Postgraduate Conference 2011 Schedule

School of Electrical, Electronic and Computer Engineering
Newcastle University

Contents

Welcome Message

On behalf of The EECE Postgraduate Conference 2011 (PGC2011) Organising Committee, it is my great pleasure to extend a warm invitation to you to participate in the 2nd student-led PGC to be held in Research Beehive, Newcastle University on 26th and 27th of January, 2011.

Newcastle University has developed unique expertise in diverse fields of research, such as wireless communications, sensors and devices for harsh environments. The Postgraduate Conference is an excellent opportunity to meet people from other research areas, exchange knowledge, discuss common research interests and develop communication skills.

This year, a new website has been introduced for the PGC which allows online registration and submission. The committee members are delighted that the new website has facilitated the submission of papers and peer reviews to a great deal and allowed supervisors to check their student assignments directly from the website.

The PGC2010 committee is lucky to be able to include keynote talks and exhibition stands from Imagination Technologies, Dyson, Institution of Engineering and Technology (IET), Siemens as well as contributions from the Newcastle University Careers Services. The conference will be opened by Prof. Bayan Sharif, Head of School followed by an opening address.

We will have two remarkable keynote talks presented by representatives from Imagination Technologies and Dyson. The plenary on first day will be given by Dr. Crescenzo S. D'Alessandro, one of the leading Systems on Chip Development Engineers at Imagination Technologies and a Newcastle University graduate. His talk is about pushing engineering outside its traditional boundaries, bringing art and philosophy closer to our discipline. During the second day, a talk will be given by Dr. Andrew Clothier, Technical Director of the Motor and Power Systems Division at Dyson, a chartered member of the IET and a Newcastle University graduate.

On behalf of the Organizing Committee, I would like to express my gratitude for our generous sponsors that made this event possible. Contributions from several sponsors have allowed the committee to bring more value and clarity to the postgraduate conference. I would like to take this opportunity to extend our personal thanks to the Postgraduate Research Coordinator: Mrs. Gill Webber, the Director of Postgraduate Studies: Dr. Alton Horsfall and the Head of School: Prof. Bayan Sharif for their invaluable helps and support.

With best wishes,

Shirin Mojarad
Conference Chair, PGC 2011

Organizing Committee

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Mrs. Gill Webber – Postgraduate Research Coordinator

Dr. Alton Horsfall – Director of Postgraduate Studies:

Prof. Bayan Sharif – Head of School

Mr. Ghaith Tarawneh – Previous Web Manager and Peer Review Coordinator

Mr. Xuefu Zhang – Photographer

Mr. Gholamreza Rafiee – Booklet Design

Invited Talks

Dr. Crescenzo S. D'Alessandro – Systems on Chip Development Engineer, Imagination Technologies

Day 1 9.40am

"Engineering" and "Beauty" seem to be diametrically opposed concepts: one concerned with hard reality and experimentation, the other related to feelings and pleasure. And yet science and beauty are often discussed together, and many parallels have been drawn between the two disciplines. In fact, engineering solutions are often beautiful (think of a Phase Lock Loop, for instance) - or are they? Can the pursuit of beauty help the engineering endeavour? What about elegance - does this concept have any more bearing on engineering? In this talk, Dr. D'Alessandro pushes engineering outside its traditional boundaries, bringing art and philosophy closer to our discipline, and will attempt to show that in spite of the dangers of aesthetic rules inevitably steering the judgement of the "cold engineer", beauty and elegance do indeed have an often undermined, but positive effect on the practice of engineering and they should be nurtured instead of discounted.

Dr. Andrew C. Clothier – Technical Director for the Motor and Power Systems Division, Dyson Technology Ltd., Malmesbury, U.K.

Day 2 13.25pm

Andrew C. Clothier received the M.Eng (Hons) degree in electrical and electronic engineering and the Ph.D. degree on the topic “Switched Reluctance Motors with Fully Pitched Windings” from Newcastle University, Newcastle-upon- Tyne, U.K., in 1992 and 2000, respectively. He joined the “Electronic Motion Systems Group” at International Rectifier (GB) Ltd. in 1996 to develop customized power electronic solutions for motor drive and power supply applications. He is currently Technical Director for the Motor and Power Systems Division at Dyson Technology Ltd., Malmesbury, U.K., which he joined in 1999. His main research and development activities are in ultra high-speed SR and BLDC motor technologies for domestic and commercial products. Dr. Clothier is a chartered member of the Institution of Engineering Technology, U.K.

Presentation Sessions Day 1

Room 2.21

Semi-Adaptive Doppler-shift compensation for OFDM Underwater Acoustic Communications system

Mr Ammar Ebdelmelik Abdelkareem
CSP, Stage 3
Prof Bayan Sharif, Dr Charalampos Tsimenidis, Mr Jeffrey Neasham

In this paper, a semi-adaptive Doppler-shift compensation technique for wideband orthogonal frequency division multiplexing (OFDM) is presented. The system estimates both the time scaling factor and carrier frequency offset (CFO) for each OFDM symbol depending upon a built-in cyclic-prefix. Also, this scheme adopts the centroid-based localization method to tackle the randomization of the different symbols' data. Compared with block Doppler compensation, the proposed technique utilizes a single linear-frequency-modulation (LFM) as a preamble and it works with a variable speed during packet duration. This variation is dealt with by adopting a dynamic symbol synchronization point during the data packet. To evaluate the proposed algorithm performance, an experiment is conducted at the North Sea, 2009 in addition to simulations.

Efficient Architecture for FPGA Prototyping of Blind CFO Estimator for OFDM Systems

Mr Sedki Younis
CSP, Stage 3
Prof Bayan Sharif, Dr Charalampos Tsimenidis, Dr Arafat Al-Dweik

This paper presents an efficient field programmable gate array (FPGA) prototyping architecture of a blind carrier frequency offset (CFO) estimation algorithm for OFDM systems. A parallel-stream and multiplexed-stream architectures for the considered CFO estimation algorithm are designed and evaluated for FPGA implementation using xilinx system generator (XSG) tool. The multiplexed-stream architecture results into a resource efficient implementation for the CFO estimation algorithm where a single FFT core can be shared between the parallel-streams. The impact of the architecture configurable parameters on the CFO estimation accuracy are accessed in terms of mean square error (MSE) which helped to tune some design parameters. The prototyoing results showed that at least 50% saving of the resources can be achieved using the multiplexed-stream architecture compared with the parallel-stream one.

Approximated BER Based Semi-Analytical Throughput Evaluation for OFDMA Systems

Mr Muayad Al-Janabi
CSP, Stage 3
Dr Charalampos Tsimenidis, Prof Bayan Sharif, Dr Stephane Le-Goff

In this paper, we propose an efficient semi-analytical throughput evaluation strategy for an orthogonal frequency division multiple access (OFDMA) system. We compare the performance of the simulated and semi-analytical throughput values in terms of average signal to noise ratio (SNR). In the investigated system, OFDMA is combined with adaptive modulation and coding (AMC) technique based on distinct modulation and coding schemes (MCSs). The semi-analytical throughput evaluation of the proposed strategy depends on the calculation of the introduced bit error rate (BER) and the corresponding spectral efficiency based on the utilized MCS levels across fading channels. The utilized BER calculation method considers the approximated exponential formula with respect to SNR values. The transmitter of the AMC-OFDMA system divides the OFDMA frame into sub-channels depending on the detected number of users at an assigned base station (BS). The simulation results show that the simulated and semi-analytical throughput plots of the AMC-OFDMA system are converging together particularly for high SNR levels.

Feasibility Studies on Microwave Heating for Non-destructive Evaluation of Reinforced Glass Fibre Composite

Mr Liang Cheng
CSP, Stage 2
Prof Gui Tian, Dr Volker Pickert

Recent developments in non-destructive evaluation (NDE) have concentrated in two directions: 1) sensors and arrays for local material/defect detection at both macro and/or micro levels; 2) large-scale component imaging and monitoring such as thermography. In this paper, microwave heating is proposed for defect detection of reinforced glass fibre composite (GFRP) material in far field. Such system using rectangle waveguide as illumination device is implemented and compared via both numerical simulation and experiment. In experiment, a GFRP wind turbine blade is chosen as test sample. Results for GFRP composite blade from simulation and experiment show that heat is accumulated at defect edge regions. This phenomenon enables defect detection using microwave heating. To achieve better contract of heat patterns at defect and non-defect region, an improvement of the system is proposed and simulated. The corresponding experiment study is conducted subsequently.

Corrosion versus Liftoff on Mild Steel Plates using Pulsed Eddy Current

Mr Mohammed Alamin
CSP, Stage 2
Prof Gui Tian

Steel components and structures serving in aggressive environments are exposed to corrosion, which can occur beneath coatings. The coating layer can reduce the detection of corrosion due to variations in thickness. In this paper we investigate the behaviour of a set of mild steel samples, with different coating types and varying levels of corrosion grading defined by the Steel Structures Painting Council (SSPC), compared against liftoff behaviour using pulsed eddy current (PEC) non-destructive testing method. The effects of conductivity, permeability and lift-off on the PEC response are analysed and identified using Principal Component projection spaces of both non-normalised and normalised PEC responses. Based on the experimental studies and data analysis, we can conclude that corrosion contribution to PEC response differs from the pure lift-off effect since the iron oxide has non-zero electrical conductivity and relative magnetic permeability which differ from that of coating. The effect of electrical conductivity is lower than that of magnetic permeability since magnetic permeability is a more important feature of the iron oxide.

Acoustic Source Localization using Wireless Sensor Network at Low Sampling Frequency: Challenges

Mr Omar M Bouzid
CSP, Stage 2
Prof. Gui Tian, Mr. Jeff Neasham, Prof. Bayan Sharif

In a previous work of the authors, a wired acoustic source localisation (ASL) system was implemented. This work aims to explore the use of acoustic wireless sensor networks (AWSNs) in the development of a wireless ASL system so that the robustness of the overall system increases in terms of good coverage and adaptability for several applications. However, the sampling rate (48 KHz) used to acquire acoustic signals in the wired system places a constraint on employing such network in such application. This is because such sampling rate will not only lead to high volume of data, but also to a requirement of a high bandwidth for data transmission as IEEE 802.15.4 (Zigbee) can only achieve an absolute maximum data throughput of 250 kbps. Another critical issue in applying AWSNs to ASL is the time synchronisation of sensor nodes because errors in sound source location estimations can be caused by an unsynchronised local time of individual sensor nodes. This paper summarises the work that has been done in utilisation of wireless sensor networks for acoustic source localisation at low sampling rates (4 KHz), investigates and discusses challenges that face this utilisation including low time axis resolution due to the use of low sampling rate and uncertainties in estimated time delays among received signals.

Object Identification Using Feature Extraction for Electromagnetic Images

Mr Abdalrahman Al-Qubaa
CSP, Stage 2
Prof Gui Tian, Prof Satnam Dlay, Dr Wai Lok Woo

Electromagnetic imaging is widely applied to medical and engineering applications based on the fundamentals of electromagnetics and the relationship between electromagnetic fields and material properties is under evaluation. This paper addresses the issue of identifying conductive objects based on their response to electromagnetic fields. Image processing and feature extraction of the electromagnetic signal were carried out. Features were extracted by using an edge chain code technique and maximum and minimum pixel values. The identification process was realised by feature integration and combination. A security application has been adopted as a case study using six weapons. Promising results indicating the feasibility of using electromagnetic imaging to identify objects have been found.

Interference Cancellation for OFDM Systems with Hierarchical Modulation over Non-linear Satellite Channels

Mr EMAD AL-DALAKTA
CSP, Stage 3
Prof Bayan Sharif, Dr Charalampos Tsimenidis, Dr Arafat Al-Dweik

This paper presents an efficient technique to eliminate the inter-layer interference (ILI) inherent in hierarchical modulation (HM) schemes operating over nonlinear satellite channels. The HM considered in this work is used in conjunction with an orthogonal frequency division multiplexing (OFDM) system. The proposed technique is based on an enhanced version of the selective mapping (SLM) scheme used for peak-to-average power ratio (PAPR) reduction. The enhanced SLM is constructed by using a new metric, which is more informative than the conventional PAPR metric. Simulation results confirmed that a noticeable bit error rate (BER) and interference reductions can be achieved by using the proposed technique.

