

Welcome to the 28th Irish Signals and Systems Conference 20th—21st June 2017, Killarney, Co. Kerry

Also Hosting:

2017 Information Technology and
Telecommunication Conference



Technical Sponsors

IEEE UK and Ireland Signals Processing Chapter



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OS-1B—Control Systems 1**33**

- *MAV Based SLAM and Autonomous Navigation: A View Towards Efficient On-Board Systems*
- *Optimal Closed-Loop Transfer Functions for Non-Standard Performance Indices*
- *Distributed Hierarchical Droop Control of Boost Converters in DC Microgrids*
- *Performance modelling of a small-scale wind and solar energy hybrid system*

OS-1C—Imaging & Sensing 1**35**

- *Fast Volume Calibration and Occlusion Free Depth Estimation using Enhanced Optical Orthogonal Codes*
- *Continuous Affect Prediction using Eye Gaze*
- *Non-invasive Respiratory Rate Detection in Spontaneous Respiration by Humidity Measurement*
- *Sub-Pixel Point Detection Algorithm for Point Tracking with Low-Power Wearable Camera Systems*

OS-2A—Imaging & Sensing 2**38**

- *Smartphone based Parameter Estimates of a Dynamic Oscillator using High-Speed Video Imaging and Incremental Discriminating Colour Learning*
- *A Hardware-Software WSN Platform for Machine and Structural Monitoring*
- *Investigating stimuli graphics' size and resolution performance in Steady State Visual Evoked Potential*

OS-2B—Systems & Information Security & Test 1**40**

- *Social dogfood: A Framework to minimise Cloud field defects through crowd sourced testing*
- *Digital Certificate-based Port Knocking for Connected Embedded Systems*
- *A Novel Approach for Secure Identity Authentication in Legacy Database Systems*

OS-3A—Control Systems 2**42**

- *Observations of the Differences between Closed-loop Behavioral and Feed-forward Model Simulations of Fractional-N Frequency Synthesizers*
- *A Linearised PV Maximum Power Tracking Controller for AC Network Integration Analysis*
- *The application of digital accelerometers for wired and non-wired Mechanomyography*
- *Improving Controller Performance in a Powder Blending Process using Predictive Control*

OS-4A—Analogue, Digital & Mixed Signal Circuit Design 1**45**

- *A Low Close-In Phase Noise Class-C Differential Clapp VCO Topology in 180nm Si-Ge HBT Technology*
- *Analysis, Modeling and Implementation of a new 1.8V Pierce-Gate crystal oscillator based on the constant gm cell in 28nm CMOS technology for automotive radar applications*
- *Performance Limits for Open-Loop Fractional Dividers*
- *Design of Voltage Regulators for Automotive Applications: A Sensitivity-Driven Approach*

OS-5A—Systems & Information Security & Test 2**47**

- *Advanced Methodologies to deter Internal Attacks in PTP Time Synchronization Networks*
- *Evaluating Password Advice*
- *One-to-Cloud One-Time Pad Data encryption: Introducing Virtual Prototyping with PSpice*

OS-5B—Analogue, Digital & Mixed Signal Circuit Design 2**49**

- *Methodology for Automated and Recursive Verification of Verilog AMS Models against Schematic*
- *A 5 W High Efficiency Class AB Power Amplifier for LTE Base Station Application*
- *Board Parasitic Integration in the PCB Verification Process*

OS-6A—Signal Processing**51**

- *Speech Intelligibility and Quality: A Comparative Study of Speech Enhancement Algorithms*
- *Predicting short-term wholesale prices on the Irish Single Electricity Market with Artificial Neural Networks*
- *V2Hz: Music Composition from Wind Turbine Energy using a Finite-State Machine*
- *Speaker Recognition Based on MFCC and BP Neural Networks*

OS-6B—Information Technology & Telecommunications**54**

- *An Evaluation of the UniDoodle Student Reponse System in a First Year Systems and Control Module*
- *Applying a MDE Approach to a Healthcare Environment: a case study of an AE department*
- *A ZigBee Honeypot to assess IoT Cyberattack Behaviour*

Abstracts (Posters)**56**

- *Voice Conversion based on Continuous Frequency Warping and Magnitude Scaling*
- *Neural Networks to Aid the Autonomous Landing of a UAV on a Ship*
- *Bitwise Operations of Cellular Automaton on Gray-scale Images*
- *Integrated Sensors Kit for Investigation of Perishable Produce Shelf -Life Extension*
- *Development of a low-cost, hand-held, remote vacuum profile monitoring system*
- *Functional safety and Industrie 4.0*
- *Artificial Calf Weaning Strategies and the role of Machine Learning - A Review*

- *Adaptive Sliding Window Load Forecasting*
- *Low Power IoT Platform for Vital Signs Monitoring*
- *Maximising the Efficiency of a Class-D Audio Amplifier Output Stage*
- *Identity Document Authentication using Steganographic Techniques: The Challenges of Noise*

Venue—The Brehon Hotel Killarney

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Welcome Message

On behalf of the ISSC 2017/IT&T 2017 Organising Committee, we would like to extend a warm welcome to all participants of the Irish Signals and Systems Conference 2017 Technical Sponsors IEEE UK and Ireland Signals Processing Chapter. This year's conference is organised jointly by the Institute of Technology, Tralee and the Cork Institute of Technology.

The ISSC is currently the premier annual research forum in Ireland addressing all aspects of signals and systems, focusing on digital signal processing, control and communications. Over the last 28 years, the ISSC has brought together knowledgeable researchers, scientists and engineers, both academic and industrial, from all over Ireland and other parts of the world, to explore developments and advances in above fields. It has also contributed to the career development of many Irish researchers during a period of significant growth in related research activity. As agreed in the last Steering Committee meeting, the ISSC will continue to support this expanding research and offer a forum where postgraduate students in particular can find a supportive and interested audience. This year again there is a high proportion of submissions from postdoctoral researchers in the areas of signal processing, control systems, biomedical, cloud computing, sensing, analogue, mixed signal and RF processing. We are especially proud of the abundance of papers in the field of analogue, digital and mixed circuit design as in previous years. This topic is particularly important to both academia and industry and is most welcome.

The conference this year promises to be an exciting one with a strong technical programme. In total, we received 65 papers from almost every third level institution in Ireland, as well as a significant number from researchers from outside of Ireland. The conference programme will feature 38 oral presentations and 13 poster presentations, accompanied by keynote addresses from world acclaimed speakers from academia and industry.

