sanush Abeysekera (Monash University Malaysia, Malaysia); Melanie P-L. Ooi (Monash University, Malaysia); Ye Chow Kuang (Monash University Malaysia, Malaysia); Chee Pin Tan (Monash University Malaysia, Malaysia); Sharifah Syed Hassan (Monash University Malaysia, Australia)

Pathologists spend nearly 80% of their time analysing pathological tissue samples. In addition, the diagnosis is subject to inter/intra-observer variability. Thus to increase productivity and repeatability, a new field known as Computational Pathology has emerged which combines the field of pathology with computer vision, pattern recognition and machine learning. This research develops a new computational pathology framework specifically to aid with detecting a condition known as spongiosis caused by Newcastle Disease Virus infection in poultry. It combines with use of multispectral imaging with feature extraction and classification to detect areas of spongiosis in the tissue of infected poultry. The success of this framework is the first step towards a completely automated diagnosis tool for histopathology.

14:00 ***Vision Inspection System for Pharmaceuticals***

Minh Duong (RMIT International University Vietnam, Vietnam); Moi Tin Chew (RMIT University Vietnam, Vietnam); Serge Demidenko (RMIT International University Vietnam & Saigon South campus, Vietnam); Quoc Pham (National Instruments Vietnam, Vietnam); Dang Pham (National Instruments Vietnam,

Vietnam); Melanie P-L. Ooi (Monash University, Malaysia); Ye Chow Kuang (Monash University Malaysia, Malaysia)

This paper presents a low cost automatic inspection system aimed at quality monitoring of pharmaceutical products on a production line. The system is built around a smart camera and custom designed LabVIEW based software. It is capable of detecting multiple defects of various types.

14:20 ***Standard Uncertainty Estimation on Polynomial Regression Models***

Arvind Rajan (Monash University, Malaysia); Ye Chow Kuang (Monash University Malaysia, Malaysia); Melanie P-L. Ooi (Monash University, Malaysia); Serge Demidenko (RMIT International University Vietnam & Saigon South campus, Vietnam)

Polynomial regression model is very important in the modeling and characterization of sensors. The uncertainty propagation through the polynomial non-linearity can only be estimated through numerical simulation or linearization approximation according to the Guide to the expression of Uncertainty in Measurement. This paper developed a general cookbook style guide to derive the analytical expression of uncertainty propagating through the polynomial regression models. The proposed method can be easily incorporated into any computer algebra system for reliable and fast evaluation. Specific expressions are derived explicitly for some of the most commonly used low order polynomial regression models. The framework is applied to a few recently published sensor and measurement system models.

Magnetic Sensors and Applications

13:20 ***Microfluidic Injector Simulation with SAW Sensor for 3D Integration***

Hang Bui Thu (University of Engineering and Technology, VNU-H, Vietnam); Trinh Chu (VNU University of Engineering and Technology, Vietnam)

The possible creation of efficient liquid sensors on the nozzle is presented. The proposed surface acoustic wave (SAW) device utilizing Aluminum Nitride (AlN) single crystal as the piezoelectric substrate is based on the pressure variation due to the continuous droplet ejector. The design, specification and numerical simulation results are described. Output response results demonstrating the efficiency and scalability of the method have been presented. This 3D integrated system has a number of advantages such as sensitivity to droplet pressure in the nozzle. It is able to detect the whole droplet formation process, fabrication in CMOS compatible material, leading to an inexpensive and reliable system. Using a 3D model, the combination capacity between inkjet printer and piezoelectric and electrical-mechanical stability was verified.

13:40 ***Predicting Cole-Cole Parameters of Microfluids with Microstrip Technology***

Adam Santorelli (McGill University, Canada); Joshua D Schwartz (Trinity University, USA)

In this paper we present the novel design of a microstrip sensor to measure the broadband complex permittivity of small fluid samples and accurately predict their Cole-Cole parameters. This novel

approach differs from prior works by placing the fluid analyte in an enclosed chamber underneath the trace of a suspended microstrip, allowing for better overlap between the electromagnetic fields and the fluid in comparison with microfluidic sensors in coplanar technology. A simple direct measurement technique that exploits device symmetry is proposed to extract the dielectric properties of the fluid from full 2-port scattering parameters and is validated through simulation data.