Parallel Training Sequence Based Adaptive Multiuser Detection over Dispersive Channels

Mr Salah Awad Salman Al-iesawi
CSP, Stage 3
Prof Bayan Sharif, Dr Charalampos Tsimenidis

Two downlink receivers of interleave division multiple access (IDMA) with multiuser detection (MUD) are proposed for communication over highly dispersive channels using continuous pilot approach. The proposed IC-IDMA mitigate the intersymbol interference (ISI) and multiple access interference (MAI) jointly using adaptive interference canceller (IC). The Rake-IDMA receiver is also investigated using separate proposed channel estimation with continuous pilot sequence. Both iterative coded receivers are embedded with phase locked loop (PLL) and optimized jointly based on minimum mean square error (MMSE) criterion. The theoretical basis of both receivers are presented along with the experimental results obtained by processing data from realistic underwater communication experiments. The transmission results of 3 active users at a data rate of 441.3 b/s per user in 4 KHZ of bandwidth, demonstrate that the proposed IC-IDMA receiver can significantly mitigate the error floor with conventional Rake-IDMA receiver and achieve approximately error-free performance.

Online Tree-Search Algorithm for Localisation in Wireless Sensor Networks

Mr Abdullah Alhasanat
CSP, Stage 3
Prof Bayan Sharif, Dr Charalampos Tsimenidis, Mr Jeffrey Neasham

This paper presents a new and efficient Received Signal Strength RSS-based localisation algorithm in the form of an Online Tree Search Algorithm (OTSA). In comparison to the existing Least Square Estimators LSE techniques, the new OTSA is required to search for a low number of possible solutions, and according to the complexities analysis in this paper, the new proposed solution shows considerable complexity reduction in terms of time and storage requirements. In addition, the effectiveness of the OTSA is evaluated through real RSS measurements, the results show that the new OTSA demonstrates better performance compared to the ECO-localisation, Proximity and Centriod algorithms.

Novel MIMO 3-DOF Position Control for Capsule Endoscope

Mr Ibrahim khalaf Mohammed Mohammed
CSP, Stage 3
Prof Bayan Sharif, Mr Jeffrey Neasham, Dr Damian Giaouris

In this paper, a novel actuation system for Wireless Capsule Endoscopes (WCE) based on magnetic levitation is proposed. This study focuses on the design of a multi-input, multi-output (MIMO), controller to maintain a desired position and orientation of the capsule relative to the movable electromagnet frame so that it can navigate the intestine by moving this frame and/or the patient. Tracking algorithms for the linear controller based on pole placement, entire eigenstructure assignment (EEA), and linear quadratic regulator (LQR) techniques are designed and simulated using Matlab/Simulink. Simulation results suggest that the LQR controller can be used for capsule actuation.

Development of Acoustic Techniques Capable of Full Duplex Communication With a Tether Free Micro Underwater Vehicle

Mr Gerry Goodfellow
CSP, Stage 2
Mr Jeffrey Neasham, Prof Bayan Sharif, Dr Charalampos Tsimenidis

The use of remotely operated vehicles (ROV) to carry out tasks, where previously a human diver would have been required, creates a saving in both time and money. However, one of the major drawbacks of such a device is the tether, which is prone to entanglement or, due to drag, cause difficulty in movement. This paper examines the feasibility of developing an acoustic tether-free link, allowing for full duplex communication between the surface and the vehicle. Research is carried out into the use of both multi-carrier and single-carrier modulation schemes, for the transmission of compressed Video or SONAR at high data rates (>20kbps). Comparisons are made between the two systems and their operation in the presence of Inter Symbol Interference (ISI) and Doppler. Results are also presented demonstrating a viable method of full-duplex communication through the use of frequency separation and passive filtering techniques.

NOVEL UWB ANTENNA DESIGN FOR BREAST CANCER DETECTION

Mr Akinola Eesuola
CSP, Stage 1
Dr Y Chen, Prof. Gui Tian

This paper presents a novel design of elliptical ultra- wideband (UWB) antenna with a return loss better than -10dB andvoltagestandingwaveratio(VSWR)□2. Thekeyfeatureof this antenna is the careful engineering of the ground plane and the radius of the patch that permits the bandwidth to extend beyond the UWB limits. The antenna also exhibit directional property which is important in certain applications. The minimum gain of the antenna occurred at 4.3GHz at 6.99dBi and maximum value occurred at 7.5GHz at 9.8dBi. This antenna can find useful applications in the biomedical, communication and defense industry.

Design an Artificial Mirror System as an Interaction Method for the Life Logging System

Mrs Abeer Al-Shiha
CSP, Stage 2
Prof Satnam Dlay, Dr Wai Lok Woo

People are capturing and storing an ever-increasing amount of information about themselves, such as digital images. Stored personal images can play an important role in supporting people’s daily actions, so they could remember main things about their lives. New technologies, in addition to increasing the need to store daily activities via images and for retrieval capacity, have led to the development of interaction methods for this information. Therefore, this case study suggests an Artificial Mirror interaction system to enable access of personal memories stored in digital pictures, using the eye tracking as a natural way of interacting with this system.

PERFORMANCE OF KEYSTROKE BIOMETRICS AUTHENTICATION SYSTEM USING AN ARTIFICIAL NEURAL NETWORK (ANN)

Mrs norhaslinda harun
CSP, Stage 3
Prof Satnam Dlay, Dr Wai Lok Woo

Having a secure information system depends on successful authentication of legitimate users so as to prevent attacks from fraudulent persons. Traditional information security systems use a password or personal identification number (PIN). This means they can be easily accessed by unauthorised persons without access being noticed. This paper addresses the issue of enhancing such systems using keystroke biometrics as a translucent level of user authentication. The paper focuses on using the time interval (key down-down) between keystrokes as a feature of individuals' typing patterns to recognize authentic users and reject imposters. A Multilayer Perceptron (MLP) neural network with a Back Propagation (BP) learning algorithm is used to train and validate the features. The results are compared with a Radial Basis Function (RBF) neural network based on Equal Error Rate (EER).

Multimodal Biometric Fusion at Feature Level: Face and Palmprint

Mr Muhammad Imran Ahmad
CSP, Stage 2
Prof Satnam Dlay, Dr Wai Lok Woo

Multimodal biometrics has recently attracted substantial interest for its high performance in biometric recognition system. In this paper we introduce multimodal biometrics for face and palmprint images using fusion techniques at the feature level. Gabor based image processing is utilized to extract discriminant features, while principal component analysis (PCA) and linear discriminant analysis (LDA) are used to reduce the dimension of each modality. The output features of LDA are serially combined and classified by a Euclidean distance classifier. The experimental results based on ORL face and Poly-U palmprint databases proved that this fusion technique is able to increase biometric recognition rates compared to that produced by single modal biometrics.

Error Estimation Methods Applied to Probabilistic Neural Networks Used for Breast Cancer Prediction

Miss Shirin Mojarad
CSP, Stage 3
Prof Satnam Dlay, Dr Wai Lok Woo

Robust and consistent error estimation for reporting results provided by probabilistic neural networks (PNNs) is essential for their confident and reliable use in practice. This is particularly true for medical applications such as disease diagnosis. This study focuses on comparing five error estimation methods viz. random division, 10-fold cross validation (CV), leave-one-out (LOO) and two different types of bootstrapping, namely, the .632, and .632+ bootstrap for estimating misclassification error of PNNs for breast cancer prediction. Results show that using .632 + bootstrap method for evaluating the network outcome gives a reliable estimation of network accuracy while all data can still be used for training the network. This property in .632+ bootstrap allows PNNs to maintain good generalization and provide accurate analysis in limited data sets.

Multichannel Source Separation in Convolutive Mixture using NMF

Mr Abd Majid Darsono
CSP, Stage 3
Dr Wai Lok Woo, Prof Satnam Dlay

A new model of convolutive mixture for multichannel source separation is proposed in this paper. The proposed model using part based representation of nonnegative matrix factorization techniques using Itakura-Saito divergence. This technique is an unsupervised method which does not require training knowledge for separating the mixture. In addition, a faster and more robust optimization technique which is multiplicative update rule is used to minimize the cost function. Simulations using audio signals have been carried out to verify the theory and evaluate the performance of the proposed algorithm. Results obtained have shown the effectiveness of the algorithm in the presence of reverberations in the mixture.

Review of Offline Signature Identification using Principal Component Analysis & Kernel Principal Component Analysis

Mr Muhammad Razali
CSP, Stage 2
Prof Satnam Dlay, Dr Wai Lok Woo

Biometric system is an emerging field of technology using unique and measurable physical and behavioral characteristics that can be processed to identify a person. While biometric proponents stress the strength of their product technologies or biometrics in general, no system is ever completely secure. All biometric systems are another form of computer security with its own set of strengths and weaknesses. However, even the best biometric traits are facing numerous problems and some of them are inherent to the technology itself. One way to overcome this problem is by the use of a biometric system which is easy to use, low cost, accurate and fast. Handwritten signature verification is an automated method of verifying a person identity by examining the characteristics and features of the signature.

The Challenges of Content-Based Image Retrieval

Mr Gholamreza Rafiee
CSP, Stage 2
Prof Satnam Dlay, Dr Wai Lok Woo

Content-based image retrieval (CBIR) can be viewed as a methodology in which three correlated modules including patch sampling, characterizing, and recognizing are employed. This paper aims to evaluate meaningful models for one of the most challenging problems in image understanding, specifically, for the effective and efficient mapping between image visual features and high-level semantic concepts. To achieve this, the latest classification, clustering, and interactive methods have been meticulously discussed. Finally, several recommendations for future research issues have been suggested based on the weaknesses of recent technologies. Index Terms-Content-based image retrieval (CBIR), semantic concept, effective mapping, patch sampling, patch characterizing, patch recognizing.

Room 2.22

FABRICATION OF 3.3 KV RATED 4H-SIC SCHOTTKY DIODES AND TECHNICAL FEASIBILITY OF THEIR SMALL-SCALE PRODUCTION

Dr Konstantin Vasilevskiy
NME

4H-SiC diodes with nickel silicide Schottky contacts were fabricated on commercial epitaxial layers. At room temperature, the diodes have specific on-resistances down to 10.5 mOhm.cm2 and blocking voltages up to 4.6 kV, which is equal to 93 % of the calculated parallel plane breakdown voltage for used epitaxial structure. The corresponding Baliga's figure-of-merit is equal to 2015 MW/cm2 and is among the highest FOM values reported to date. The diodes demonstrated stable operation at forward current of 1A and blocking voltage in excess of 3.3kV at ambient temperatures up to 200C. The impact of practically realizable stopper rings on diode blocking characteristics was proven directly by electrical characterisation of diodes with and without field stopper rings. Leakage current densities in 4H-SiC diodes with different barrier heights and blocking voltages were compared to provide guidelines for estimation of power dissipation in reverse biased 4H-SiC Schottky diodes. Yield limiting factors and technical feasibility of small-scale production of 3.3 kV rated Schottky diodes on commercially available 4H-SiC epitaxial wafers was discussed.

High Temperature Vibration Energy Harvester System

Mr Simon Barker
NME, Stage 3
Dr Alton Horsfall, Prof Nick Wright

This work presents the first demonstration of a high temperature piezoelectric energy harvester system, capable of operation up to 300◦C. The system comprises of a PZT piezoelectric energy harvester with a silicon carbide Schottky diode full wave rectifier, which can rectify the AC supplied by the piezoelectric harvester at higher temperatures than conventional silicon components. When the harvester is driven at 400mg (3.9ms−2), into a matched load, the rectifier delivers 320µW at room temperature, falling to 80µW at 300◦C. This is caused by a combination of increased mechanical damping, decreased electromechanical coupling coefficient (K2sys) and an increase in the dielectric constant of the PZT.

Effect of halogen termination on electron affinity of the (001) diamond surface

Mr Amit Kumar Tiwari
NME, Stage 2
Dr Alton Horsfall, Dr Jonathan Goss, Prof Nick Wright

Occurrence of negative electron affinity on diamond surface by use of suitable surface termination has generated a great deal of excitement for the possible deployment of diamond in a variety of scientific and industrial applications. Using density functional calculation, the surface electron affinities are calculated for various halogen terminated diamond surfaces. Simulation results indicate that fluorine and bromine termination of the (2×1):(001) diamond surface give positive electron affinity, whilst chlorine terminated (2×1):(001) diamond surface exhibit slightly negative electron affinity. The electronic affinities of bare and monohydrogenated (001) diamond surfaces are also calculated which are found to be positive and negative, respectively. The calculated electron affinities for clean and hydrogenated diamond surface agree well with the published results and validate the present methodology for the study of new diamond surface terminations.