We are also delighted to announce that this year's conference proceedings will be published by IEEE eXpress Conference Publishing and we would like to take this opportunity to thank our technical sponsor, IEEE Signal Processing (UKRI Chapter) for its support and official endorsement.

One of the highlights of the conference will be the plenary talks by **Dr. Edmond Harty**, CEO Dairymaster, Full Adjunct Professor University College Dublin; **Mr. Barry Kennedy**, Irish Manufacturing Research Ltd; **Mr. Lionel Alexander** Former CEO HP Ireland & VP/MD of HP Global Supplies Business & Development, Chair of IT Tralee Governing Body; **Professor Shane Ward**, Director of Smart Systems Unit, Biosystems Engineering, University College Dublin and **Professor Conor McCarthy**, Confirm SFI Research Centre, University of Limerick. I would like to thank our plenary speakers for accepting our invitation to present at ISSC 2017.

We are particularly delighted with the high level of industry participation in this year's conference in terms of number of submissions, presence and support. Our technical programme includes a number of special Industry tracks.

A special thanks to all our sponsors: The IEEE Signal Processing (UKRI Chapter), Institute of Technology, Tralee and the Cork Institute of Technology, **Rohde & Schwarz**, Dairymaster, IMaR, TEC, etc

Sincere thanks to all Scientific Programme Committee members for their thorough reviews of submitted papers, and the valuable feedback to corresponding authors. To the authors, particularly the many students who submitted work, we would like to say thank you and well done on meeting the high submission standards. Particular gratitude also to all of the members of the local Organising Committee who have worked tirelessly over many months on the organisation of the conference.

We hope that you find the conference interesting and stimulating, as well as an enjoyable social gathering in Killarney, and wish you every success in your participation in ISSC 2017.

Joseph Walsh and Dirk Pesch

Technical Programme Committee

Conference Chairs

Dr. Joseph Walsh

Dr. Walsh is the Head of School of STEM and Head of IMAr at the IT, Tralee. Dr. Walsh has a Ph.D in Electronic Engineering from the University of Limerick and an M.Sc (Eng) in Bio-engineering jointly from Trinity Collage Dublin (TCD), University Collage Dublin (UCD) and the University of Limerick (UL). He has worked on national and international projects in both industry and research institutes and has received over €2.5million in research funding over the past 6 years. His research experience encompasses the field of intelligent mechatronics and sensors in dairy technology, intelligent sensor systems, robotics, automation, bio-instrumentation and microelectronic circuit test technology and is well published in these areas. Dr. Walsh is a corporate member of the Institute of Physics (MinstP), and the Institution of Engineers of Ireland (MIEI). He was been awarded the titles of Chartered Engineer and Chartered Physicist

Professor Dirk Pesch

Professor Pesch is Head of the Nimbus Research Centre at Cork Institute of Technology in Ireland. Prior to joining CIT in 1999, he was a research fellow at the University of Strathclyde in Glasgow, UK, and was a design engineer with Nokia in Germany and England. He holds a Dipl.Ing degree from RWTH Aachen University in Germany, and a PhD from the University of Strathclyde in Glasgow, both in Electrical and Electronic Engineering. His expertise centres around modelling, analysis, and design of algorithms, protocols, and services for wireless sensor and actuator networks, cyber-physical systems, and Internet of Things with applications in energy management, transportation, and smart cities. Prof. Pesch has been involved in national and international research projects funded by the International Energy Research Centre, Enterprise Ireland, Science Foundation Ireland, and the European Commission. He is an SFI funded Investigator in the CONNECT SFI Centre and jointly holds an SFI Investigator Award researching networks and service for smart cities. He has been involved in a number of EU funded projects including being the coordinator of the EU FP7 projects SCUBA and GENIC, focused on cyber-physical systems in future building automation systems and data centre energy management platforms respectively. Dirk has co-authored 8 book chapters and made over 180 publications in his area of expertise. He is on the editorial board of the IEEE Vehicular Technology Magazine, Elsevier Pervasive and Mobile Computing and the Springer Wireless Networks journal. He also contributes to conference organisation as chair/member of technical programme committees of a large number of leading international conferences and workshops.

Technical Chair

Dr. Daniel Riordan

Dr. Riordan is the Center manager of the IMaR Technology Gateway at IT Tralee. Dr. Riordan has a Bachelor of Electronic Engineering from Dublin City University (2005), a Masters of Computer Science from IT Tralee (2008) and a Ph.D. in the area of Auto-ID Systems within CIMSS (2012) under an Irish Research Council (IRCSET) scholarship. Dr. Riordan has worked within the CIMSS / IMaR group since 2008. His research experience includes, artificial intelligence, computer modelling systems, sensor systems, bio-instrumentation, electro-magnetic interference analysis, digital signal processing and hardware and embedded electronics. He is a member of the Institute of Electrical and Electronic Engineering (MIEEE).

Industrial Chair

Dr. Pat Doody

Dr. Doody is an experienced Researcher and Lecturer in the School of Science and Computing in the Institute of Technology Tralee (ITT). Pat is the Co-founder and Executive Director of the Centre for Innovation in Distributed Systems (CIDS) at ITT. Pat was also Co-Founder and Co-Leader of the Wireless and Mobility Research Group at the ITT. His research interests include AutoID technologies, wireless technologies, intelligent knowledge discovery, data mining, and application of artificial intelligence based neural network algorithms, quality of voice systems and energy initiatives. In partnership with ALTOBRIDGE Ltd. (www.altobridge.com), a network communications start-up located in the Kerry Technology Park, Pat was the principal investigator for this project to develop an integrated end-to-end RFID tag to back office architecture. Pat obtained his bachelor degree in mathematics from the University of Limerick, Ireland in 1991 and PhD in mathematics focusing on artificial intelligence and neural networks from the University Of Limerick, Ireland.