14:00 ***A coupled nonlinear circuit for E-field and B-field detection***

Angela Beninato (University of Catania, Italy); Salvatore Baglio (University of Catania, Italy); Bruno Andò (University of Catania, Italy); Adi R. Bulsara (Space and Naval Warfare Center (San Diego), USA); Teresa Emery (Space and Naval Warfare Systems Center (San Diego), USA); Vaijayanti R Palkar (Indian Institute of Technology Mumbai, India); Catherine A Jenkins (Advanced Light Source, Lawrence Berkeley National Laboratory, USA)

Multiferroic materials represent a very attractive class of materials due to the coupling between their electric and magnetic orders. A recent paper has demonstrated that a thin film of BDFO shows a good magnetoelectric coupling. Based on such a peculiarity, multiferroic composites can be successfully used to realize sensors of both electric and magnetic fields. This work reports two different ways to realize an E-field and B-field sensor with a thin layer of BDFO. The first approach shows as a single multiferroic device can be used as sensor, while the second approach exploits a coupled system made by three multiferroic devices. The multiferroic device models are presented together with the electronic circuits used in the simulations.

14:20 ***Applications of nanoparticle-based fluxgate magnetometers for positioning and location***

John Kennedy (GNS Science, New Zealand); Jerome Leveneur (GNS Science, New Zealand); John Futter (GNS Science, New Zealand); James Turner (GNS Science, New Zealand); Grant Williams (Victoria University of Wellington, New Zealand)

Magnetic sensors can provide a very useful alternative for indicating the position or location of a subject and in conditions where other technologies will fail. For instance, GPS cannot accurately be used indoor and accelerometer-based systems have not yet reached the accuracy required for location after traversing long distances. In this paper we present results from a preliminary investigation aimed at determining the potential of three axes fluxgate magnetometers for personal location. Fluxgate magnetometers can display high sensitivity to magnetic fields but are limited by the properties of the core material. We discuss the potential and advantages of nanoparticle fluxguides in fluxgate magnetometers for positioning and location applications. The nanoparticles used for this study were synthesised using an arc-discharge method.

Special Session: Environmental and Agritech Related Sensors II

15:20 ***A Miniaturized Soil Moisture Sensor Based on Time Domain Transmissometry***

Bianca Will (Ruhr-University Bochum, Germany); Ilona Rolfes (Ruhr-Universität Bochum, Germany)

Delay time measurements are a powerful method for soil moisture measurements. Besides the well-known time domain reflectometry (TDR), a new method, namely the time domain transmissometry (TDT) captures the market for soil moisture sensors. The key benefit of transmission measurements is their robustness against multiple reflections. However, the development of TDT sensors for measurements inside soils is a challenge due to specific geometric requirements. While transmission measurements are in general performed in two port setups, measurements inside soils require an one port setup. Hence, time domain sensors are in general based on reflection measurements. This contribution describes a soil moisture sensor, which combines the advantages of TDR and TDT measurements regarding the suitability for soil moisture measurements. The sensor consists of a concentric coaxial line assembly resulting in a compact setup. The measuring path is realized as an one wire line to obtain a high penetration depth and thus, a large soil sample volume.

15:40 ***Spatial Time Domain Reflectometry (spatial TDR) in geo-environmental engineering***

Alexander Scheuermann (The University of Queensland, Australia); Gonzales Christopher (The University of Queensland, Australia); Junliang Fan (The University of Queensland, Australia); Bruno Braga (The University of Queensland, Australia); Thomas Baumgartl (The University of Queensland, Australia); Stefan Schlaeger (sceme GmbH, Germany); Rolf Becker (Rhein-Waal University of Applied Science, Germany); Norman Wagner (Bauhaus-University Weimar, Germany); David Lockington (The University of Queensland, Australia); Christof Huebner (University of Applied Sciences Mannheim, Germany)

Spatial Time Domain Reflectometry (spatial TDR) is a measurement method for determining water content profiles along electrically insulated probes (transmission lines). The method is based on the inverse modeling of TDR reflectograms using an optimisation algorithm. By means of using flat ribbon cables as sensors it is possible to take two independent TDR reflectograms from both ends of the probe, which are used to improve the spatial information content of the optimisation results and to consider effects caused by electrical conductivity. The method has been used for different geo-environmental purposes, such as the monitoring of water content distributions on a sand island for investigating groundwater recharge processes and the monitoring of a mine waste cover. The contribution introduces the spatial TDR technology and presents results of different applications.