A SiC-based DC-DC Multilevel Boost Converter

Mr Omid Mostaghimi
NME, Stage 2
Dr Alton Horsfall, Prof Nick Wright

A dc-dc multilevel boost converter comprising of a switching device, an inductor , 2N-1 capacitors and 2N-1 diodes was recently proposed that offers the ability to control the input current , a high VCR without using a high duty cycle and same voltage in all the output levels. This paper presents the effect of replacing Si diodes with the equivalent SiC based devices for a 100kHz, 5W Conventional Boost converter, 3 level and 4 level Multilevel converters have been studied. The performance of the converters is experimentally evaluated and the efficiency measurements are then reported, followed by a discussion of the results. Here, a 48V–5V step-down converter operating at 100 kHz switching frequency was used for diode performance evaluation. The C3D02060A silicon carbide Schottky diode used in this experiment was compared to the similarly rated fast recovery BYX82 silicon diode and we report on experimental results; considering switching and conduction losses in the overall circuit.

Recovery of Ohmic Contacts Formed on C-face

Mr Benjamin Furnival
NME, Stage 3
Dr Alton Horsfall, Prof Nick Wright

In this paper we demonstrate the recovery of Ohmic contacts formed on C-face 4H-SiC following high temperature post-processing. After the contacts were exposed to a typical high-κ dielectric anneal in O2 for 3 minutes at 650 ºC, replacement of the metallization stack has been revealed to significantly reduce the damage produced in their I-V characteristics. With use of C-AFM we have also studied the mechanisms responsible for the Ohmic behaviour of contacts formed on 4H-SiC by the high temperature annealing of Ti/Ni stacks. In conclusion, a possible relationship is presented between changes in the SiC crystal orientation and the establishment of Ohmic behaviour.

Pd-DNA NANOWIRES FOR HYDROGEN SENSING

Mrs Mariam Nasir Said Al Hinai
NME, Stage 3
Prof Nick Wright, Prof Andrew Houlton, Dr Ben Horrocks

Palladium (Pd) nanoparticles and nanowires have been formed on a DNA template in solution using electroless deposition. The morphology and the electrical properties of the resulting Pd nanowires have been investigated by tapping mode atomic force microscopy (AFM) and conductive AFM (c-AFM). AFM observations show that the Pd wires (diameter below 45 nm) are uniform, regular, and conductive. The c-AFM studies show that the conductivity of Pd-DNA nanowires ((1.27 ± 0.30) x 102 S c m-1) is substantially lower than that in previous reports on the bulk Pd (9.5 × 106 S m−1). However, when these nanowires were evaluated for the detection of H2 gas, they showed a large and reversible response to H2 concentrations (2500 -12500 ppm). The nanowires also exhibited a fast response (~85 s) and a recovery time of (~60 s). These results indicate that DNA templated nanostructures are promising candidates for gas sensors.

TCAD for c-Si Cell efficiency enhancement

Dr Chihak Ahn
NME

Technology Computer-Aided Design (TCAD) using integrated process and device simulation is widely used in the semiconductor industry to reduce development costs and time, and to enhance device performance. In the PV industry up to now, TCAD has usually been limited to device simulation. This paper shows results of applying integrated TCAD using physics based simulation of process steps to predict the solar cell structure and 2D or 3D device simulation of the resultant cell operation. The approach is applied in detail to the simulation of Laser Grooved Buried Contact (LGBC) cells and initial results are also presented for Emitter Wrap Through and Metal Wrap Through (EWT/MWT) architectures. The use of integrated TCAD enables direct assessment of the impact of changing fabrication steps on key cell parameters such as Voc, jsc, FF and efficiency. Results suggest integrated TCAD will significantly accelerate development of future PV technology processes.

The Sinusoidal Electrode: Longevity Enhancement of Chronic Neural Recordings

Mr Harbaljit Sohal
NME, Stage 2
Prof Anthony O'Neill

The Brain-Machine Interface field requires stable chronic neural recordings. Current electrodes fail a few weeks or months post-implant due to neural tissue damage, which we hypothesize is caused by their rigidity and inability to accommodate micromotion. Our novel electrode design incorporates measures to reduce micromotion and is made from the flexible materials, Parylene-C and W/Ti. Initial testing shows that our electrode gives a longer chronic recording period, more stable Signal-to-Noise ratio and reduced neural tissue damage when compared to standard microwire electrodes. We therefore believe that electrode designs that incorporate micromotion reducing measures may lead to better chronic device performance.

The Characterization of a Silicon Nanowire

Mrs Nor Farahidah Za'bah
NME, Stage 3
Prof Anthony O'Neill, Dr Sarah Olsen

A novel method for fabricating a silicon nanowire using Silicon-on-Insulator (SOI) as a substrate has been developed and upon completion of the nanowire, a series of characterization steps are performed. The silicon nanowire is characterized to obtain its physical dimensions using Atomic Force Microscopy (AFM) and also Scanning Electron Microscope (SEM) in order to have a more detail outlook in its dimension. The silicon nanowire is electrically characterized using 4-probe measurement method. The problems in measuring the sheet resistance having unequal probe spacing were solved by using the dual configuration technique. Using this technique, the sheet resistances for a number of samples were measured with consistent and repeatable results.

Effect of annealing on SrTiO3 metal-isulator-metal capacitance

Mr shahin ameiryan mojarad
NME, Stage 2
Prof Anthony O'Neill, Dr Jonathan Goss

Metal-insulator-metal capacitors are widely used for dynamic random access memory applications. SrTiO3 is one of the important materials used as an insulator in metal-insulator metal structures. In this paper, the impact of annealing on the dielectric constant of SrTiO3 metal-insulator-metal capacitance is studied. To fulfill this aim, SrTiO3 thin films (45nm) were deposited by atomic-layer-deposition at a temperature of 250˚C followed by post-deposition-annealing at a temperature of 600˚C. Results of comparison between SrTiO3 as-deposited and SrTiO3 after post-deposition-annealing revealed that the permittivity of SrTiO3 has a significant enhancement after post-deposition-annealing. However, there is a substantial corresponding increase in leakage current. This high leakage current is probably due to the formation of micro-cracks near the grain boundaries during the crystallization.

Minimizing the number of the wave functions by using the filtration method

Mr Fadil Shrif
NME, Stage 2
Dr Patrick Briddon, Dr Jonathan Goss

First principles methods are currently in widespread use in the determination of the properties of systems at an atomistic level. The number of atoms that can typically be simulated is of the order of a few hundred, which represents a significant limitation. The use of a modified representation of the electrons via the choice of basis is one method that can be exploited in the drive to increase the system size accessible to first principles methods. In this paper a scheme based upon the filtration of a large computational basis into a smaller basis without significant loss of accuracy, but with a considerble improvement in computational effort, is presented. To quantitatively assess the affect of the basis set filtration energies of radiation damage in diamond and the frequency of the one-phonon maximum of pure diamond are presented. It is shown the filtration has no significant impact upon accuracy, but even for very modest system sizes the amount of computer time required is reduced by a factor of four.

Faster First Principles Calculations Through Improved Filtration Algorithm

Mr Andrew Lawson
NME, Stage 2
Dr Patrick Briddon, Dr Jonathan Goss

Filtration is a computer based method that speeds up first principles calculations with a no noticeable loss of accuracy. The filtration process itself takes some time to run, so an overall reduction in calculation time only takes place for systems over a certain size (typically a few hundred atoms). A method known as Aggressive Pruning (AP) reduces the amount of time this filtration process takes. This in turn allows filtration to generate speed increases for ab-initio calculations on smaller system sizes. The effect on the speed and accuracy of ab-initio calculations for silicon crystals containing an interstitial defect is examined. By using AP filtration to calculate the equilibrium positions of atoms, then obtaining the energy of this structure using standard filtration, greater accuracy is obtained than simply using AP to calculate both the equilibrium structure and energy. This also does not have a significant impact on the overall speed of the calculation, as the final energy calculation makes up a small percentage of the total calculation time when optimising structures.

Characterising the effect of uniaxial strain on the surface roughness of Si using MEMS-based nanobeams

Dr Enrique Escobedo-Cousin
NME

This work addresses the paucity of roughness measurements by reporting on roughness parameters in uniaxial strained Si beams relevant for state of the art MOSFETs, nanowire and MEMS devices, with varying degrees of strain. Roughness is characterised high resolution AFM and strain is characterised by Raman spectroscopy. Microstructures comprising a silicon nitride actuator are used to induce a wide range of stress levels in Si beams. The microstructures also allow the comparison of surface evolution in the strain direction (along the Si beam) compared with the unstrained direction (across the Si beam). A gradual reduction in rms roughness amplitude and increase in roughness correlation length in the direction of the applied stress are found for increasing values of strain. In contrast, surface roughness in the direction perpendicular to the applied stress remained largely unchanged from the unstrained initial state. This is the first time that roughness in uniaxially strained structures has been studied and provides unequivocal confirmation that a reduction in rms roughness accompanies increasing tensile strain.

RF Extraction of Self-Heating Effects in FinFETs of Various Geometries

Mr Sergej Makovejev
NME, Stage 3
Dr Sarah Olsen

Multi-gate semiconductor devices are celebrated for good electrostatic control and improved short-channel effects. However, non-planar architecture suffers from increase of access resistances and capacitances and self-heating effect due to confinement and increased phonon boundary scattering. In SOI technology the self-heating effect is aggravated by the presence of thick buried oxide with low thermal conductivity which blocks the heat removal from the device active region. Dynamic self-heating effect is characterised in n-channel FinFETs on Silicon-on-Insulator (SOI) platform. RF extraction technique is discussed and dependence of thermal resistance on FinFET geometry is discussed. It was confirmed experimentally that fin width and number of parallel fins are the most important parameters for thermal management in FinFETs while fin spacing plays less significant role.

Local characterisation of silicon nanowires

Mr Ferran Urena
NME, Stage 2
Dr Sarah Olsen

Raman spectroscopy is a non-destructive technique for chemical and mechanical analysis which has been widely used for local strain characterisation in different materials. The relation between the Raman frequency shift and strain is controlled by the so-called phonon deformation potentials (PDP's) and the second order strain tensor εij, being both set of coefficients characteristic of the material. Despite silicon being an extensively studied material and all these coefficients have already been calculated theoretically and experimentally for bulk material, there is not up to present experimental conclusions in the nanometric regime especially for high stress values. In this paper, we present an overview of the Raman spectroscopy technique together with some preliminary results obtained for some silicon nanowires under tensile uniaxial stress. High stress values up to 4.5 GPa have been possible due to a novel nanowire fabrication technique.

Characterising gate dielectrics in high mobility devices using novel nanoscale techniques

Mr Raman Kapoor
NME, Stage 3
Dr Sarah Olsen

Strained Si and strained SiGe layers can increase the speed of MOS devices through enhanced electron and hole mobilities compared with bulk Si. However epitaxial growth of strained Si and SiGe layers induces surface roughness which impacts gate dielectric properties including leakage, breakdown and interface traps. Gate dielectric quality is conventionally studied at a macroscopic level on individual transistors or capacitors. To understand precisely the effect of roughness on the quality and reliability of dielectrics on high mobility substrate devices requires high spatial resolution characterization techniques. Device processing modifies the dielectric/semiconductor interface compared with its initial form. Therefore nanoscale analysis on completed devices is necessary. In this work we present new techniques to enable gate leakage analysis on a nanoscale in fully processed high mobility MOSFETs. This is achieved by careful selective removal of the gate from the dielectric followed by C-AFM measurements on the dielectric surface. Raman spectroscopy, AFM and SEM (EDX) confirmed complete layer removal. The techniques are applied to strained Si devices which have different surface morphologies and different macroscopic electrical data. Dielectric reliability is also assessed thorough device stressing.

Presentation Sessions Day 2

Room 2.21

New DCT-OFDM System Utilizing Discrete Walsh-Hadamard Transform

Mr Hussein Al-Sodani
CSP, Stage 2
Prof Said Boussakta, Dr Stephane Le-Goff

In this paper, an improved discrete cosine transform (DCT) orthogonal frequency division multiplexing (DCT-OFDM) system is presented. Discrete Walsh-Hadamard transform (WHT) is utilized in the proposed OFDM system as a channelindependent precoder. The bit-error-rate (BER) performance of the proposed WHT-DCT-OFDM, incorporating a zero-padding guard interval scheme, is compared with a zero-padded DCTOFDM system and conventional OFDM system that uses discrete Fourier transform (DFT) with the employment of minimum mean-square error (MMSE) detection over multipath fading channel. Simulation results show that the BER performance is significantly improved when using the new scheme. This is because different copies of information symbols are included in the transmitted signal which increases the diversity. Furthermore, the performance of the proposed WHT-DCT-OFDM system is investigated in the presence of carrier frequency offset (CFO). The new OFDM system has the merits of being resilience to multipath fading transmission and has the same bandwidth of DCT-OFDM and DFT-OFDM systems.