Steering Committee

Joseph Walsh (Chair)	Institute of Technology, Tralee
Dorel Picovici	Institute of Technology Carlow
Abdulhussain Mahdi	University of Limerick
Anthony Holohan	Dublin City University
Anthony Quinn	Trinity College Dublin
Emanuel Popovici	University College Cork
Fearghal Morgan	NUI Galway
John Ringwood	NUI Maynooth
Kevin Curran	University of Ulster
Kevin Carey	Limerick Institute of Technology
Mark Flanagan	University College Dublin
Nigel McKelvey	Letterkenny Institute of Technology
Martin Hayes	University of Limerick
Ronan Flynn	Athlone Institute of Technology
Ronan Farrell	NUI Maynooth
Sean McCloone	Queens University, Belfast
Wasif Naeem	Queens University, Belfast
Andrew Donnellan	Institute of Technology Tallaght
Martin Hill	Cork Institute of Technology
William Lyons	Dundalk Institute of Technology

Scientific & Review Committee

Joseph Walsh	Institute of Technology Tralee
Krishna Panduru	Institute of Technology Tralee
Pat Doody	Institute of Technology Tralee
Daniel Riordan	Institute of Technology Tralee
Eoghan Furey	Letterkenny Institute of Technology
Dorel Picovici	Institute of Technology, Carlow
Edward Jones	NUI Galway
Jim Harkin	Ulster University
John Healy	University College Dublin
John Nelson	University of Limerick
Joseph Kehoe	Institute of Technology Carlow
Liam Kilmartin	NUI Galway
Mark Flanagan	University College Dublin
Martin Hill	Cork Institute of Technology
Ronan Farrell	Maynooth University
Ronan Flynn	Athlone Institute of Technology
Rudi Villing	Maynooth University
William Lyons	Dundalk Institute of Technology
Andrew Shields	Institute of Technology Tralee
Adrian Locke	Institute of Technology Tralee
Emanuel Popovici	University College Cork
Sean McLoone	Queen's University Belfast
Kevin Curran	Ulster University
Dirk Pesch	Nimbus Centre, Cork Institute of Technology
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Ciaran Doyle	Institute of Technology Tralee
Flannagan Noonan	Institute of Technology Tralee

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Kang Li	Queen's University Belfast
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Juan Manuel Escano	Cork Institute of Technology
Samira Roshany-Yamchi	Cork Institute of Technology
Abdulhussain Mahdi	University of Limerick
Ciaran MacNamee	University of Limerick
Anthony Holohan	Dublin City University
Ferghal Morgan	NUI Galway
Wasif Naeem	Queen's University Belfast
Aidan O'Dwyer	Dublin Institute of Technology
Marie O'Neill	Queen's University Belfast
Piestrak Stanislaw	University of Lorraine
Xiaojun Wang	Dublin City University
James Mooney	Athlone Institute of Technology
Barry Cardiff	University College Dublin
Donnacha Lowney	Institute of Technology Carlow
Gabriel Banarie	Analog Devices
Dermot Farrelly	Irish Defence Forces
Darren Kavanagh	Institute of Technology Carlow
David Allen	Institute of Technology Carlow
Dean Callaghan	Institute of Technology Carlow
Michael Mahon	Institute of Technology Carlow
Yvonne Kavanagh	Institute of Technology Carlow
David Denieffe	Institute of Technology Carlow
Andrew Donellan	Institute of Technology Tallaght
Bin Chen	University College Dublin
Ruairí de Fréin	KTH Royal Institute of Technology

Keynote Speaker Profiles

Dr. Edmond Harty

Dr. Harty is CEO of Dairymaster and has been involved in the dairy farm equipment industry during his entire working and academic life. While completing his PhD in University College Dublin he developed a new method for the evaluation of milking units by measuring performance under flow conditions. The methodology he invented then became the adopted international standard for performance measurement of machine milking. In May 2017, Edmund was appointed as Adjunct Full Professor in the School of Biosystems and Food Engineering at UCD College of Engineering and Architecture.

Through his leadership and, in particular, the advances and innovations he has introduced, Dairymaster is now a world leader in technology for dairy farming. Dr Harty's concentration is always on future possibilities, scientifically developed and proven. The level of patent applications (over 45 so far) speaks to his commitment to innovation. Dr Harty and Dairymaster apply physics, chemistry, mechanics, software, electronics and fluid dynamics to an industry in need of technological revolutions. His expertise has been recognised internationally and he was the youngest person appointed to the top three scientific committees globally in the dairy industry including the International Dairy Federation, the ISO standards and the US based National Mastitis Council milking expert groups, largely as a result of his PhD on milking performance. Dr Harty is certified in Ireland for the installation and testing of milking equipment and is a Chartered Engineer and Fellow of Engineers Ireland. Dr Harty was elected to the Board of Directors of Agri-Aware, which is a charitable trust that creates awareness, builds understanding and educates consumers about agriculture.

In Ireland he has previously been named the international and overall Ernst & Young Entrepreneur of the Year. He was also a finalist in the World Entrepreneur of Year competition held in Monte Carlo.

Barry Kennedy

Mr. Kennedy is currently CEO of Irish Manufacturing Research Ltd. (www.imr.ie) having previously worked until 2014 as New Business and Strategic Program manager for Ireland Fab Operations in Intel and on secondment as CEO of 2 cross sector research centres for manufacturing productivity (ICMR - Irish Centre for Manufacturing Research) and energy efficiency (i2e2 - Innovation for Irelands Energy Efficiency). These centres have been set up in partnership with multinational and national indigenous companies across ICT, pharmaceutical, bio medical, heavy industry and food sectors. He qualified with an MSc from University of Dublin, Trinity College Dublin in 1996 and has worked in a research environment in Trinity College Dublin for 10 years before commencing work with Intel. He has worked in a number of senior engineering roles in Intel as process integration, failure analysis engineer. He has worked in a number of management roles within Intel such as Laboratory and Failure Analysis manager, Process Integration manager, Device, Process Control and Statistics manager, Yield Analysis manager, Quality and Reliability manager, Yield Q&R department manager.

Lionel Alexander

Mr. Alexander is the former CEO of HP Ireland and Vice-President / Managing Director of HP Global Consumer Supplies Business & Development. He brings a wealth of significant relevant Enterprise and Board experience to current role of Chair of the Governing Body of the Institute of Technology, Tralee. He has served as a Board Member on the Irish Development Authority (IDA) since 2009. He was previously both the President and a Board Member of the American Chamber of Commerce and also served a six year period as a Board Member of the Irish Business and Employers Confederation (IBEC). He was also the Governing Board Chairman of Information Communication Technology (ICT) Ireland.

Mr. Alexander also has a longstanding interest in developing the talent and competencies of Irish students which he sees as key to driving future economic growth and prosperity for the country. In his role as chair of ICT Ireland he contributed to the introduction of Bonus Points for those taking Honours Level Maths in the Leaving Certificate which has led to an increase in the numbers of students taking Higher Level Maths over recent years.