16:00 ***Estimation of the Soil Water Characteristics from Dielectric Relaxation Spectra***

Norman Wagner (Bauhaus-University Weimar, Germany); Alexander Scheuermann (The University of Queensland, Australia); Moritz Schwing (University of Queensland & School of Civil Engineering, Australia); Frank Daschner (University of Kiel, Germany)

The frequency dependence of dielectric material properties of porous mineral materials such as soil are not only disturbing in applications with high frequency electromagnetic (HF-EM) measurement techniques (TDR, FDR, GPR, remote sensing) but also contain valuable information of the material due to strong contributions by interactions between an aqueous pore solution and mineral phases. This circumstance opens the possibility to estimate physico-chemical parameters such as water content, texture, mineralogy and matric potential with broadband HF-EM measurement techniques. In this

context, a multivariate approach was applied to estimate the Soil Water Characteristic Curve (SWCC) from experimental determined dielectric relaxation spectra of a silty clay soil.

16:20 ***Non-destructive Coaxial Transmission Line Measurements for Dielectric Soil Characterization***

Moritz Schwing (University of Queensland & School of Civil Engineering, Australia); Norman Wagner (Bauhaus-University Weimar, Germany); Alexander Scheuermann (The University of Queensland, Australia); Zhen Chen (The University of Queensland, Australia)

A high-frequency electromagnetic measurement technique is employed to investigate dielectric properties of a fine-grained soil. As a case study, a standardized compacted fine-grained soil was investigated using a coaxial transmission line cell in combination with vector network analyzer technique in a frequency range from 1 MHz to 3 GHz. The measurement results indicate that this type of sensor enables the broadband determination of soil dielectric spectra, i.e. the frequency dependent relative effective complex permittivity. Hence, with the introduced coaxial transmission line setup the dielectric relaxation behavior of the investigated soil can reliably characterize defined structural states. Moreover, it was found that dielectric material parameters at high frequencies are mainly related to the volume fractions of the soil phases, i.e. water content whereas at low frequencies to soil structure and density due to interface processes.

16:40 ***A Comparison of Two Ranging Approaches in an Active, Optical Plant Canopy Sensor***

Michael T Schaefer (University of New England & CSIRO, Australia); David Lamb (University of New England & Precision Agriculture Research Group, Australia)

Active optical sensors that contain their own modulated light sources are becoming popular for 'sensing' photosynthetically-active biomass in crops and pastures. Primarily confined to on-ground deployment, these sensors rely on detecting optical reflectance in two or more wavebands (for example red and near infrared). The derived spectral vegetation indices, such as the widely-used normalised difference vegetation index (NDVI) are subsequently calibrated to a measure of biomass, tiller number, leaf area index or the like. However, research has demonstrated the accuracy of the derived measurements can often be improved by including both a spectral index and a corresponding measure of plant height. This paper describes an active, optical sensor that integrates modulated reflectance sensing with the ability to measure (range) the distance between the source and a target surface. Two ranging techniques are evaluated; one based on the inverse square law (ISL) of reflected radiation from a target and another based on a position-sensitive detector (PSD).

Sensors Applications in Robotics and Automation

15:20 ***Direction of Arrival Estimation of Kiwi Call in Noisy and Reverberant Bush***

Craig Gray (University of Canterbury, New Zealand); Yusuke Hioka (University of Canterbury, New Zealand)

This paper outlines the steps taken to accurately perform acoustic source localisation of kiwi calls using microphone arrays in the presence of noise and reverberation. A generalised cross correlation using a combinational weighting function, exploiting the benefits of two traditional methods was investigated and implemented as part of the system. To reduce correlated noise, spectral subtraction and Wiener filtering were investigated; and their suitability in the system was analysed. A novel algorithm exploiting the harmonic structure of the kiwi call is proposed to determine whether or not a kiwi call is present. The angle of which the acoustic source (kiwi call) originated from was estimated and had an an average deviation of 7.53 degrees. This was significantly better than a previous attempt to acoustically locate the kiwi call, which could estimate the incident angle of the kiwi call, with an average deviation of 22.18 degrees.

15:40 ***A New Approach On Advanced Compact Plasma Sensors for Industrial Plasma Applications***

Christian Schulz (Ruhr-Universität Bochum, Germany); Ilona Rolfes (Ruhr-Universität Bochum, Germany)

A novel compact plasma sensor applicable for the supervision and control of industrial plasma processes is presented in this contribution. Based on the multipole resonance probe (MRP), the new planar multipole resonance probe (P-MRP) flush-mounted into the reactor wall can be used for an effective suppression of disruptions on the plasma process itself. Instead of external parameters, which only give indirect information about the plasma parameters and the deposition process, an adjustment is directly affected by the plasma parameters themselves. Using 3D-electromagnetic field simulations, the MRP and the P-MRP are investigated and compared. Furthermore, limitations concerning position tolerances are shown and the suitability is demonstrated.