An Enhanced OFDM/OQAM System Exploiting Walsh-Hadamard Transform

Mr Mohammed Al-Attraqchi
CSP, Stage 3
Prof Said Boussakta, Dr Stephane Le-Goff

In this paper, an enhanced orthogonal frequency division multiplexing (OFDM) with offset quadrature amplitude modulation (OQAM) system utilising Walsh - Hadamard transform (WHT) is presented. This system demonstrates high resistance to the multipath transmission. The simulation results over standard international telecommunication union (ITU) channels for pedestrian and vehicular confirm the superiority of the proposed system over the conventional OFDM and OFDM / OQAM systems by approximately 6 dB in terms of Eb / No at 10 to power 3 of bit error rate (BER). Furthermore, the computational complexity of the proposed system is reduced by 50% for the integration of the Walsh - Hadamard transform in the system.

Hardware-Oriented FFT Algorithm for Computing 2-D Discrete Fourier Transform

Mr MONIR TAHA HAMOOD
CSP, Stage 3
Prof Said Boussakta, Prof Gui Tian

In this paper, a new hardware-oriented vector-radix-2^2×2^2 fast Fourier transform (VR-22×22-FFT) decimation-in-time algorithm for computing the two dimensional discrete Fourier transform (2-D DFT) is presented. The algorithm is derived by applying a two-stage decomposition approach and by introducing an efficient technique for grouping the twiddle factor. The computational complexity of the proposed algorithm is analyzed and the number of real multiplications and real additions are computed for different transform sizes. Furthermore, a comparison with the existing 2-D vector-radix FFT algorithms has shown that the presented algorithm can be considered as an optimal compromise between the structural and computational complexities.

Block Cipher Cryptosystem Based on NMNT

Mr Mohammed Al-Gailani
CSP, Stage 3
Prof Said Boussakta, Mr Jeffrey Neasham

The security of information being transmitted over insecure channels has become the most important issue in today's communications. Cryptography is used to protect and keep such transmitted data secure. In this paper, a block cipher cryptosystem based on the Substitution Permutation Networks (SPN) structure has been proposed. The proposed algorithm is of a variable block length and key length, in the range of 128 bits up to 2048 bits, with a power of two. It is characterized by high security, reliability and flexibility. It is designed to work efficiently on different platforms, as well as being suitable for real time implementations.

Modified PTS Scheme Based on an Efficient Low Complexity Transform

Mr Mohammed Shweesh Ahmed
CSP, Stage 3
Prof Said Boussakta, Prof Bayan Sharif, Dr Charalampos Tsimenidis

Partial transmit sequence (PTS) is an efficient scheme to reduce the high peak-to-average power (PAPR) inherited in the transmitted signal of orthogonal frequency division multiplexing (OFDM) systems. However, the main drawbacks of a such technique are the high computation complexity requirements and the redundant bits transmitted as side information (SI). The high complexity inherent to this technique is mainly due to the necessity to perform several inverse discrete Fourier transform (IDFT) operations and phase optimization at the transmitter side. In this paper, a low computational complexity T-transform, which combines the Walsh-Hadamard transform (WHT) and the IDFT is utilized in OFDM-PTS systems instead of IDFTs. The utilisation of T-transform with the OFDM-PTS system achieves a considerable peak-to-average power ratio (PAPR) reduction. The PAPR reduction can be achieved without any noticeable effect on the original power spectrum of the OFDM signal. In addition, the proposed scheme is resilient technique against the multipath dispersion owing to increase the frequency diversity of transmitted subcarriers, even in the presence of high power amplifier (HPA). Moreover, the proposed scheme requires lower computational complexity when compared with the conventional PTS scheme.

Task scheduling based on energy token model

Dr Danil Sokolov
MSD

Energy becomes the most critical aspect in the design of modern microelectronic devices, which is reflected in the increasing number of conflicting requirements to the power characteristics of the circuits. However, modern design tools do not consider dynamics of energy resource, do not have flexible notion of energy efficiency and limit power optimisation to few design-specific techniques. We propose to address these limitations through a fundamental token-based model of computation, extended with the concept of energy tokens to represent energy flows in the circuit. The energy token model will serve as a foundation for building systems in such a way that while maintaining functional equivalence, their operation will be altered to meet energy mode requirements under dynamically changing energy resource and operating conditions.

Deadlock Detection for Networks-on-Chip Using Transitive Closure Networks

Mr Ra'ed Al-Dujaily
MSD, Stage 2
Prof Alex Yakovlev, Dr Fei Xia

Interconnection networks with adaptive routing are susceptible to deadlock, which could lead to performance degradation or system failure. Detecting deadlocks at run-time is challenging because of their highly distributed characteristics. In this paper, we present a deadlock detection method that utilizes run-time Transitive Closure (TC) computation to discover the existence of deadlock-equivalence sets, which imply loops of requests in networks-on-chip (NoC). This detection scheme guarantees the discovery of all true-deadlocks without false alarms in contrast with state-of-the-art approximation and heuristic approaches. A distributed TC-network architecture which couples with the NoC architecture is also presented to realize the detection mechanism efficiently. Our results based on a cycle-accurate simulator demonstrate the effectiveness of the TC-network method. It drastically outperforms timing-based deadlock detection mechanisms by eliminating false detections and thus reducing energy dissipation in various traffic scenarios. For example, timing based methods may produce two orders of magnitude more deadlock alarms than the TC-network method. Moreover, the implementations presented in this paper demonstrate that the hardware overhead of TC-networks is insignificant.

Intensity Based Colour Image Compression Algorithm Using 2D-DWT and BTC

Mr Saad Al-Azawi
CSP, Stage 2
Prof Alex Yakovlev, Prof Said Boussakta

This paper introduces an algorithm for colour image compression which uses a combination of block based 2-D Discrete Wavelet Transform (2D-DWT) and Block Truncation Coding (BTC) algorithms. The Discrete Wavelet-Absolute Moment Block Truncation Coding (DWT-AMBTC) algorithm was used for grey-scale image compression with bit rate of 0.5 bit per pixel (bpp). The proposed algorithm tackles each (4×4) pixel block of the luminance component individually to preserve image quality, then uses larger block size for the chrominance components. The bit rate was reduced further by discarding the whole bit plane of the coarse wavelet coefficients for the smooth blocks. Coarse coefficients of each block are classified into smooth or edge blocks according to predefined thresholds. The results obtained with the proposed algorithm showed a noticeable improvement in peak signal to noise ratio (PSNR) with lower bit rate.

Soft Analysis in C-element

Mr NORHUZAIMIN JULAI
MSD, Stage 2
Prof Alex Yakovlev, Dr Gordon Russell

Abstract- Soft error could cause digital circuit to temporary malfunction. In an asynchronous circuit, the temporary malfunction of the control circuit will cause deadlock; a state where the system will be disabled indefinitely until the system has been reset or the error is filtered or corrected from the system. C-element is most commonly found in control circuit. We have studied the vulnerability of six different c-elements towards soft error by injecting current pulse into different locations. We developed method for assessing vulnerability of circuits towards soft error and from the analysis, we could prove that dual rail c-element is more resistant toward soft error compared with single rail c-element.

Modified Bisection Search for Faster Metastability Characterization

Mr Ghaith Tarawneh
MSD, Stage 2
Prof Alex Yakovlev, Dr Gordon Russell

Circuit state bisection is a robust technique to characterize the performance of multi-stage synchronizers. The passage of metastability between synchronizer stages introduces effects that are not captured by small-signal models and thus numerical integration remains the most reliable method for characterizing this behavior. However, the large number of transient simulations required to characterize one circuit through bisection makes it very difficult to use this technique to run variability analysis or parametric optimization on synchronizer circuits. We present a modified bisection search algorithm that performs 2.5 to 3.2 times faster than conventional bisection without any loss of accuracy. Our method is not restricted to any latch topology or behavior and can safely replace conventional bisection for characterizing any synchronizer circuit.

Parameterized FPGA-Based Architecture for Parallel 1-D Filtering Algorithms

Mr Sami Hasan
MSD, Stage 2
Prof Alex Yakovlev, Prof Said Boussakta

a parameterized efficient FPGA-based architecture is developed for parallel 1-D real-time signal filtering algorithms using Xilinx System Generator. The developed architecture achieves a 38 % higher performance per Watt at maximum frequency. The parameterized implementation provides rapid system-level abstraction FPGA prototyping and portability. Consequently, the results are obtained independent of the two targeted Virtex-6 FPGA boards, namely xc6vlX240Tl-1lff1759 and xc6vlX130Tl-1lff1156, to achieve lower power consumption of (1.6 W) and down to (0.99 W) respectively at a maximum frequency of up to (216 MHz). A case study of real-time speech, with excellent quality of performance results, for parallel 1-D real-time speech filtering algorithm of power consumption down to (0.99) at maximum frequency of up to (216 MHz).

Automated Generation of Control Logic for Processor Architectures

Mr Maxim Rykunov
MSD, Stage 2
Prof Alex Yakovlev, Dr Albert Koelmans

Automated design of processor architectures has traditionally been focused on the clocked pipeline organisation consisting of a fairly standard datapath and control logic. Control logic has been normally generated from the architectural description of a processor using the conventional techniques based on Finite State Machines (FSMs). As the area of processor design automation is becoming increasingly inclusive of system paradigms that are eterogeneous in terms of timing, such as multiclock and asynchronous circuits, there is a need for appropriate models and associated synthesis algorithms. This paper approaches the problem of designing control logic for a processor using Conditional Partial Order Graphs (CPOGs). The new method allows composing a large set of microarchitectural algorithms (instructions) into a compact relational form, which opens way for various transformation and optimisation procedures leading to an efficient implementation of control logic. The paper presents a CPOG-based design methodology and demonstrates how it can be applied to it on synthesis of control logic for Intel 8051 microcontroller.

A Novel Power Delivery Method for Asynchronous Loads in Energy Harvesting Systems

Mr Xuefu Zhang
MSD, Stage 2
Prof Alex Yakovlev, Dr Alex Bystrov

This paper investigates influences of variable power supply from an energy harvesting circuit on synchronous and asynchronous systems with a switching converter power delivery method. In order to setup testing environment, a switched capacitor DC/DC converter is introduced and a piezoelectric element is employed in the energy harvesting circuit. A self-timed counter is deployed as workload operated in synchronous and asynchronous modes. Additionally, based on the asynchronous system, a new power delivery method, which employs a capacitor bank to separately store all available energy during a certain period from the energy harvesting circuit, is introduced and also compared with the systems deploying switching converters.

Voltage Sensing Using an Asynchronous Charge-to-Digital Converter for Energy Harvesting Circuits

Mr Reza Ramezani
MSD, Stage 2
Prof Alex Yakovlev, Dr Alex Bystrov

Energy harvesting generators deliver nondeterministic power density over a range of explicit environmental conditions. To mitigate the variability of power provided by the harvesters, this paper presents a novel energy-proportional design approach, in which the computational circuit is driven by input power so that its switching activity is a function of this power. Such an approach realizes an autonomous power gating, as the circuit starts to compute only when input power has arrived. We present a voltage sensor to exemplify the energy-proportional design principle, and such a sensor can be readily adopted in energy harvesting systems for on-chip dynamic power management. This sensor is driven by the charge from a capacitor that samples the measured input voltage to subsequently power up the asynchronous counter, which performs charge-to-digital conversion. We also present an analytical model that characterizes energy-proportional properties of the proposed voltage sensor. SPICE simulation results show that the proposed sensor design outperforms conventional voltage sensor circuits in terms of robustness and energy efficiency.

Stability analysis of limit cycles in CMOS circuits by Floquet theory and Filippov method

Mr IOANNIS SYRANIDIS
MSD, Stage 2
Prof Alex Yakovlev, Dr Damian Giaouris

A wide class of CMOS circuits exhibits periodic behaviour. One of the principal characteristics of a periodic solution is the stability properties of the underlying limit cycle. Stability analysis can provide insight on the ability of a system to converge to the limit cycle when a perturbation is added to the periodic orbit. In this paper, a CMOS circuit is modelled as a nonsmooth dynamical system and is described by a set of differential equations. The stability of the periodic orbits is determined by the application of the Floquet theory. The Filippov method is also used to account for the nonsmoothness of the system. The implementation of the stability algorithm is presented on a 3-stage ring oscillator.