Professor Shane Ward

Professor Ward is professor of Biosystems Engineering (also known as Agricultural & Food Engineering) at UCD. UCD is Ireland's premier university (ranked in the top 2% of universities worldwide). Professor Ward specialises in the application of "smart systems" within the agri-food industry, to enable efficiency optimisation and minimisation of environmental impact. He has extensive academic and senior management experience. He served (2008-2011) on the Senior Management Team (SMT) Executive of the university and also as Head (2008-2011) of UCD's largest and most research active school, the UCD School of Agriculture, Food Science & Veterinary Medicine, including Biosystems Engineering. He is Director of the Smart Systems Unit (SSU). The Smart Systems Unit Team comprises of two academics (Prof Ward & Dr Brennan); three postdoctoral researchers (Drs. Shanahan, Jackman and Cushen) and several graduate students. The Team works closely with industry, and has a number of "smart systems" ranging from TRL2-7 stages under development, some deployed within the industry. The application of the *internet of things* and "BIG DATA" to the agri-food industry is a major focus of the Team: specializing in agri-food data mining and transformation into knowledge to enhance the efficiency of the agri-food sector. The Team has published extensively in this area.

Professor Conor McCarthy

Professor McCarthy is an Associate Professor of Aeronautical Engineering at the University of Limerick and the Centre Director for the new SFI Confirm Centre for Smart Manufacturing, with 8 academic Institutions and 45 industrial partners. Prof. McCarthy's main area of research is in joining lightweight materials, mostly for high performance structural applications, where he has published over 120 papers and four book chapters. He currently leads a large research group looking at novel joining methods (see www.falcom.ie). Prof. McCarthy is a Science Foundation Ireland Principle Investigator and leads major research programmes in Engineering Science. His interests include bolted, bonded and thermally joined composites, multi-scale damage mechanics and non-linear finite element analysis.

Technical Programme

Tuesday, 20th June

- 08:00 – 09:00 Registration, Tea/Coffee - The Mezzanine**
- 09:00 - 09:20 Welcome/Conference Opening - The Brehon Suite**
Dr. Oliver Murphy President, Institute of Technology Tralee
Dr. Joseph Walsh ISSC 2017 General Chair
Prof. Dirk Pesch ISSC 2017 General Chair

KN-1

- 09:15 - 09:45 Keynote - The Brehon Suite**
Keynote Title: IoT in Agriculture
Dr. Edmond Harty, CEO Dairymaster,
Full Adjunct Professor University College Dublin

OS-1A

- 09:45 - 11:05 Communication Systems - The Brehon Suite**
Chair: Dr. Daniel Riordan *Institute of Technology, Tralee*
- 09:45 - 10:05 *Rebuilding the Internet eXchange Point in Uganda***
Diarmuid O'Briain (Institute of Technology, Carlow) David Denieffe (Institute of Technology, Carlow) Yvonne Kavanagh (Institute of Technology Carlow) Dorothy Okello (Makerere University)
- 10:05 - 10:25 *Application of multiple change point detection methods to large urban telecommunication networks.***
Andrew Shields (Institute of Technology Tralee), Pat Doody (Institute of Technology Tralee) Ted Scully (Cork Institute of Technology)

- 10:25 - 10:45** ***An Analysis of Loss-Free Data Aggregation for High Data Reliability in Wireless Sensor Networks***
Stephen Brown (Maynooth University)
- 10:45 - 11:05** ***Maximization of Sum Rate in AF-Cognitive Radio Networks Using Superposition Approach and n-out-of-k Rule***
Md Sipon Miah (National University of Ireland Galway)
Michael Schukat (National University of Ireland Galway)
Enda Barrett (National University of Ireland Galway)

OS-1B

- 09:45 - 11:05** **Control Systems 1 - The Park Suite**
Chair: Dr. Eoghan Furey, Letterkenny Institute of Technology
- 09:45 - 10:05** ***MAV Based SLAM and Autonomous Navigation: A View Towards Efficient On-Board Systems***
Peter Murray (National University of Ireland Galway) Michael Schukat (National University of Ireland Galway)
- 10:05 - 10:25** ***Optimal Closed-Loop Transfer Functions for Non-Standard Performance Indices***
Pdraig Basquel (University College Dublin) Ronan Burke (University College Dublin) Paul Curran (University College Dublin)
- 10:25 - 10:45** ***Distributed Hierarchical Droop Control of Boost Converters in DC Microgrids***
Daniel O'Keeffe (University College Cork)
- 10:45 - 11:05** ***Performance modelling of a small-scale wind and solar energy hybrid system***
Zhengnan Cao (Dundalk Institute of Technology) Fergal O'Rourke (Dundalk Institute of Technology) William Lyons (Dundalk Institute of Technology)

OS-1C

09:45 - 11:05

Imaging & Sensing 1 - The Munster Suite

Chair: Dr. Joseph Walsh *Institute of Technology, Tralee*

09:45 - 10:05

Fast Volume Calibration and Occlusion Free Depth

Estimation using Enhanced Optical Orthogonal Codes

LakshmiSravya Koppula (Indian Institute of Technology Kanpur) Indra Kiran (Indian Institute of Technology Kanpur) Venkatesh Subramanian (Indian Institute of Technology Kanpur)

10:05 - 10:25

Continuous Affect Prediction using Eye Gaze

Jonny O' Dwyer (Athlone Institute of Technology) Ronan Flynn (Athlone Institute of Technology) Niall Murray (Athlone Institute of Technology)

10:25 - 10:45

Non-invasive Respiratory Rate Detection in Spontaneous Respiration by Humidity Measurement

Robert Scholz (Anhalt University of Applied Sciences) Boris Romanus Bracio (Anhalt University of Applied Sciences) Michael Brutscheck (Anhalt University of Applied Sciences) Peter Trommler (HELIOS Klinikum Köthen)

10:45 - 11:05

Sub-Pixel Point Detection Algorithm for Point Tracking with Low-Power Wearable Camera Systems

Mariusz Wilk (UCC/Tyndall National Institute) Andrea Urru (UCC/Tyndall National Institute) Salvatore Tedesco (UCC/Tyndall National Institute) Brendan O'Flynn (UCC/Tyndall National Institute)

PS-1

11:05 - 11:30 Refreshments and Poster Session — The Brehon Suite Lobby

- *Voice Conversion based on Continuous Frequency Warping and Magnitude Scaling*
- *Neural Networks to Aid the Autonomous Landing of a UAV on a Ship*
- *Bitwise Operations of Cellular Automaton on Gray-scale Images*
- *Integrated Sensors Kit for Investigation of Perishable Produce Shelf-Life Extension*
- *Development of a low-cost, hand-held, remote vacuum profile monitoring system*
- *Functional safety and Industrie 4.0*
- *Artificial Calf Weaning Strategies and the role of Machine Learning - A Review*
- *Adaptive Sliding Window Load Forecasting*
- *Low Power IoT Platform for Vital Signs Monitoring*
- *Maximising the Efficiency of a Class-D Audio Amplifier Output Stage*
- *Identity Document Authentication using Steganographic Techniques: The Challenges of Noise*

KN-2

11:30 - 12:00 Keynote - The Brehon Suite

Keynote Title: Advanced Manufacturing and Industry 4.0

Mr. Barry Kennedy, Irish Manufacturing Research Ltd.