16:00 ***Real-time classification of industrial products based on the photonic-mixer-device sensor technology***

Stephan Hussmann (West Coast University of Applied Sciences, Germany)

During the last years, Time-of-Flight sensors achieved a significant impact onto research fields in machine vision. In comparison to stereo vision system and laser range scanners they combine the advantages of active sensors providing accurate distance measurements and camera-based systems recording a 2D matrix at a high frame rate. Moreover low cost 3D imaging has the potential to open a wide field of additional applications and solutions in markets like consumer electronics, multimedia, digital photography, robotics and medical technologies. This paper focuses on the classification task of typical industrial products in the close-up range. A new approach due to the use of the photonic-mixer-device (PMD) sensor technology is presented which achieves a much simpler real-time classification. Experimental results show that the proposed approach is well suited for machine vision applications.

16:20 ***Phase-Height Relationship by Plane Analysis in 3D Shape Measurement using Fringe Pattern Projector***

Byeong-Mook Chung (Yeungnam University, Korea); Yoon-Chang Park (Sunmoom University, Korea); Jin-Yeong Do (AVACO Co., Ltd, Korea)

In a three-dimensional(3-D) measurement system based on a digital light processing (DLP) projector and a camera, a height estimating function is proposed based on geometric analysis. The proposed 3-D shape measurement method is a hybrid method that combines the geometric parameter measuring method and the least squares method. This method uses the phase-to-height relationship for one line by plane analysis, and the related parameters are estimated using the least squares method. The method has one function per image line instead of one function per image pixel. Sinusoidal fringe patterns of the projector are projected on the object, and the phase of the measuring point is calculated from the camera image. Then, the relationship between the phase by fringe patterns and the height of the measuring point is described as a parameter of the horizontal coordinate on the image plane. Thus, the 3-D shape of the object can be obtained. Our experiments show that the model for the entire working space can be represented by several plane models because all the x-z plane models along the y-axis are nearly the same. Therefore, the proposed method can dramatically reduce the number of mapping functions needed for 3-D measurement.

16:40 ***PointsBug Versus TangentBug Algorithm, A Performance Comparison In Unknown Static Environment***

Norlida Buniyamin (Universiti Teknologi MARA, Malaysia); Wan Ahmad Jailani Wan Ngah (Universiti Teknologi MARA, Malaysia); Zainuddin Mohamad (Universiti Teknologi MARA (UiTM), Malaysia)

This paper presents an overview of Bug algorithm family local path planning methodology timeline. The Bug algorithm approach detects the nearest obstacle as a mobile robot moves towards a target with limited information about the environment. It uses obstacle border as guidance toward the target. The robot circumnavigates the obstacle till it finds certain condition to fulfill the algorithm criteria to leave the obstacle towards target point. In addition, this paper presents the performance of a new path planning approach, PointsBug algorithm. The performance of PointsBug was compared to TangentBug in term of duration and distance in various types of environment. TangentBug was selected as the algorithm to be compared to as it is the best performing Bug family algorithm that uses a range sensor similar to PointsBug. The outcomes of the research indicates that PointsBug have outperformed TangentBug in average speed in the selected environment as described in this paper.

Thursday, February 20

Sensors Applications in Robotics and Automation II

09:00 ***Sensing and processing of Bio-metric Signals for use in Low Cost Bio-robotic Systems***

Christopher Scott (Researcher, New Zealand); Gourab Sen Gupta (Massey University, New Zealand); Liqiong Tang (Massey University, New Zealand)

Use of bio-metric signals, from muscle and neurons, to build intelligent control systems to mimic human behaviour is an important area of active research. Such bio-robotic systems are finding use in rehabilitation and recovery of human organ functions. They also aid in removing the human beings from dangerous and hazardous working conditions. This paper reports the research attempts that have been

undertaken to develop a cost-effective bio-driven robotic system for hand amputees, more precisely for wrist disarticulation. The system uses the EMG signals from an amputee's arm to realize a few commonly used finger and hand movements. The developed system is able to obtain the EMG signals through a specifically designed data acquisition and signal processing circuit. A specially designed finger unit has been built and the test model is able to carry out the desired functions of gripping an object. Initial outcomes are very promising and ongoing research will ensure that the entire system will be able to be driven by the amputees using their EMG signals and realize the functions of a selected finger and hand for their everyday activities.