Adaptive Controllers for Synchronization via Wagging

Mr James Guido
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Prof Alex Yakovlev, Dr Alex Bystrov

Synchronization via wagging is a method by which a high bandwidth data signal can be partitioned into several lower bandwidth data signals in order to increase the synchronization time of a master-slave latch configuration, and by consequence the mean time between failures of each of the devices in the array. This work compares three separate controller implementations for wagging synchronizers, and demonstrates the benefits of a reconfigurable controller design over more brute force methods in accounting for process variations. Speed, power, and synchronization time are then analyzed, and the reconfiguration protocol is discussed in detail. Conclusions are then drawn outlining future directions for research.

A Synchronizer Design Based on Wagging

Mr Mohammed Alshaikh
MSD, Stage 2
Prof Alex Yakovlev, Dr Gordon Russell

The reliability of a synchronizer depends on its recovery time from metastability, a time which is reduced if the delay through the synchronizer flip flops is large. The D to Q delay in a dual edge triggered D flip flop based on wagging is lower than in other designs allowing more time for metastability recovery. We also apply wagging to the synchronizer itself, reducing its delay even more when compared with conventional cascaded two flip-flops single clock cycle synchronizer, hence increasing the time available for recovery from metastability, and improving its latency. This advantage is greater in multiple cycle synchronizers.

An Analysis of SEU Robustness and Performance of C-Element Structures Implemented in Bulk CMOS and SOI Technologies

Mr Ziyad Al-Tarawneh
MSD, Stage 3
Prof Alex Yakovlev, Dr Gordon Russell

Market place demands for higher performance and greater functionality per unit area have been the force driving down minimum feature sizes. However, several unintended consequences resulting from the advances in technology to address these market place demands has been an increase in the susceptibility of the circuits to SEUs and a growing uncertainty in the determination of timing parameters which is becoming detrimental to achieving timing closure. Some of the issues related to timing closure and the associated increase in power dissipation resulting from the increase in performance can be addressed through the adoption of an asynchronous design style. A logic element which is not only widely used but also peculiar to asynchronous design is the Muller C-element, which can be realised in a number of different configurations. In view of the increased susceptibility of logic elements to the effects of SEUs as device geometries are reduced this paper reports on the analysis of the robustness of various C-element configurations implemented in different technologies, to the effects of SEUs. It has been observed that of the static C-element configurations the symmetric C-element is the most robust.

On-Chip Parametric Measurement Architectures for IP Characterisation

Mr Ahmed Naif Alahmadi
MSD, Stage 3
Dr Gordon Russell, Prof Alex Yakovlev

Recently, Integrated Circuits (ICs) have seen a large enhancement in terms of performance, a reduction in size and an increased ability to work at very high speeds. However, these improvements have led to an increase in complexity and variability. Therefore, testing and measuring the parameters of ICs are necessary to ensure circuit reliability. The idea of this project is to incorporate five parameter measurements (time delay, jitter, temperature, NBTI (negative bias temperature instability), and On-Chip Oscilloscope Measurement) to be run with regard to one chip using the Built in Self Test (BIST) method. It can be referred to as ‘lab on a chip’ (LOC). Measurements are applied on a field-programmable gate array (FPGA) and then FPGA is migrated onto a wrapper and a statistical distribution can be produced by characterising IP cores.

System Level Modeling of Manufacturing Process Variations

Mr Chenxi Ni
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Dr Gordon Russell, Dr Alex Bystrov

The process variation has become a main topic in the electronic research area, and will gain more importance in the future due to the continually scaling of the electronic device dimensions. Therefore, it requires appropriate timing analysis, such as Statistical Timing Analysis. Unfortunately, at present the investigation of the effect of process variation is limited to small circuits, such as logic gate. This paper will introduce the idea that modelling the system from gate level to larger blocks, which can allow designer to efficiently analyze the performance of their systems early in the design cycle. Currently this work is focused on the time domain.

Distributed Dual-Tier Cluster-Based Intrusion-Detection System for Wireless Sensor Networks

Mr ABDULAZIZ ALSHAMMARI
MSD, Stage 3
Dr Albert Koelmans, Dr Alex Bystrov

In Wireless Sensor Networks (WSN), malicious or even faulty nodes can harm the network performance. Intrusion-Detection (ID) method should be used to detect- and eventually remove- such malicious activities. However, due to limitation of WSN in terms of both computation power and energy, standard ID techniques intended for other systems are not suitable to be adapted directly into such networks. A novel Distributed Dual-Tier Cluster-Based Intrusion-Detection (DDTCB) system is presented in this paper that is not only power efficient but also has lower false-positive rate compared with existence ID methods. The idea is to dynamically divide the networks evenly into clusters for efficient and balanced coverage, with an elected leader for each cluster (cluster head). Cluster head is then in charge of collecting reports from cluster members on any malicious activities and report back to the network base station. Nodes belong to a cluster can take turns periodically as cluster leader. Keywords-component; Secure Routing; Intrusion Detection; Clusters; Wireless Sensor Network.

Predictive Scheduling for Multi-Clocked SoCs

Mr. Neil Denver
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Dr Alex Bystrov, Prof Alex Yakovlev

Clock distribution in synchronous digital designs has become one of the main problems facing designers. Asynchronous designs offer an alternative; however synchronous systems remain hugely preferable to designers due to an easier design flow, wide range of CAD tools available, and experienced designers. Large chips are commonly partitioned into multiple synchronous domains each operating at a clock frequency specific to the localized constraints. Dynamic Voltage scaling (DVS) is a technique used to make dramatic energy savings and work has been done to adapt DVS for Embedded Systems with real-time deadlines. This work presents an adaption of DVS which uses prediction in order to perform the scheduling of tasks in order to meet timing deadlines and minimize power consumption.

Room 2.22

Automatic Compensator Controller Based on Adaptive Filter Strategies for Switch Mode DC-DC Power Converter

Mr Maher Algreer
PEDM, Stage 3
Dr Matthew Armstrong, Dr Damian Giaouris

This paper presents an alternative technique for the adaptive control of power electronic converter circuits. Specific attention is given to the adaptive control of a dc-dc converter. The proposed technique is based on a simple adaptive filter method and uses a one-tap finite impulse response (FIR) prediction error filter (PEF). The method is computationally efficient and based around a Dichotomous Coordinate Descent (DCD) algorithm. The DCD-RLS (recursive least squares) algorithm has been employed as the adaptive PEF to reduce the computational complexity of existing RLS algorithms for efficient hardware implementation. Results show the DCD–RLS is able to improve the dynamic performance and convergence rate of the adaptive gains (filters taps) within the controller. In turn, this yields a significant improvement in the overall dynamic performance of the closed loop control system, particularly in the event of abrupt parameter changes. The proposed controller uses an adaptive PD+I structure which, alongside the DCD algorithm, offers an effective substitute to a conventional Proportional-Integral-Derivative (PID) controller.

Use of Wavelets to Identify the Position of Short Duration, High Frequency Components in a Periodic Signal

Mr Richard Gibson
PEDM, Stage 3
Dr Matthew Armstrong, Dr Volker Pickert

This paper gives a novel application of the Wavelet Transform used to identify unwanted high frequency components in a voltage or current signal from a variable speed drive (VSD). An introduction to the Wavelet Transform is presented and the benefits over Short Time Fourier Transform (STFT) are discussed. A chirp signal is used as an example to highlight the benefits of the Wavelet Transform. The Wavelet transform is used to show the position in time of the various frequency components and their magnitude. A discussion of how the high frequency components which give rise to the EMC problem is presented.

An Investigative Study on how the Adaptive PI Controller Gains affect the Speed Estimation, Convergence and Noises at Sensorless Induction Motor Drives

Mr Muez Shiref
PEDM, Stage 2
Dr Matthew Armstrong, Dr Damian Giaouris

Abstract The paper will investigate the performance of an MRAS-based speed sensorless induction motor drive under different PI gains. The effect of the PI controller has on the estimated speed will be examined in terms of introducing high order harmonics and noises. In this scheme, an Adaptive full-order flux observer will be used. The simulation results show that with the large PI gains for the adaptive scheme, the convergence for the speed estimation is fast, however, higher order harmonics, noises, and overshoots are included in the estimated speed. The desired gains are a trade-off between a high speed of response, and high robustness to noise

Control Method to Mitigate Harmonics in Parallel, Grid Connected, PV Inverters

Mrs Suriana Salimin
PEDM, Stage 2
Dr Matthew Armstrong, Dr Bashar Zahawi

This research is concerned with the problem of network power quality when grid connected systems are used to feed the grid. Parallel connection of photovoltaic system is the main interest of study for this research. This type of PV system uses power electronic components such as inverters that produce harmonics and reduce network power quality. Development and simulation of new control method is considered to overcome the total harmonic emissions in single and parallel PV inverters. The consideration is given to either eliminate specific harmonic orders or modify the parameters of PI controller that will result in overall improvement in power quality. Experimental hardware will also be developed to test and verify promising simulation results.

High efficiency MPPT of stanalone PV system using interleaved boost converter

Mr saleh babaa
CSP, Stage 2
Dr Matthew Armstrong, Dr Volker Pickert

Photovoltaic generation is gaining increased importance as a renewable source due to a number of advantages; such as absence of fuel cost, low maintenance, lack of noise and minimal wear due to absence of moving parts etc. In particular, energy conversion from a solar cell array received considerable attention in the last decads.So this paper presenting and studying the efficiency of standalone (PV) system giving much concentration on conventional boost converter, interleaved boost converter, and maximum power tracker controller. And the goal of the research is going to make comparative between non-isolated boost converters (conventional boost converter and the interleaved boost converter), and looking into improving the efficiency of DC/DC boost converters with maximum power point tracking (MPPT) with changeable irradiation and temperature.

Research into Aerospace Electronics

Dr John Bennett
PEDM

There has been considerable research by the Newcastle University Centre for Advanced Electric Drives in the field of Aerospace. This presentation provides an introduction into this research.
The propulsion drives for the world record-breaking Zephyr unmanned aerial vehicles are described, with their high-efficiency motors and various evolutions of power electronic controllers.

A decade of research into actuation for commercial aerospace is described, with systems developed for high-lift surface actuation and nose wheel steering. All actuators feature fault tolerance and the basic principles are explained, showing the safety considerations necessary for aircraft electronics and the restrictions these place on the application of electric drives and electromechanical actuators.

High tourque Density Permanent Magnet Machine for Automotive Applications

Mr Yasser ALAMOUDI
PEDM, Stage 2
Dr Glynn Atkinson, Prof Barrie Mecrow

this paper discusses a study of new permanent magnet machine topologies to achieve high torque densities specifically for automotive applications along with mentioning the different types of electric motors which are suitable for automotive applications now a days. Also a comparison between these different machines is given by highlighting the advantages and disadvantages of each one of them.The method used here to model the new design involved splitting the stator teeth of a conventional brushless permanent magnet D.C. machine of the same dimensions in order to increase the torque density as the specific torque output from conventional electric machines is constrained by the product of the magnetic and electrical loading. The former is limited by the saturation flux levels in the magnetic circuit, and the latter by the maximum permissible temperature within the machine for a given stator current apart from certain secondary effects this limit is essentially independent of the number of machine poles. If increased torque densities are to be produced then a departure from conventional configuration is required.

CALCULATION OF IRON LOSS IN ELECTRICAL GENERATORS USING FINITE ELEMENT ANALYSIS

Mr Philip Hargreaves
PEDM, Stage 3
Prof Barrie Mecrow

The accurate calculation of iron loss from finite element analysis in electrical machines is essential if optimal machines are to be designed. This paper conducts a holistic review of the extensive literature field before examining, in detail, several methods in order to recommend an optimum engineering solution. Both frequency domain and time domain methods are discussed including the use of different orthogonal components as well as the relative merits of using all, or some, of the Eddy Current, Anomalous and Hysteresis loss components. A theoretical cubic meter of iron is simulated to quickly demonstrate the inaccuracies of Cartesian coordinate methods before calculation on manufactured machines are undertaken showing the superior accuracies of major/minor loop calculation. Calculation undertaken using the radial tangential orthogonal plane is shown to have less than 1% average difference to the major/minor loop yet is over 6 times quicker. The peak percentage error in an individual element is shown to be less than 5%. Discussions are also made regarding the method of curve fitting to gain loss constants and any possible sources of in accuracy particularly during manufacture.