OS-2A

12:00 - 13:00

Imaging & Sensing 2 - The Brehon Suite

Chair: Prof. Dirk Pesch *Cork Institute of Technology*

12:00 - 12:20

Smartphone based Parameter Estimates of a Dynamic Oscillator using High-Speed Video Imaging and Incremental Discriminating Colour Learning

Modestas Zeimys (University College Dublin) Michael O'Byrne (University College Dublin) Vikram Pakrashi (University College Dublin)

12:20 - 12:40

A Hardware-Software WSN Platform for Machine and Structural Monitoring

David Rojas (Nimbus Centre, Cork Institute of Technology) John Barrett (Nimbus Centre, Cork Institute of Technology)

12:40 - 13:00

Investigating stimuli graphics' size and resolution performance in Steady State Visual Evoked Potential

Artur Szalowski (Institute of Technology, Carlow) Dorel Picovici (Institute of Technology, Carlow)

OS-2B

12:00 - 13:00

Systems & Information Security & Test 1 - The Park Suite

Chair: Dr. Pat Doody *Institute of Technology Tralee*

12:00 - 12:20

Social dogfood: A Framework to minimise Cloud field defects through crowd sourced testing

Jonathan Dunne (Maynooth University) David Malone (Maynooth University)

12:20 - 12:40

Digital Certificate-based Port Knocking for Connected Embedded Systems

*Basim Mahbooba (National University of Ireland Galway)
Michael Schukat (National University of Ireland, Galway)*

12:40 - 13:00 ***A Novel Approach for Secure Identity Authentication in Legacy Database Systems***

Juanita Blue (University of Ulster) Eoghan Furey (Letterkenny Institute of Technology) Joan Condel (University of Ulster)

13:00 - 14:00 **Lunch—Danú Restaurant**

KN-3

14:00 - 14:30 **Keynote - The Brehon Suite**

Keynote Title: The Quadruple Helix: Research/Industry/ Government/Education - A Collaborate Approach for Success
Mr. Lionel Alexander Former CEO HP Ireland & VP/MD of HP Global Supplies Business & Development, Chair of IT Tralee Governing Body

OS-3A

14:30 - 15:50 **Control Systems 2 - The Park Suite**

Chair: Dr. Eoghan Furey, Letterkenny Institute of Technology

14:30 - 14:50 ***Observations of the Differences between Closed-loop Behavioral and Feed-forward Model Simulations of Fractional-N Frequency Synthesizers***

Dawei Mai (UCC/Tyndall National Institute) Hongjia Mo (UCC/ Tyndall National Institute) Michael Peter Kennedy (UCC/Tyndall National Institute)

14:50 - 15:10 ***A Linearised PV Maximum Power Tracking Controller for AC Network Integration Analysis***

Colin Levis (Cork Institute of Technology) Martin Hill (Cork Institute of Technology)

15:10 - 15:30 ***The application of digital accelerometers for wired and non-wired Mechanomyography***

Niall Campbell (Institute of Technology Blanchardstown)
Thomas Egan (Institute of Technology Blanchardstown)
Catherine Deegan (Institute of Technology Blanchardstown)

15:30 - 15:50

***Improving Controller Performance in a Powder Blending
Process using Predictive Control***

*Niall O' Mahony, Institute of Technology Tralee; Krishna Panduru,
Institute of Technology Tralee; Daniel Riordan, Institute of
Technology Tralee; Joseph Walsh, Institute of Technology Tralee*

OS-3B

14:30 - 15:50

Industry Track—AgriTech - The Brehon Suite
Chair: Dr. Edmond Harty, Dairymaster

PS-2

15:50 - 16:10

**Refreshments and Poster Session — The Brehon
Suite Lobby**

KN-4

14:00 - 14:30

Keynote - The Brehon Suite

Keynote Title: The Agrocycle Project

Prof. Shane Ward, Director of Smart Systems Unit,
Biosystems Engineering, UCD

OS-4A

16:40 - 18:00 **Analogue, Digital & Mixed Signal Circuit Design 1-**
The Park Suite

Chair: Mr. Krishna Panduru, *IMaR, Institute of Technology, Tralee*

16:40 - 17:00 ***A Low Close-In Phase Noise Class-C Differential Clapp VCO Topology in 180nm Si-Ge HBT Technology***

Giuseppe Macera (Analog Devices International) Valerio Marotta (Tyndall National Institute)

17:00 - 17:20 ***Analysis, Modeling and Implementation of a new 1.8V Pierce-Gate crystal oscillator based on the constant gm cell in 28nm CMOS technology for automotive radar applications***

Giuseppe Macera (Analog Devices International)

17:20 - 17:40 ***Performance Limits for Open-Loop Fractional Dividers***

Stefano Tulisi (Tyndall National Institute) Michael Peter Kennedy (UCC/Tyndall National Institute)

17:40 - 18:00 ***Design of Voltage Regulators for Automotive Applications: A Sensitivity-Driven Approach***

Pasquale Napolitano (On Semiconductor Ireland Ltd.) Kevin Kelliher (On Semiconductor Ireland Ltd.)

OS-4B

16:40 - 18:00 **Industry Track 2—Advanced Manufacturing**

- The Brehon Suite

Chair: Mr. Tom Fitzmaurice Applied IoT Cluster

18:10 - 19:00 **ISSC Steering Committee Meeting**

- The Munster Suite

19:30—20:00 **Drinks Reception - The Mezzanine**

20:00 - 22:00 **Conference Gala Banquet**

- The Brehon Suite

Wednesday, 21st June

KN-5

09:15 - 10:00 **Keynote - The Brehon Suite**

Keynote Title: An Introduction to Confirm Centre for Smart Manufacturing

Prof. Conor McCarthy, Confirm SFI Research Centre,
University of Limerick

OS-5A

10:00 - 11:00 **Systems & Information Security & Test 2**

- The Brehon Suite

Chair: Dr. Pat Doody, Institute of Technology Tralee

10:00 - 10:20 ***Advanced Methodologies to deter Internal Attacks in PTP Time Synchronization Networks***

Waleed Alghamdi (National University of Ireland, Galway)

Michael Schukat (National University of Ireland, Galway)