09:25 ***Investigation of Force Sensors for use in Bipedal Humanoid Dynamic Gait Generation***

Rick Pierce (Massey University, New Zealand); Gourab Sen Gupta (Massey University, New Zealand)

A humanoid robot is being developed for implementing and evaluating dynamic gait algorithms. Force sensors are placed on the bottom of the feet of the robot to provide feedback for the control system. The use of resistive force sensors is being investigated as an inexpensive and lightweight alternative to multi-axis force/torque sensors. However, resistive force sensors have a more limited accuracy and response time. Sensors from three companies have been tested: Sensitronic, Interlink, and Inaba Rubber. The sensors were tested with a TA.XTPlus texture analyzer, which is capable of applying specific forces at different rates. The sensors were tested for repeatability of response, drift, and response time to both application and removal of the force. An inverting op-amp is used to convert the force measurement of the sensor to an output voltage, which is read by an oscilloscope. The force measurements from texture analyzer and the voltage output from the oscilloscope are recorded digitally. The data obtained from the measurements is analyzed and the potential uses and limits of the sensors as feedback mechanisms in a bipedal humanoid robot are discussed.

09:50 ***Sensor Signal Filtering in Quadrotor Control***

Son Pham (RMIT International University Vietnam, Vietnam); Moi Tin Chew (RMIT University Vietnam, Vietnam)

This paper presents a simple low cost quadrotor remotely controlled through a standard 4-channel terminal and ARM-based flight controller board employing two MEMS sensors (3-axis gyroscope and 3-axis accelerometer). With the aim to improve the quality of the aerial vehicle control the paper presents the experimental comparison between two sensor data filtering algorithms: complementary filtering and Kalman filtering.

10:15 ***Automating Monitoring of Cat Feeding Behaviour***

Donald G. Bailey (Massey University, New Zealand); David Thomas (Massey University, New Zealand); Michelle Cho (Massey University, New Zealand); Said Al-Souti (Massey University, New Zealand)

Cat food manufacturers spend a significant proportion of their research budget on food formulation and palatability. In this paper we propose an efficient and economic method of monitoring cat feeding behaviour during palatability trials. Instrumenting food bowls with load cells measures how much is

eaten in each meal, and video records the interaction with the food during meals. Adaptive background subtraction is used to trigger recording, eliminating long periods of uninteresting video. A single computer is able to monitor and record 4 cages simultaneously at 25 frames per second.

Wireless Sensor Networks I

09:00 ***Wireless Aircraft Fuel Quantity Indication System***

Andrew Robb (Boeing, USA); Jason Bommer (The Boeing Company, USA); Rene Martinez (Intermec Technologies, USA); Jason Harrigan (Intermec, USA); Shashi Ramamurthy (Intermec Technologies, USA); Harikiran Muniganti (Indian Institute of Science, India); Vivekanand Mannangi (Indian Institute of Science, India); Kj Vinoy (Indian Institute of Science, India)

A wireless fuel quantity indication system has been developed using an RFID-enabled sensing platform. The system comprises a fully passive tag, modified reader protocol, capacitive fuel probe, and auxiliary antenna for additional energy harvesting. Results of fluid testing show sensitivity to changes in fluid height of less than 0.25in. An RF-DC harvesting circuit was developed, which delivers up to 5dBm of input power through a remote radio frequency (RF) source. Testing was conducted in a loaded reverberation chamber to emulate the fuel tank environment. Results demonstrate feasibility of the remote source to power the sensor with less than 1W of maximum transmit power and under 100ms dwell time (100mW average power) into the tank. This indicates adequate coverage for large transport aircraft at safe operating levels with a sample rate of up to 1 sample/s.