Fault Tolerant In-Wheel Motor Topologies for High Performance Electric Vehicles

Mr Chukwuma Junior Ifedi
PEDM, Stage 2
Prof Barrie Mecrow, Dr Glynn Atkinson

The Drive for Alternative energy has been the most talked about subject in recent times. Hence the need for vehicles to be powered by any energy source other than petroleum has received huge interest. Worldwide, researchers are working to develop very efficient drive systems for vehicles using electric motors. Therefore it is required to design a very efficient motor with high torque density, which must comply with space limitation in the wheel and be well housed for protection. This paper presents a newly developed concept for the design of wheel motors. The main aim of the motor design is to achieve high torque density and to sustain a good level of torque during a fault.

High Speed High Power Machine Design: Satisfying the Myriad Constraints

Mr Daniel Smith
PEDM, Stage 3
Prof Barrie Mecrow, Dr Glynn Atkinson

A High Speed, High Power (HSHP) Permanent Magnet Synchronous Machine (PMSM) rated for 1.1MW at 30,000rpm is being developed for test stand applications. There are numerous mechanical, thermal and electromagnetic design constraints on a machine of this size. This paper will discuss some of these constraints and their effect on the design process. I need to make this up to 100 words for some reason so I will just say that design work is currently in progress and will focus in the future on end region effects and thermal management of the machine. I hope that will satisfy the moderators, thank you.

Three phase modulated pole machine topologies utilising mutual flux paths.

Mr Jamie Washington
PEDM, Stage 3
Dr Glynn Atkinson

Modulated Pole Machines (MPMs) have existed for over 100 years since first proposed by W. M. Morday. They are characterized by 3D flux paths and a high torque density due to the decoupled nature of the electric and magnetic circuits in the machine. Until the 1980's the concepts were not thoroughly explored, this was mainly due to the lack of a suitable material to construct them from. Since the advent of materials with isotropic magnetic properties and acceptable losses such as Soft Magnetic Composite Materials constructing machines with complex 3D flux paths has become much easier. This paper discusses three phase topologies for modulated pole machines. The authors introduce a new three phase topology which takes advantage of mutual flux paths, this is analysed using 3DFE methods and compared to a three phase topology using three single phase units stacked axially. The results show the new Modulated Pole Machine exhibits a greater torque density, whilst offering a reduction in the number of components.

New Approach to Active Power Compensation Utilising the Energy of line Current Harmonics

Mr Afshin Pashaei
PEDM, Stage 3
Dr Bashar Zahawi, Dr Damian Giaouris

A new method for harvesting the energy of harmonic currents present in the electricity supply network is presented in this paper. In this study, harmonic energy is used to charge the dc capacitor which forms part of a distributed static series compensation (DSSC) device while in conventional method another power electronics circuit is needed to charge up the DC capacitor and makes it possible to inject active power through the system. The energy is absorbed by the DSSC unit at harmonic frequencies and injected back into the line at power frequency. For simplicity, it is assumed that the line harmonics are known; no harmonic detection methods are discussed in this paper.

ANALYSIS OF THE NEIMARCK-SACKER BIFURCATION IN DC CHOPPER FED DC DRIVES VIA THE MONODROMY MATRIX APPROACH

Mr Nelson Okafor
PEDM, Stage 3
Dr Damian Giaouris, Dr Bashar Zahawi

Abstract—The nominal behaviour of DC chopper fed DC drive under the proportional integral (PI) control is a period-1 orbit. But as some controller parameters are varied, this nominal orbit loses stability via a hopf or Neimarck-Sacker bifurcation leading to the birth of a quasi periodic orbit (the so called torus). Further variation of the system parameter leads to several period-adding, phase-locking and chaotic phenomena as the torus breaks down. In this paper, by employing the recently introduced monodromy matrix approach, we were able to determine analytically the system parameter value at which the quasi-periodic attractor was born. The analytical result was in agreement with the bifurcation diagram of the system obtained through numerical simulation. Keywords:Bifurcation,chaos,phase-locking,quasi-periodic orbit.

Speed Control of Electric Vehicles for Drivetrains with Gear Backlash

Mr David Hodgson
PEDM, Stage 3
Dr Damian Giaouris, Prof Barrie Mecrow

Non-linear components such as gearbox play in the drivetrains of electric vehicles can often lead to a poor speed control response, due to the speed feedback only being available from the motor encoder. Other issues encountered by the controller such as varying loads, changing driving conditions and tyre slip are all difficult to deal with as they are mostly unknown and not measured. It is desirable for electric vehicles to have a smooth yet fast acting response to the driver demands and also offer features such as hill hold. A detailed vehicle model has been developed in order to investigate these issues.

Evaluating the Suitability of Available Proton Exchange Membrane (PEM) Fuel Cell Models for use in a Virtual Fuel Cell System

Miss Rachel Taylor
PEDM, Stage 3
Dr Volker Pickert, Dr Matthew Armstrong

The aim of this paper is to evaluate three fuel cell models; Nehrir PEMFC (Proton Exchange Membrane Fuel Cell) model, Mathsworks Simulink fuel cell (FC) block and Spiegel MATLAB PEMFC model. From these, one model will be chosen for use in a virtual fuel cell system (VFCS). The chosen model is then validated against the output of a real fuel cell stack (Ballard Nexa 1.2kW FC system). The VFCS is able of creating virtual simulations and emulations of FC systems. The final VFCS incorporates the novel use of hardware, firmware and software operating in real-time to simulate real applications in vehicles and buildings.

Comparison of Supercapacitor and Lithium-Ion Capacitor Technologies for Power Electronics Applications

Mr Simon Lambert
PEDM, Stage 3
Dr Volker Pickert, Dr Dave Atkinson

New developments in the technology behind the double-layer capacitor are yielding devices with ever more wide ranging characteristics. Particularly interesting is the trend of increasing maximum cell voltage whilst maintaining the high capacitance which characterises these devices. The desire to achieve this goal has led to the development of a hybrid lithiumion capacitor technology with impressive energy storage characteristics. Presented is a comparison between this new technology and a more traditional supercapacitor technology relevant for power electronic applications. A hierarchy of comparisons is introduced which is used to define meaningful contrast between the devices for power electronic interface. Results from experimentation on two real-world components are presented and conclusions drawn from the response to input conditions designed to characterise the devices.

A Loss of Mains Detection Technique for Inverter Based Distributed Generation

Mr Andrew Watts
PEDM, Stage 3
Dr Dave Atkinson, Dr Matthew Armstrong

Distributed energy resource (DER) systems include several technologies, such as combined heat and power (CHP), fuel cells, photovoltaic systems, diesel engines, small wind power systems, etc. Due to the intermittent nature of many DERs, it is necessary to include energy storage devices, such as batteries, capacitors and flywheels. Many issues arise when increasing the number of DER systems connected within the distribution network. The focus of this paper is loss of mains (LOM) detection, which is required by law before the connection of a power source to the power grid is permitted. The LOM detection technique is designed to be incorporated within established inverter control methods.

Experimental and Simulation Comparison for Timer Action Crowbar of Doubly-Fed Induction Generator Under 15% Fault

Miss Wenjun chen
PEDM, Stage 3
Dr Dave Atkinson, Dr Bashar Zahawi

The sensitivity of the DFIG to the grid disturbances such as a voltage dip restricts network stability and risks damage to generator converters during the fault period due to the over-current and/or over-voltage. It is now a requirement that wind turbine manufacturers demonstrate what is commonly called ‘Fault Ride Though’ (FRT) capability in their turbine systems. The rotor crowbar, as a cost-effective and reliable method of protecting the power converters of the DFIG, was employed as a part of the FRT scheme. A computer model created in Matlab/Simulink was validated with the results of a 7.5kW experimental system.

A Carrier-based PWM Control Method for a Three-Phase Four-leg Voltage Souce Inverter

Mr Min Zhang
PEDM, Stage 2
Dr Dave Atkinson, Dr Matthew Armstrong

Abstract—In this paper, carrier-based PWM switching scheme and 3-Dimensional SVM switching scheme for a three-phase four-leg voltage source inverter are compared and analyzed. For the carrier-based PWM method, a new Discontinuous PWM peculiar to 3-D SVM is presented. It has been proved that the algorithm of the carrier-based PWM is simplified and will not be a computational burden to the Digital Signal Processor. Simulation results show that with a newly-designed control loop for the system, simultaneous supply of three-phase voltage can be obtained even when the load is unbalanced or/and nonlinear. Keywords- carrier-based PWM, three-phase four-leg inverter, control loop design, unbalanced/nonlinear loads

Inter-turn short circuits in fault tolerant permanent magnet machiens

Mr Andrew Wechsler
PEDM, Stage 3
Dr Dave Atkinson, Prof Barrie Mecrow

The fault tolerant permanent magnet motor has become an increasingly popular concept motor in the aerospace application due to its high torque density as well as its fault handling characteristics. Despite the motor being able to withstand a wide range of faults, the shorted turn fault remains a difficult fault to detect and handle. The problem arises from the magnets on the spinning rotor that cannot be ‘turned off’ at will. When a fault occurs in the stator windings, the magnets will continue to induce an emf in to the windings, potentially resulting in various unwanted features such as overrated current flow, drag torque and thermal instability. This paper will investigate the effect of the current in the shorted turns versus its position in the slot. It will also investigate the current in the shorted turn after a terminal short is applied.

Posters Day 1

Investigations on SRAM's Typical Delay Line

Mr Abdullah Baz
MSD, Stage 1
Prof Alex Yakovlev, Dr Alex Bystrov

Portable digital systems tend to be not just low power but power efficient as they are powered by low batteries or energy harvesters. Energy harvesting systems tend to provide nondeterministic, rather than stable, power over time. Normally SRAM works based on timing assumptions where the timing control block is in charge of regulating the timing relationship between different blocks in the SRAM system to guarantee safe and successful reading and writing operation. In this brief paper, we have investigated the latency mismatch between memory cells and the corresponding controller using typical delay elements and the obtained result confirms that the mismatch is highly variable under different Vdd values.

RAF: Variation Tolerant Architecture

Mr Hock Soon LOW
MSD, Stage 1
Prof Alex Yakovlev, Dr Albert Koelmans

This paper proposed a new Reconfigurable Asynchronous Fabric (RAF) or Asynchronous Field Programmable Gate Arrays (FPGA) mainly aimed at tolerating the unpredictable delay variations caused by process and environment variations in current and future VLSI technology nodes also targeting for dynamic voltage scaling and variable Vdd, as in applications featuring energy harvesting. The Motivations and Methodology for the proposed architecture are discussed in this paper. The results of initial basic logic element of proposed RAF architecture are shown. This Project also proposed to develop a complete design and synthesis flow, including a fully automatic synthesis method, for the architecture studied in this paper.

Ultra Wideband Microwave Breast Cancer Time domain Analysis

Mr Syed Ahmad
CSP, Stage 1
Dr Wai Lok Woo, Prof Satnam Dlay

The investigation of Ultra-Wideband (UWB) microwave technology for the purpose of breast cancer detection is presented in this paper. The two-dimensional model is used to simulate the microwave propagation in the heterogeneous phantom having different dielectric profiles. The Finite Difference Time Domain method (FDTD) is adopted to simulate the electromagnetic (EM) waves. To minimize the reflections and interference from the outer boundaries the perfectly matched layer (PML) absorption boundary conditions (ABC) are implemented. The numerical phantom has illuminated by the Gaussian modulated sine wave at 5GHz frequency. The received signals from the different phantom composition i.e. different dielectric profile are analysed to detect the malignant masses in the phantom.

Hybrid Bio-Silicon Neuronal Models

Mr Jun Wen Luo
CSP, Stage 1
Prof Alex Yakovlev, Dr Terrence Mak

Abstract— Biophysical neural network model is difficult to analysis due to the interdependence of parameters (intrinsic properties, wiring architecture and synapses) in a complex dynamic space. A novel method is propos aiming to model neurons by using high-speed computer and to interact with biological neurons in real time, and the artificial synapses could be modeled using memristor to interconnect with the model neuron and its biological counterpart. This method could analysis neuronal networks in different experimental preparations and configurations and could lead to novel hybrid bio-silicon computer innovation, which also a powerful and trustworthy new tool for neural network analysis.