10:20 - 10:40 ***Evaluating Password Advice***

*Hazel Murray (Maynooth University) David Malone
(Maynooth University)*

10:40 - 11:00 ***One-to-Cloud One-Time Pad Data encryption: Introducing Virtual Prototyping with PSpice***

*Paul Tobin (Dublin Institute of Technology) Lee Tobi
(University College Dublin) Roberto Gandia Blanquer
(Flowcad) Michael Mc Keever (Dublin Institute of Technology)
Jonathan Blackledge (Military Technological College)*

OS-5B

10:00 - 11:00 Analogue, Digital & Mixed Signal Circuit Design 2

- The Park Suite

Chair: Mr. Krishna Panduru, *IMaR, Institute of Technology, Tralee*

10:00 - 10:20 *Methodology for Automated and Recursive Verification of Verilog AMS Models against Schematic*

Stephen Ogunniran (On Semiconductor Ireland Ltd.) Pasquale Napolitano (On Semiconductor Ireland Ltd.) Kevin Kelliher (On Semiconductor Ireland Ltd.)

10:20 - 10:40 *A 5 W High Efficiency Class AB Power Amplifier for LTE Base Station Application*

Abdulrahman Alqadami (Maynooth University) Sidath Madhuwantha (Maynooth University) Ronan Farrell (Maynooth University) John Dooley (Maynooth University)

10:40 - 11:00 *Board Parasitic Integration in the PCB Verification Process*

Wilfried Wessel (Mentor Graphics) Bernhard Hoppe (University of Applied Sciences, Darmstadt)

PS-3

11:00 - 11:40 Refreshments and Poster Session — The Brehon Suite Lobby

OS-6A

11:40 - 13:00

Signal Processing - The Brehon Suite

Chair: Dr. Daniel Riordan, *Institute of technology Tralee*

11:40 - 12:00

Speech Intelligibility and Quality: A Comparative Study of Speech Enhancement Algorithms

Xiaodong Xu (Athlone Institute of Technology) Ronan Flynn (Athlone Institute of Technology) Michael Russell (Athlone Institute of Technology)

12:00 - 12:20

Predicting short-term wholesale prices on the Irish Single Electricity Market with Artificial Neural Networks

Pengfei Li (Ark Energy) Francesco Arci (Ark Energy) Jane Reilly (Ark Energy) Kevin Curran (Ulster University) Ammar Belatreche (Northumbria University) Yauheniya Shynkevich (Ulster University)

12:20 - 12:40

V2Hz: Music Composition from Wind Turbine Energy using a Finite-State Machine

Mark O'Sullivan (University College Cork) Bruno Srbinovski (University College Cork) Hugh McCarthy (Cork Institute of Technology) Andriy Temko (University College Cork) Emanuel Popovici (University College Cork)

12:40 - 13:00

Speaker Recognition Based on MFCC and BP Neural Networks

Yi Wang (Maynooth University) Bob Lawlor (Maynooth University)

OS-6B

11:40 - 12:40

Information Technology and

Telecommunications- The Park Suite

Chair: Mr. Andrew Shields, *Institute of Technology Tralee*

11:40 - 12:00

An Evaluation of the UniDoodle Student Reponse System in a First Year Systems and Control Module

*Seamus McLoone (Maynooth University) Christine Kelly
(Maynooth University)*

12:00 - 12:20

Applying a MDE Approach to a Healthcare Environment: a case study of an AE department

*Joseph Timoney (Maynooth University) Hao Wu (Maynooth
University) Hussein Gannud (Maynooth University)*

12:20 - 12:40

A ZigBee Honeypot to assess IoT Cyberattack Behaviour

*Seamus Dowling (National University of Ireland Galway)
Michael Schukat (National University of Ireland Galway)
Hugh Melvin (National University of Ireland Galway)*

13:00 - 14:00

Lunch & Awards Ceremony—Danú Restaurant

14:00

Closing Address

Abstracts (Presentations)

OS-1A

Communication Systems

Rebuilding the Internet eXchange Point in Uganda

Diarmuid O'Briain, Institute of Technology, Carlow; David Denieffe, Institute of Technology, Carlow; Yvonne Kavanagh, Institute of Technology, Carlow; Dorothy Okello, Makerere University

Uganda is a land locked country in South East Africa. It is separated from the Indian ocean by Kenya to the east and Tanzania to the south. It is separated from South Atlantic by the Democratic Republic of the Congo to the west. Uganda's connection to the Internet is overland to Mombasa, Kenya where the Seacom cable installed in 2009 connected Mombasa to Europe with a capacity of 640 Gb/s and the World Bank funded Eastern Africa Submarine Cable System (EASSy) undersea fibre optic cable connects Eastern Africa to South Africa and Europe with a capacity of 1.4 Tb/s. Additionally until recently Uganda was dependent upon a single overland link to Kenya via Uganda Electricity Transmission Company Limited (UETCL) power lines whereas today there are a number of options such as the Seacom cable fibre cable completed in 2015. During the 2010 FIFA World Cup Final a terrorist attack on the Kyandondo Rugby Club in Nakawa, Kampala brought all Internet Service Providers (ISP) in Uganda off-line as the rugby ground sits directly underneath the UETCL power lines bring Internet services from Kenya. This leaves Uganda at significant disadvantage regionally and to-date the technology industry has tended to converge at Mombassa and Nairobi as well as in Dar es Salaam, Tanzania. Recently however as the modern Internet services require Global Service Providers (GSP) to get closer to the end-user so they can avail of lower latency, higher bandwidth applications, the justification for serving all of South East Africa from data centres in Nairobi, Mombassa, Dar es Salaam and even from South Africa is becoming less valid. In order to facilitate the deployment of locally hosted content and reduce the country's reliance on international cables, additional capacity was required at the country's primary local interconnection point, the Uganda Internet Exchange Point (UIXP). UIXP is currently developing its infrastructure to support a larger membership encompassing growing demand from both ISPs and Application Service Providers (ASP).

Providers (ASP). This paper serves to outline the developments that are being put in place to take UIXP from a local Internet eXchange Point (IXP) supporting local ISPs and e-government services to the next level where it is in a position to support GSP Content Delivery Networks (CDN) and therefore pave the way for the next phase of development of the Internet in Uganda.

Application of multiple change point detection methods to large urban telecommunication networks.