09:20 ***Mobility-Aware Hybrid Medium Access Control Protocol for Wireless Sensor Network (WSN)***

Abdul Razaque (University of Bridgeport, USA); Khaled M. Elleithy (University of Bridgeport, USA)

Medium access control (MAC) protocol is highly demanded alongside the introduction of wireless sensor network. Finding suitable wireless sensor network, MAC protocol has increasingly been important to improve performance. In this paper, Boarder Node Medium Access Control (BN-MAC) mobility aware hybrid protocol is introduced for WSN that controls overhearing, idle listening and congestion issues by preserving energy over WSN. We introduce novel semi synchronous low duty cycle technique in BN-MAC that takes less time for accessing channel and faster delivery of data. The objective of introducing BN-MAC protocol is to support four application areas: monitoring and behavioral areas, controlling natural disasters, tracking and handling home automation devices and human-centric application areas. These application areas need contention free mobility support features with high delivery of data. Evaluation of BN-MAC is conducted using network simulator-2 (ns2) then compared with known low power listening (LPL) and X-MAC low duty cycles MAC protocols and MAC hybrid protocols: Zebra medium access control) (Z-MAC), advertisement-based MAC (A-MAC), Speck-MAC, Adaptive Duty Cycle SMAC (ADC-SMAC), low power real time medium access control (LPR-MAC) protocol. On basis of initial Simulation results, we claim that BN-MAC protocol saves extra 18% to 45% energy resources as compare with other MAC protocols.

09:40 ***Low-power wireless interface for handheld smart metering devices***

Luca Berghella (University of Brescia, Italy); Alessandro Depari (University of Brescia, Italy); Paolo Ferrari (University of Brescia, Italy); Alessandra Flammini (University of Brescia, Italy); Stefano Rinaldi (University of Brescia, Italy); Emiliano Sisinni (University of Brescia, Italy); Angelo Vezzoli (University of Brescia, Italy)

Advantages of smart metering are well known: more control of resource usage, accurate bills and better budgeting. For this reason roll out plans have been created not only for electricity, but also for gas distribution. In such a scenario, some additional difficulties arise due to the need of a wireless and autonomous functioning of meters. In particular, measurement techniques and communication protocols must take into account limited power source availability. In this work the need of a low power handheld device for maintenance (and monitoring) in the context of gas smart metering is addressed. The proposed architecture exploits smartdevices (e.g. smartphones or tablets) as user-friendly terminals. Low power consumption is ensured using inductive coupling for data transmissions. A proof-of-concept prototype has been realized confirming the effectiveness of the proposed solution. In particular the consumption of the interface does not affect the overall system lifetime.

10:00 ***An Empirical Path Loss Model for Wireless Sensor Network Deployment in a Dense Tree Environment***

Abdulaziz Alsayyari (Florida Institute of Technology, USA); Ivica N. Kostanic (Florida Institute of Technology, USA); Carlos Otero (Florida Institute of Technology, USA)

This paper presents a model for predicting radio frequency (RF) propagation for Wireless Sensor Network (WSN) deployment in a dense tree environment. To create the model, data from a physical deployment are collected and an empirical path loss prediction model is derived from the actual measurements. Furthermore, the presented measurements and empirical path loss model are compared with measurements and models obtained from WSN deployments in other terrains, such as one characterized by long-grass and another by sparse-tree environments. The results from the comparison of these different terrains show significant differences in path loss and empirical models' parameters. In addition, the proposed model is compared with Free Space Path Loss (FSPL) and Two-Ray models to demonstrate the inaccuracy of these theoretical models in predicting path loss between wireless sensor nodes deployed in dense tree environment.

10:20 ***BlurSense: Dynamic Fine-Grained Access Control for Smartphone Privacy***

Justin Cappos (Polytechnic Institute of New York University, USA); Lai Wang (NYU-Poly, USA); Richard Weiss (The Evergreen State College, USA); Yi Yang (Fontbonne University, USA); Yanyan Zhuang (University of British Columbia & Polytechnic Institute of New York University, Canada)

For many people, smartphones serve as a technical interface to the modern world. These smart devices have embedded on-board sensors, such as accelerometers, gyroscopes, GPS sensors, and cameras, which can be used to develop new mobile applications. However, the sensors also pose privacy risks to users. This work describes BlurSense, a tool that provides secure and customizable access to all of the sensors on smartphones, tablets, and similar end user devices. The current access control to the

smartphone resources, such as sensor data, is static and coarse- grained. BlurSense is a dynamic, fine-grained, flexible access control mechanism, acting as a line of defense that allows users to define and add privacy filters. As a result, the user can expose filtered sensor data to untrusted apps, and researchers can collect data in a way that safeguards users' privacy.