Single Channel Blind Source Separation Using Time-Frequency Masking

Miss Naruephorn Tengtrairat
CSP, Stage 1
Dr Wai Lok Woo, Prof Satnam Dlay

The blind source separation (BSS) approach has been successfully applied to extensive demand in various fields. In practice, it may not be realistic to provide a sensor for each and every signal source due to the economical and performance reasons. Hence the number of sensors is mostly much lesser than the number of source signals and this leads to the challenging problem of single channel blind source separation (SCBSS). This research area has recently drawn considerable attention to fulfill its needs. Many techniques have been developed to separate the captured mixed signal into a set of the original source signals included statistical methods based on matrix factorization, principal/independent component analysis and time-frequency (TF) mask. This research will investigate and develop advanced TF mask approach to solve the SCBSS problem. In particular, this research will formulate an efficient probabilistic platform with the aim of optimising the TF mask filter using Gaussian Mixture Model (GMM) and Hidden Markov Model (HMM). Performance analysis will be carried out to assess the proposed methods on real-time captured audio sources. The separated results will be evaluated using such as the mean square error and signal-to-distortion ratio. Keywords- Single Channel Separation; Blind Source Separation; Speech Signal Analysis.

Non-Stationary Blind Separation of Time-Varying Temporally Correlated Sources

Mrs Phetcharat Parathai
CSP, Stage 1
Dr Wai Lok Woo, Prof Satnam Dlay

There has been much interest in the field of Blind Source Separation (BSS). BSS is broadly applied in different disciplines in order to automatically extract and track a sound signal of interest in real world scenarios. It is necessary to handle hostile environments with multiple speeches, moving sensors and noise sources. This research presents the blind source separation problem when the mixing of sources is non-stationary and addresses the problem of separating the sources when speakers or microphones are moving and generative model for analysis of non-stationary multivariate time series. The aim of this proposed method is to perform blind signal separation in time-varying mixing process of linear instantaneous mixture of independent temporally correlated, non-stationary sources. The research will firstly focused on separation of two audio sources in a multi-channel recording. A novel approach will be developed to extract better quality of audio signals. This approach will exploit the Hidden Markov Model to identify the time-varying mixing process and the non-Gaussian Generalised Autoregressive model to estimate the sources. The performance of the developed algorithms will be measured using real-time audio signals in terms of the signal-to-distortion ratio. Keywords-Non-Stationary signal; Non-Stationary Blind Source Separation; Speech Signal Analysis.

Cooperation in Wireless Networks

Mr Anvar Tukmanov
CSP, Stage 1
Prof Said Boussakta, Dr Zhiguo Ding

Node cooperation provides additional degree of freedom to wireless networks, with a potential to improve system performance characteristics. The general concept is that other users' signals are no longer considered as a destructive interference - instead, they are treated as additional information to be exploited. Current industrial implementation of cooperation is introduced in LTE-Advanced and IEEE 802.16j, justifying importance of the technology. Although cooperative strategies demonstrate ability to provide performance gains, associated capacity limits' estimation and efficient cooperative protocol designs are still in progress. In addition, application of network coding and cross-layer protocol designs could be merged with cooperative strategies to overcome limitations and tradeoffs. The ultimate aim of this research is to increase reliability and performance of wireless networks by exploiting opportunities of cooperation. Central directions are expected to be efficient cooperative protocol design, network coding and performance analysis in terms of delay and outage probability. Specific aims, objectives and research plan are expected to be included in poster presentation.

Silicon Carbide electronics for diamond single electrode array

Mr Hua Khee Chan
NME, Stage 1
Dr Alton Horsfall

This research aspires to construct single or multi element sensors array and its supporting circuitry using Silicon Carbide based Junction Field Effect Transistor technology. The intended outcome will be able to survive high temperature environments (at least 500°C) over a life span of thousands of hours. Silicon Carbide is more favourable over Silicon ultimately for its attribute toward operating at high temperature and superior heat conductivity. There is a vast area of unknown for device and circuit behaviour when it is operating at high temperature. Thermally generated noise has become an issue of concern as it is directly proportional to the lattice temperature of the device. On top of that there isn't a very well defined noise source and characterization since the first model established by Aldert Van der Ziel in the 60s.

Silicon Carbide Electronics For Hostile Environments

Mr Daniel Brennan
NME, Stage 1
Dr Alton Horsfall, Prof Nick Wright

Silicon carbide electronics are capable of operation in hostile environments far exceeding the limitations of standard silicon devices. This ability is providing a new area of research and commercialisation, for devices and systems that can monitor and extract information in ambients which can reach 600°C and also be subject to intense radiation. Initial work has primary focused upon the research and comissionsing of high temperature communication systems. We have proven the feasibility of both amplitude and frequency modulated high temperature transmitters capable of operating above 300̊C, along with SiC based energy harvesting electronics capable of powering these transmitters from a thermoelectric generators.

Temperature Dependence of Metal Contacts on the Electrical Characteristics of Epitaxial Graphene

Mr Venkata Karthik Nagareddy
NME, Stage 1
Dr Alton Horsfall, Dr Jonathan Goss, Prof Nick Wright

We performed high temperature measurements to investigate the impact of Cr/Au and Ti/Au metal contacts on the electrical behaviour of epitaxial graphene on 4H-SiC. Significant variations were observed in resistance parameters of these contacts at 300K and decreased substantially with the temperature. Nature of doping due to the difference in work function and the change in adsorption and diffusion energies of metal atoms are the likely factors responsible for the observed variation. Electrical behaviour of our contacts suggest that doping via metals could be an alternative way of inducing p-type doping in n-doped graphene on SiC, for hostile environment applications.

Ferroelectrics for Nanoelectronics

Mr Daniel Appleby
NME, Stage 1
Prof Anthony O'Neill

The demonstration of negative capacitance in a MOSFET utilizing a ferroelectric film in the gate stack will allow a new generation of powerful processors to be integrated on a chip. This has possibilities of reducing the subthreshold swing below the 'Boltzmann tyranny', which caused the need for multi core processors as stand-by power dissipation lead to overheating chips. A possible solution to the ferroelectric material is barium titanate. Extensive characterisation of the ferroelectric material is imperitive for the successful completion of the project; atomic layer deposition methods will be compared to pulsed laser deposition to fully understand the requirements for a fully integrated, thin ferroelectric film in the field of nanoelectronics.

Parallel Operation of Three Phase PWM Converers

Mr Bassim M.H. Jassim
PEDM, Stage 1
Dr Dave Atkinson, Dr Bashar Zahawi

Abstract– Parallel converters can increase power levels, system reliability and efficiency, and improve the flexibility of a system. However, circulation currents are automatically generated and this will lead to current distortion, unbalanced load and overall system performance decline.This work will investigates the average current control method for paralleled three phase pulse width modulation (PWM) converters of the same ratings in order to achieve good current sharing and minimum circulating current with minimized size and cost. The proposed method is used to control the circulating current by controlling the difference between the converter current and the average current value of all modules. A digital control system for these parallel converters is simulated using Matlab / Simulink R2009a.

Optimal Microgrids Architectures

Mr Idris Musa
PEDM, Stage 1
Dr Bashar Zahawi, Dr Damian Giaouris

Abstract— This paper presents a summary of the research proposal for the development of an elaborate power systems optimization tool based on Particle Swarm Optimization (PSO) for optimal placement and sizing of Distributed Generation in a medium voltage distribution network to form an optimal Microgrid Architecture. The objectives are Loss reduction and minimization of infrastructural cost of the Microgrid. A brief overview on the development and some current challenges in the research area and the benefits of this research proposal are highlighted. in addition, to reduce the computational complexities of the PSO algorithm some PSO variants will be implemented. Keywords-component; distributed generation, microgrid, particle swarm optimization.

Posters Day 2

Game Theoretic Real-Time Scheduling

Mr James Docherty
MSD, Stage 1
Prof Alex Yakovlev, Dr Alex Bystrov, Dr Albert Koelmans

The use of real-time systems has proliferated over the last decade. These systems run a set of tasks; all of which have a desired start, execution and end time (deadline). If a task takes longer than its end time to complete, items external to the system could be jeopardized. Where a missed deadline could be catastrophic, it is said to be a “hard” deadline, while one that can be missed at a reduction of usefulness is said to be “soft”. Game theory was developed in the 1940’s by John von Neumann. Its theories have been used in a wide variety of fields from economics to evolutionary biology, with some focus on its use within electronic engineering for queuing theory within protocols such as TCP/IP This paper summarizes the initial investigation into the use of game theory to design schedulers for real time systems, along with demonstrations of its possible applications within real-time processing; especially where a resource, such as energy, is limited.

Reinforcement Learning Based Networks-on-Chip Optimization

Mr Nizar Dahir
MSD, Stage 1
Dr Terrence Mak, Prof Alex Yakovlev

NoC is used to interconnect components on the same chips and the transfer of data is achieved in a way similar to the Internet. Information (or packets) are routed from the source to the destination. The interconnected components can be general purpose microprocessors, memory blocks or control circuitry. Many works aimed to design an adaptive and fault tolerant routing algorithms for NoC, but a little emphasis is given to the energy consumption optimization. Energy-aware routing means that the routing decision must be made to optimize for the power consumption not the delay. The main objective of this work is to exploit the power of RL algorithms for the NoC design and optimization. One potential future research direction is the design of adaptive energy-aware routing algorithm for network on chip.

Advanced Development of Encryption Techniques

Mr Nick Rutter
CSP, Stage 1
Prof Said Boussakta

Through the continual rapid increase in the power of processers, risks of weakening current encryption schemes are becoming more apparent with regard to current key sizes. An obvious remedy for this would be to increase the key size accordingly. However, it is apparent that this is clearly not an option. This is exemplified with respect to pervasive computing, which is ubiquitous today in general everyday life, where processing memory constraints of these devices render larger key sizes as being impractical. In addition to processing power being a factor in the weakening of such encryption schemes, methods of attacking these schemes are also increasing in terms of both the theoretical and physical.

Impulsive Noise Cancelation in OFDM system Based Power Line Communication

Mr Sabah Nayyef
CSP, Stage 1
Dr Charalampos Tsimenidis, Prof Bayan Sharif

In recent years, the use of existing power lines for transmitting data and voice has been receiving interest. However, there are some challenges for communications over power lines such as noise, attenuation and multipath propagation Noise in a power line is not an additive white Gaussian noise (AWGN) The noise is categorized into five different types of noise :coloured background noise, narrowband noise, periodic impulsive noise asynchronous to the mains frequency, periodic impulsive noise synchronous to the mains frequency and asynchronous impulsive noise. In the literature a number of impulsive noise cancelation methods have been proposed. These techniques include:time-domain methods such as Clipping, Blanking, and Clipping / Blanking. Also there are Frequency-domain methods, as well as combined time-domain/frequency-domain (TD/FD) method. Numerical Results have shown a good performance of OFDM than single carrier BPSK systems. A comparison based OFDM system of the three time domain techniques illustrates that the best technique is the clipping/blanking. On the other hand, combined TD/FD technique is better than clipping/blanking technique. We can conclude that TD/FD technique outperforms the conventional techniques (time domain techniques). However, conventional techniques still attractive because they are very easy to implement with low combining complexity.

A Brief Paper
Mr Hong Zhang
CSP, Stage 1
Prof Gui Tian

The current NDT technologies are not good enough for the detection of Corrosion under Insulation (CUI) and coatings, as coatings and particularly thermal insulation increase the lift-off distance between the sensor and target surface. This project will design and develop the next generation of electromagnetic RFID for non-destructive evaluation and structural health monitoring systems. Four current NDT technologies have been reviewed: Ultrasonic, Radiography, Magnetic Flux Leakage and Eddy current. A comparison of these technologies is investigated. The aim of the overview is to identify the advantages and limitations of current techniques and provide a novel solution to overcome them. The proposed project roadmap is discussed to provide a big picture of the project. RFID testing is also discussed along with the basic principles of RFID. The proposed RFID testing is also presented. Previous work in this field is summarised along with intended future work.

INTELLIGENT PIGs FOR PIPELINES: A DESCRIPTIVE OVERVIEW
Mr Ibukun Dapo Adewale
CSP, Stage 1
Prof Gui Tian

The main thrust of this paper is to give an overview of the state of the art sensor technologies and data acquisition techniques adopted for in-line inspection, ILI, tools typically called intelligent PIGs (Pipeline inspection gauges) for the detection, sizing, characterisation and monitoring of defects in order to maintain the integrity of pipelines and to keep them in a fitness-for-purpose condition using Non-destructive Evaluation, NDE and Structural Health Monitoring, SHM, techniques. In this overview, the major technical and operational challenges were identified and brought to light, and a new proposed work reported. In the end, conclusion and further study are clearly elicited.