Andrew Shields, Institute of Technology Tralee; Pat Doody, Institute of Technology Tralee; Ted Scully, Cork Institute of Technology

Abstract —An integral enabler of the smart city vision is the ability to effectively model collective population behaviour. The realisation of sustainable smart mobility is underpinned by the effective modelling of the spatial movements of the population. Furthermore, it is also crucial to identify significant deviations in collective behaviour over time. For example, a change in urban mobility patterns would subsequently impact traffic management systems. This paper focuses on the issue of modelling the collective behaviour of a population by utilizing mobile phone data and investigates the ability to identify significant deviations in behaviour over time. Mobile phone data facilitates the inference of real social networks from their call data records (CDR). We use this data to model collective behaviour and apply change-point detection algorithms, a category of anomaly detection, in order to identify statistically significant changes in collective behaviour over time. The result off the empirical analysis demonstrate that modern change point detection can accurately identify change points with an R_2 value of 0.9633.

An Analysis of Loss-Free Data Aggregation for High Data Reliability in Wireless Sensor Networks

Stephen Brown, Maynooth University

Data aggregation is an important feature in Wireless Sensor Networks, used primarily to reduce energy use. This paper extends our previous results, which showed that data aggregation can improve the reliability of data delivery rather than degrading it as previously assumed. These previous results were based on the use of scaleable aggregation functions, such as SUM, COUNT, MIN, MAX which work independently of the network size.

In this paper we extend these results to consider the reliability and energy efficiency of lossless data delivery with the semi-scaleable aggregation function APPEND, and determine the boundary conditions under which the data reliability can be maintained without an increase in the energy cost. These new results show that lossless aggregation using the APPEND aggregation function can provide improved reliability with reduced energy usage in certain conditions.

Maximization of Sum Rate in AF-Cognitive Radio Networks Using Superposition Approach and n-out-of-k Rule

Md Sipon Miah, National University of Ireland Galway; Michael Schukat, National University of Ireland Galway; Enda Barrett, National University of Ireland Galway

The spectrum sensing strategy plays a vital role in Amplify-Forward (AF)-Cognitive Radio Networks (CRNs). However, AF-CRN cannot obtain maximal throughput, when existing sensing strategies are applied to AF-CRNs. In this paper, we present a superposition approach in AF-CRNs, in which firstly a Secondary User (SU) extends its sensing time until right before the beginning of its reporting time slot, and secondly each SU sends its measurement results containing amplified reports to the Cluster Head (CH), while the CH with soft-fusion report is forwarded to the Fusion Center (FC). With such extended sensing intervals and amplified reporting, a better sensing performance can be obtained than with the conventional rigid strategy. In addition to this, the sum rate of primary and secondary networks is also investigated for the superposition approach and the n-out-of-k rule. Numerical experiments show that the proposed strategy guarantees maximum sum rate compare to the conventional strategy under any condition.

OS-1B

Control Systems 1

MAV Based SLAM and Autonomous Navigation: A View Towards Efficient On-Board Systems

Peter Murray, National University of Ireland Galway; Michael Schukat, National University of Ireland Galway

In the field of autonomous drone or micro air vehicle (MAV) research, much of the existing literature focuses on novel approaches to MAV automation and navigation. Whilst discovering these new approaches has scientific merit, these works rarely focus on the impact that the deployment of such systems have in terms of the operational time, power consumption or efficiency of the MAV. This work sets out to review the parallel tracking and mapping algorithm (PTAM) as applied to MAV control systems. Through experimentation, the limits of this algorithm are found in an attempt to determine the minimum computational and power requirements for a computer to have, in order to run PTAM effectively. This work demonstrates that it is feasible with current available technology, to operate PTAM on a 5 watt computer by limiting the parameters that add computational overhead to the system.

Optimal Closed-Loop Transfer Functions for Non-Standard Performance Indices

Padraig Basquel, University College Dublin; Ronan Burke, University College Dublin; Paul Curran, University College Dublin

Multiple indices are available for measuring the performance of closed-loop systems, some of which are explored in the seminal work of Graham & Lathrop in 1953. In their paper, a determination is made of closed-loop transfer functions for optimal performance relative to the non-standard performance indices ITSE and ISTSE. A new approach is presented to calculate such metrics using Lyapunov matrix equations, and is validated by reproducing previous results.

Distributed Hierarchical Droop Control of Boost Converters in DC Microgrids

Daniel O'Keeffe, University College Cork

Voltage stability and accurate current-sharing are primary features of an efficiently operating power distribution network, such as a dc islanded-microgrid. This paper presents the development of a distributed hierarchical droop control architecture for dc-dc boost converters within a dc islanded-microgrid. Decentralised controllers are conventionally designed for local voltage and current control without accounting for coupling to other converters. However, due to the non-minimum phase action of boost converters, global knowledge of coupling is required to inform stable local controller tuning over a range of load disturbances. Consensus-based distributed secondary controllers, utilising low-bandwidth communications, are designed to coordinate voltage levels and improve current-sharing accuracy. The control architecture is tested in response to communication faults, non-linear loads, and plug-and-play operations.

Performance modelling of a small-scale wind and solar energy hybrid system

Zhengan Cao, Dundalk Institute of Technology; Fergal O'Rourke, Dundalk Institute of Technology; William Lyons, Dundalk Institute of Technology

Wind and solar energy have become very popular options for energy conversion over the past years. This is particularly true for wind energy which is experiencing significant growth year-on-year. A significant part of this growth is at large-scale commercial power systems. However, there is a growing interest in small-scale renewable energy technologies to capture this intermittent but plentiful resource. A combined wind and solar energy hybrid system utilises two renewable energy resources, in doing so diversifies supply and as a result will make the system power output more stable and continuous. In this paper the details of the hybrid system model, using Matlab Simulink, are given. The model developed, is discussed giving key details on the characteristics of each part of the wind and solar energy hybrid system. The hybrid system model developed includes four subsystems: the solar energy subsystem, the wind energy subsystem, the inverter subsystem, the battery

storage subsystem. The renewable energy resource is converted, using the wind turbine and photovoltaic panels to AC, via an inverter, which supplies the load. Any surplus energy is stored in the battery. It was found, from the simulation that the maximum power can be obtained under different circumstances using the developed maximum power point tracking algorithm.

OS-1C

Imaging & Sensing 1

Fast Volume Calibration and Occlusion Free Depth Estimation using Enhanced Optical Orthogonal Codes

LakshmiSravya Koppula, Indian Institute of Technology Kanpur; Indra Kiran, Indian Institute of Technology Kanpur; Venkatesh Subramanian, Indian Institute of Technology Kanpur

Structured light techniques have received increased attention for depth estimation as they are robust and accurate. In this paper, we propose a method for camera-projector calibration which is required for structured light based depth estimation. We also propose enhancements to the existing hierarchical orthogonal coding (HOC) technique. The proposed space calibration technique is simple and fast compared to current camera-projector calibration techniques. The existing HOC, though being robust to ambient environmental lighting conditions, fails at occluded regions due to its pixel decoding strategy. With this in mind, we propose a self occlusion detection method to detect such 'shadows' in advance and to recommend to readjust the camera-projector positions to eliminate the shadows. Additionally an address transition rule is also proposed to correct any erroneously detected code. The proposed method is evaluated by computing the depth maps of objects of different known shapes.