Wireless Sensor Networks II

11:00 ***What is the First Step in Designing an Application Protocol for Wireless Sensor Networks (WSNs)?***

Quazi Ehsanul Kabir Mamun (Charles Sturt University, Australia); Mohammed Kaosar (Charles Sturt University, Australia)

This paper introduces a novel notion in the application protocol design paradigm for wireless sensor networks (WSNs). The traditional approaches of designing application protocols tend to focus primarily on developing the protocols first, and then using them on different topologies for implementation. We, however, argue that the logical topology of WSNs should be considered before designing application protocols. The argument is made on the basis that the logical topology of WSNs dictates the communication abstraction, the structure, and the hierarchy of the network. Thus, a well-designed logical topology helps in minimising the constraints of the WSNs and provides benefits to design various application protocols. In this paper we demonstrate how a well-designed logical topology influences the performances of protocols developed in WSNs. In doing so, the logical structure and the communication abstraction of the logical topology are used to design a number of application protocols, and their performances are evaluated.

11:20 ***UWB Sensor Network on 2-D Waveguide Sheet***

Yuta Kudo (University of Tokyo, Japan); Akihito Noda (The University of Tokyo, Japan); Hiroyuki Shinoda (University of Tokyo, Japan)

High-throughput and low-latency wireless connection of sensors is one of key issues in wireless multimedia sensor network (WMSN). Ultra-wideband (UWB) technology is expected to realize high data rate wireless communications within tens of meters by its sufficiently large channel capacity. In this paper we propose a room-size ultra-wideband (UWB) wireless communication system for fast data transmission of sensor networks. We use two-dimensional signal transmission (2DST) for wireless communication. In the proposed system, planar waveguide sheet is used as a medium guiding microwave and receiver couplers on the sheet extract microwave across the sheet surface. We design the UWB coupler and demonstrate the validity by numerical simulation. Experimental results show that the fabricated couplers can mediate sufficient power for UWB communication.

11:40 ***A Networked High-Speed Vision System for Vehicle Tracking***

Akihito Noda (The University of Tokyo, Japan); Masahiro Hirano (University of Tokyo, Japan); Yuji Yamakawa (University of Tokyo, Japan); Masatoshi Ishikawa (University of Tokyo, Japan)

The paper presents a networked vision system for tracking vehicles traveling along highway. The system aims to continuously track the vehicles from the entrance to the exit while never losing the targets. Such a system should be useful for surveillance and analysis of traffic congestion and accident. Each vehicle crosses a large number of cameras at high speed, one ofter another. To realize the system, higher frame rate and smaller data communication are desired for reliable target tracking and system scalability. We developed a prototype system that captures the moving vehicle with approximately 720 frames-per-second and that shares the small feature data only between a pair of adjacent cameras. A 1/10-scale vehicle moving across two cameras at 2000 mm/s = 7.2 km/h was successfully tracked by the experimental system.

12:00 ***Fuzzy Logic Control Mechanism for Flash Flood Monitoring Station***

Paskorn Champrasert (Chiang Mai University, Thailand); Supamit Jankoo (Chiang Mai University, Thailand)

This paper proposes an adaptable flash flood monitoring station, called (MixKey). MixKeys have been designed, implemented, and installed on the target area. To meet the installation requirements, MixKey has been designed as an modular wireless sensor node. It is flexible to install. In order to efficiently operate under the real environmental conditions, fuzzy logic control mechanism has been applied in the design. This makes MixKeys automatically adapt its operation parameters (e.g., data transmission rate, electric power source) against the environmental condition changes. The results show that the fuzzy logic control mechanism contributes to reduce the variant of the sensing data to the real-time environmental data with efficient battery consumption.

12:20 ***A Processing Approach for a Correlating Time-of-Flight Range Sensor Based on a Least Squares Method***

Michael Hofbauer (Vienna University of Technology, Austria); Johannes Seiter (Vienna University of Technology, Austria); Milos Davidovic (Vienna University of Technology, Austria); Horst Zimmermann (Vienna University of Technology, Austria)

A novel processing approach for the output data of a correlating time-of-flight range sensor based on a least squares method is presented. Until now, the fast Fourier transform and a trigonometric approach have been widely used to derive the distance information from the output signal of the sensor. Compared to these methods, the presented approach does not suffer from a systematic phase dependent error for ideal signals. Moreover, this method allows the detection of multipath propagation, i.e., it is possible to detect if light from different distances is received at the same time. Under certain circumstances, it is even possible to extract the distances of the different paths. Simulation results are presented, comparing the performance of this novel approach to the existing ones. Moreover, first measurement results prove the feasibility of this method and show a reduction of the phase dependent error by 90% compared to the alternative approaches.