Emulating colour constancy
Mr Stuart Owen John Crichton
CSP, Stage 1
Prof Gui Tian

This paper introduces the challenge posed by trying to emulate the natural mechanism of colour constancy present within the human visual system. Colour constancy can be described as the natural mechanism existing within the visual system that keeps colours constant even as the illumination spectrum varies. Current camera systems do not have this ability and so as the spectrum over an object changes so does the RGB value recorded by the camera. As such the author aims to investigate the natural mechanism within the human visual system through psychophysical experiments and use the findings to implement an improved colour constancy algorithm.

Ferroelectric Tunable Capacitors for Radio Frequency Applications

Mr Nikhil Karunakaran Ponon
NME, Stage 1
Prof Anthony O'Neill

Tunable capacitors using ferroelectric materials have attracted interest as active elements in microwave devices due to its highly nonlinear response to applied electric field. The permittivity of these materials are normally atleast three orders of magnitude higher than normally used Silicon dioxide. Their integration to back end line integraion will enable further cheap single chip silicon applications. The ultimate usage of the technology will be to reduce power consumption in mobile phone antenna or power amplifier by automatic and dynamic impedance matching. The aim of the project is to identify, fabricate and characterize suitable ferroelectric material to enable these features.

Transistors based silicon nanowires for nanoelectronics and nanosensors

Mr Sami Ramadan
NME, Stage 1
Prof Anthony O'Neill

Due to the high packing density of silicon nanowires, transistors based on silicon nanowires are expected to have performance comparable or even better than of conventional MOSFET devices and could overcome their fundamental problems. Silicon nanowires with high surface to volume ratio and small dimensions could make the nanodevices based silicon nanowires exhibit high sensitivity. Several nanowires cross sections with different gate geometries and shapes will be fabricated to demonstrate the possibility of having high sensitive nanosensors. The aim is to integrate Si nanowires into different types of transistors and study their properties and compare their performance with conventional MOSFET devices.

Modelling the Polarization of Defect Orientation in CVD Diamond Growth

Mr Mohammed Atumi
NME, Stage 1
Dr Patrick Briddon, Dr Jonathan Goss

Many dopants and defects in diamond are thought to be selectively incorporated and polarised according to the surface orientation during growth. The properties of these defects (thermodynamic and kinetic factors, electronic structure, vibrational frequencies and hyperfine interaction tensors) will be analysed to compare with previous models and experiment. The simulation of these defects, which are key in understanding and optimising diamond synthesis, will be achieved by the application of density functional methods, as implemented within the AIMPRO code developed in Newcastle. A number of key developments in the method uniquely allow for the routine simulation of thousands of atoms or rapid processing of many smaller systems, crucial in the development of models of processes in crystal growth.

Modelling of TiN, ATiO3 and their (001) Interfaces

Mr Raied Al-Hamadany
NME, Stage 1
Dr Jonathan Goss, Dr Patrick Briddon

State of the art quantum mechanically based simulations are employed to calculate bulk and interface properties of TiN, SrTiO3 and PbTiO3. The bulk properties (lattice constant and bulk modulus) are in excellent agreement with experiment, as is the work function of TiN(001). The most favourable (001) interfaces between TiN and each ATiO3 (A either Sr or Pb) are determined. The electronic properties of the interfaces are problematic due to the well known errors in the calculated band-gaps of metal oxides. The most stable geometries of the interfaces have been determined to be either TiN:TiO2 or TiN:Sr/PbO. A simple thermodynamical model will be applied to differentiate in energy terms whether the interfaces are more likely to be Ti-rich or Sr/Pb rich.

Genetic Algorithm optimization of broadband light for optical communication

Mr MINHAJ HUSSAIN SYED
NME, Stage 1
Dr Gareth Roberts

this paper presents a Genetic Algorithm (GAs) approach for optimization of broadband light in advanced optical fiber communication system. This describes a method for development of Designer Phase and frequency modulation protocols for optimum use of the bandwidth of femtosecond light transmitters. The Generation of genetically tailored light and data streams for specific communication purpose can be obtained. The femtosecond laser with Spatial Light modulators whose output fields are narrowed down. Since the search space is restricted to a limited filed, the Algorithm works very fast. The phase and amplitude modulation can be expected within one or two generations independent of size of the system.

Cost Functions for Powertrain Optimisation in Hybrid Electric Vehicles

Mr Dave Winterborne
PEDM, Stage 1
Dr Volker Pickert, Prof Barrie Mecrow

A cost function, as the name suggests, describes the cost of operating a system a certain way in terms of a number of variables. By evaluating the cost function for a number of potential actions and choosing the one that minimises it, the system is optimised. The relative importance of the impact on the different variables is subjective, however, but by including weighting factors in the cost function, different aspects can be prioritised.This approach lends itself well to the control of energy in an HEV where there are different, sometimes conflicting, priorities - fuel efficiency, pollutant emissions and battery usage. Different ways this can be implemented will be seen, including a method of optimising a weighting factor online to enable the system to adapt to real situations. How cost functions can be used at a lower level to achieve predictive control of power converters optimised for a number of different objectives will also be seen.

Power Supplies & Chargers for Portable Consumer Equipment

Mr David Grant
PEDM, Stage 1
Prof Barrie Mecrow

All electrical equipment that does not operate directly from the mains supply requires some form of offline power supply and/or charger. This is therefore an area of significant research and development due to the net impact of any improvement made in cost or performance. This paper presents an overview of the design of power supplies and chargers for portable consumer equipment, forming a basis for more detailed research as part of a PhD thesis. The move from transformer/rectifier systems to smaller and more economical switched mode converters is discussed along with the factors influencing the choice of power supply and charger topology.

Presentation Schedule Day 1

Day 1				
Time	**Room 2.21**	**Time**	**Room 2.22**	**Room 2.20**
9.00	**Registration**			
9.20	**Opening**			
9.40	**Keynote - Imagination Technologies**			
10.20	**Coffee Break**			**Poster Hanging**
10.40	Ammar Ebdelmelik Abdelkareem	**10.40**	Dr Konstantin Vasilevskiy	
10.55	Sedki Younis			
11.10	Muayad Al-Janabi	**11.00**	Simon Barker	
11.25	Liang Cheng	**11.15**	Amit Kumar Tiwari	
11.40	Mohammed Alamin	**11.30**	Omid Mostaghimi	
11.55	Abdalrahman Al-Qubaa	**11.45**	Benjamin Furnival	
12.10	Omar Bouzid	**12.00**	Mariam Nasir Said Al-Hinai	
		12.15		
12.25	**Lunch Break**			**Poster Session**
13.25	Emad Al-Dalakta	**13.25**	Dr Chihak Ahn	
13.40	Salah Awad Salman Al-Iesawi			
13.55	Abdullah Alhasanat	**13.45**	Harbaljit Sohal	
14.10	Ibrahim Khalaf Mohammed Mohammed	**14.00**	Nor Farahidah Za'bah	
14.25	Gerry Goodfellow	**14.15**	Shahin Mojarad	
14.40	Akinola Eesuola	**14.30**	Fadil Shrif	
14.55		**14.45**	Andrew Lawson	
15.00	**Coffee Break**			**Poster Removal**
15.20	Abeer Al-Shiha	**15.20**	Dr Enrique Escobedo-Cousin	
15.35	Norhaslinda Harun			
15.50	Muhammad Imran Ahmad	**15.40**	Sergej Makovejev	
16.05	Shirin Mojarad	**15.55**	Ferran Urena	
16.20	Abd Majid Darsono	**16.10**	Raman Kapoor	
16.35	Muhammad Razali			
16.50	Gholamreza Rafiee			
17.05	**Close**	**16.25**	**Close**	

Presentation Schedule Day 2

Day 2				
Time	**Room 2.21**	**Time**	**Room 2.22**	**Room 2.20**
9.00	Hussein Al-Sodani	**9.00**	Maher Algreer	
9.15	Mohammed Al-Attraqchi	**9.15**	Richard Gibson	
9.30	Monir Taha Hamood	**9.30**	Muez Shiref	
9.45	Mohammed Al-Gailani	**9.45**	Suriana Salimin	
10.00	Mohammed Shweesh Ahmed	**10.00**	Saleh Babaa	
10.15	**Coffee Break**			**Poster Hanging**
10.35	Dr Danil Sokolov	**10.35**	Dr John Bennett	
10.55	Ra'ed Al-Dujaily	**10.55**	Yasser Alamoudi	
11.10	Saad Al-Azawi	**11.10**	Philip Hargreaves	
11.25	Norhuzaimin Julai	**11.25**	Chukwuma Junior Ifedi	
11.40	Ghaith Tarawneh	**11.40**	Daniel Smith	
11.55	Sami Hasan	**11.55**	Jamie Washington	
12.10	Maxim Rykunov	**12.10**	Afshin Pashaei	
12.25	**Lunch Break**			**Poster Session**
13.25	**Keynote - Dyson**			
14.05	Room Adjustment			
14.15	Xuefu Zhang	**14.15**	Nelson Okafor	
14.30	Reza Ramezani	**14.30**	David Hodgson	
14.45	Ioannis Syranidis	**14.45**	Rachel Taylor	
15.00	**Coffee Break**			**Poster Removal**
15.20	James Guido	**15.20**	Simon Lambert	
15.35	Mohammed Alshaikh	**15.35**	Andrew Watts	
15.50	Ziyad Al-Tarawneh	**15.50**	Wenjun Chen	
16.05	Ahmed Naif Alahmadi	**16.05**	Min Zhang	
16.20	Chenxi Ni	**16.20**	Andrew Wechsler	
16.35	Abdulaziz Alshammari			
16.50	Neil Denver			
17.05	**Close**	**16.35**	**Close**	

Poster Schedule

	Day 1		Day 2	
1	Abdullah Baz	MSD	James Docherty	MSD
2	Hock Soon Low	MSD	Nizar Dahir	MSD
3	Syed Ahmad	CSP	Nick Rutter	CSP
4	Jun Wen Luo	CSP	Sabah Nayyef	CSP
5	Naruephorn Tengtrairat	CSP	Hong Zhang	CSP
6	Phetcharat Parathai	CSP	Ibukun Dapo Adewale	CSP
7	Anvar Tukmanov	CSP	Stuart Owen John Crichton	CSP
8	Hua Khee Chan	NME	Nikhil Karunakaran Ponon	NME
9	Daniel Brennan	NME	Sami Ramadan	NME
10	Venkata Karthik Nagareddy	NME	Mohammed Atumi	NME
11	Daniel Appleby	NME	Raied Al-Hamadany	NME
12	Bassim M. H. Jassim	PEDM	Minhaj Hussain Syed	NME
13	Idris Musa	PEDM	Dave Winterborne	PEDM
14			David Grant	PEDM

Assessors Schedule

			Room 2.21	Room 2.22
Day 1	1st Morning Session	Chair	Dr A. Horsfall	
	2nd Morning Session	Chair	Prof. S. Boussakta	Prof. N. Cowern
		Assessor	Dr Z. Ding	Dr P. Briddon
	1st Afternoon Session	Chair	Prof. G. Y. Tian	Dr A. Horsfall
		Assessor	Prof. S. Boussakta	Prof. N. Cowern
	2nd Afternoon Session	Chair	Dr S. Le Goff	Dr A. Horsfall
		Assessor	Dr Y. Chen	Dr J. Goss
Day 2	1st Morning Session	Chair	Prof. S. Dlay	Prof. B. Mecrow
		Assessor	Dr W. L. Woo	Dr G. Atkinson
	2nd Morning Session	Chair	Dr N. Coleman	Dr D. Atkinson
		Assessor	Dr G. Chester	Dr M. Armstrong
	1st Afternoon Session	Chair	Dr G. Russell	Dr V. Pickert
		Assessor	Dr F. Xia	Dr W. Cao
	2nd Afternoon Session	Chair	Dr G. Chester	Dr B. Zahawi
		Assessor	Dr A. Koelmans	Dr D. Giaouris

Poster Session	Chair	Dr C. Tsimenidis
	Assessor 1	Dr A. Bystrov
	Assessor 2	Dr Z. Ding
	Assessor 3	Dr W. Cao
	Assessor 4	Dr P. Degenaar