Special Session: Sensors and Systems for Emergency and First Response

11:00 ***Using Directional Antennas as Sensors to Assist Fire-fighting Robots in Large Scale Fires***

Byung-Cheol Min (Purdue University, USA); Eric Matson (Purdue University, USA); Anthony Smith (Purdue University, USA); Eric Dietz (Purdue University, USA)

Humans will replace human labor with new robotics technologies, especially where humans can placed in danger. Evolving sensor and robotic technologies allow the transfer of humans from mundane, dangerous or difficult tasks, leaving robots to apply their specific capabilities to replace human's daily routines or hazardous tasks. Often, humans work in teams to resolve difficult scenarios, such as the aftermath of some natural or man-made disaster. Communication between each and every team member is critical to resolve relief efforts or remediation in most disasters. This research presents robotic technology developed to remediate the long lead time to re-establish new networks in the case of a disaster situation. The specific application and test domain, of this research, is with fire fighting.

11:20 ***An Efficient Area Coverage Algorithm using Passive RFID System***

SangYup Lee (Kyung-Hee University, Korea); Choong-Yong Lee (Kyung-Hee University, Korea); Won-Seo Cho (Kyung-Hee University, Korea); Donghan Kim (Kyung Hee University, Korea)

This paper proposes an efficient area coverage algorithm for multi-agent robotic systems in the smart floor environment consists of passive RFID system. The passive RFID system used in this research allows to store and read information on an RFID tag, which should be located within the detection range of RF antenna. The location information is explicitly stored in the RFID tag, where the smart floor environment is constructed by laying RFID tags on the floor. Mobile robot equipped with an antenna receives the location information in the RFID tag. Based on this information, the position of mobile robot can be estimated and at the same time, the efficiency of area scanning process can be improved compared to other methods because it provides a scanning trace for other mobile robots. This paper proposes an efficient area coverage algorithm for multi-agent mobile robotic systems using the smart floor environment.

11:40 ***Infrared Depth Sensor KinectTM-based Smart Room Controller***

Arthur Silitonga (President University, Indonesia); Sugianto Thoeng (President University, Indonesia)

Most software programmers tend to take part in creating applications and hardware engineers deal with designing devices, especially, in purpose to cause human life simpler. We implemented a certain controller based on hardware/software co-design which is occupied to control electronic devices in a room using a KinectTM sensor. KinectTM sensor is a separated input device for video game console, but we developed it with several electronic devices forming a smart room controller which may be considered as one method of making human life simpler. Our smart room controller may turn on lamps, and lock & unlock a solenoid door lock by creating several types of human body gestures in front of the KinectTM sensor. Based on the result of this study, we were able to operate turning on/off lamps, and lock/unlock a solenoid door by applying contactless interaction between the user and the room controller occupying an Infrared Depth Sensor - KinectTM.

12:00 ***Fluvial Monitoring and Flood Response***

Shi-Wei Lo (National Center for High-performance Computing, Taiwan); LunChi Chen (National Center for High-Performance Computing, Taiwan); Fang-Pang Lin (Narlabs, Taiwan)

One of the most challenging problems of flood response is the precise localization of flood risk; this task is performed by Early Warning Systems (EWS) for flood prevention and disaster management. EWS are extensively applied in the mitigation of flood risk, detecting abnormalities and predicting the onset of flooding by remote sensors. This paper proposes a framework for an Image-based Flood Alarm (IFA) that includes bi-seeded region-based image segmentation for the extraction of a water region of interest from an image, as well as an alarm classifier for identifying the degree of flood risk. When the risk reaches the predetermined threshold, a flood response message reports to the main EWS (Early Warning Systems) for end-user decision support.

12:20 ***Uncertainty analysis for optical time-of-flight sensors based on four-phase-shift range calculation***

Torsten Edeler (HAW Hamburg, Germany); Stephan Hussmann (West Coast University of Applied Sciences, Germany); Florian Johannes Knoll (Institute for Machine Vision Technology, Germany)

Time-of-flight (Tof) range imaging is a new suitable choice for measurement and modeling in many different applications such as robotics, machine vision, medical imaging, multimedia and so forth. But due to the technology's relatively new appearance on the market the knowledge of its capabilities is very low. This paper presents an uncertainty analysis for optical Tof sensors based on a four-phase-shift algorithm for range value calculation. The measurement uncertainty indicates the interval of the values that the quantity to be measured (in this paper range information) may assume, after all systematic biases have been corrected. The uncertainty analysis is evaluated by simulation. At the end of the paper the results are discussed.