Continuous Affect Prediction using Eye Gaze

Jonny O' Dwyer, Athlone Institute of Technology; Ronan Flynn, Athlone Institute of Technology; Niall Murray, Athlone Institute of Technology

In recent times, there has been significant interest in the machine recognition of human emotions, due to the suite of applications to which this knowledge can be applied. A number of different modalities, such as speech or facial expression, individually and with eye gaze, have been investigated by the affective computing research community to either classify the emotion (e.g. sad, happy, angry) or predict the continuous values of affective dimensions (e.g. valence, arousal, dominance) at each moment in time. Surprisingly after an extensive literature review, eye gaze as a unimodal input to a continuous affect prediction system has not been considered. In this context, this paper evaluates the use of eye gaze as a unimodal input to a continuous affect prediction system. The performance of continuous prediction of arousal and valence using eye gaze is compared with the performance of a speech system using the AVEC 2014 speech feature set. The experimental evaluation when using eye gaze as the single modality in a continuous affect prediction system produced a correlation result for valence prediction that is better than the correlation result obtained with the AVEC 2014 speech feature set. Furthermore, the eye gaze feature set proposed in this paper contains 98% fewer features compared to the number of features in the AVEC 2014 feature set.

Non-invasive Respiratory Rate Detection in Spontaneous Respiration by Humidity Measurement

Robert Scholz, Anhalt University of Applied Sciences; Boris Romanus Bracio, Anhalt University of Applied Sciences;; Michael Brutscheck, Anhalt University of Applied Sciences; Peter Trommler, HELIOS Klinikum Köthen

This paper investigates an innovative, non-invasive and contactless approach for respiratory rate detection in spontaneous breathing by using an industrial standard humidity and temperature sensor controlled by a microcontroller. Hardware and software have been designed and manufactured and for a spontaneous respiration simulation two different test beds have been developed

and evaluated. Results have been analyzed and statistically verified with special focus on accuracy and coverage of the broad frequency range in human respiration.

Sub-Pixel Point Detection Algorithm for Point Tracking with Low-Power Wearable Camera Systems

Mariusz Wilk, UCC/Tyndall National Institute; Andrea Urru, UCC/Tyndall National Institute; Salvatore Tedesco, UCC/Tyndall National Institute; Brendan O'Flynn, UCC/Tyndall National Institute

With the continuous developments in vision sensor technology, highly miniaturized low-power and wearable vision sensing is becoming a reality. Several wearable vision applications exist which involve point tracking. The ability to efficiently detect points at a sub-pixel level can be beneficial, as the accuracy of point detection is no longer limited to the resolution of the vision sensor. In this work, we propose a novel Simplified Linear Interpolation (SLI) algorithm that achieves high computational efficiency, which outperforms existing algorithms in terms of the accuracy under certain conditions. We present the principles underlying our algorithm and evaluate it in a series of test scenarios. Its performance is finally compared to similar algorithms currently available in the literature.

Smartphone based Parameter Estimates of a Dynamic Oscillator using High-Speed Video Imaging and Incremental Discriminating Colour Learning

Modestas Zeimys, University College Dublin; Michael O'Byrne, University College Dublin; Vikram Pakrashi, University College Dublin

Image-based systems are increasingly being used for Structural Health Monitoring (SHM) applications. Video-based motion tracking algorithms can be used to analyse dynamic responses characterised by low frequencies, large deflections and low damping ratios. The advantages of image processing over other methods include the ability to track multiple points on a structure, its scalability, and its ease of use. Standard video acquisition devices are limited in their ability to assess dynamic responses and identify natural frequencies or damping ratios of structures due to the relatively low sampling rate, or frame rate. As such, there becomes a need to use video cameras that possess the ability to record at high frame rates – a feature that is becoming increasingly common on modern smartphones. This paper demonstrates how such video cameras can be used to estimate natural frequencies and viscous damping ratios of structures by considering a Single Degree of Freedom (SDOF) linear system undergoing free vibrations. The slow-motion feature on a Nexus 6P Smartphone was used to capture the dynamic response of the vibrating system. The video was assessed by an Incremental Discriminative Colour Tracking (IDCT) algorithm which tracked the position of points on the system, from which the natural frequency and damping ratio could then be extracted. The results were compared to a reference accelerometer and theoretical estimates. This paper acts as an evidence base for the evolving capabilities of smartphone based monitoring, and ultimately, shows that smartphones have value as a tool for the cost-effective assessment of structures.

A Hardware-Software WSN Platform for Machine and Structural Monitoring

David Rojas, Nimbus Centre, Cork Institute of Technology; John Barrett, Nimbus Centre, Cork Institute of Technology

Traditional wired vibration and acoustic sensors used for machine and structural monitoring are currently being replaced by low-cost MEMS-based wireless sensor networks (WSN). However, existing platforms are lacking in computing capabilities and integration, as well as the necessary software features to manage wireless sensing experiments. In this paper, we present a novel hardware-software platform designed to monitor machinery in remote deployments and expedite collection of experimental data, which could also be used for structural monitoring. The hardware module is composed of a single PCB with an IEEE 802.15.4-compatible microcontroller, waterproof Micro-USB connector, battery, battery charger/monitor, humidity/temperature sensor, IMU, and a MEMS microphone. The software developed allows for wireless experiment control and data collection through a gateway node connected to a laptop. Additionally, the user interface supports the placement of the nodes in a 3D view of the environment, as well as visualisation of the collected data. The platform was tested in the laboratory in two different motor setups by measuring vibration and sound in normal operation, showing that the system can facilitate the execution of sensing experiments in rotating machinery and similar equipment.

Investigating stimuli graphics' size and resolution performance in Steady State Visual Evoked Potential

Artur Szalowski, Institute of Technology, Carlow; Dorel Picovici, Institute of Technology, Carlow

This paper investigates brain signal peaks and their relationship to flicker size and resolution using colour red-white (RW) and monochrome black-white (BW) graphics. The raw electroencephalograph (EEG) signals were recorded using Emotiv EPOC headset into Windows based PC running Emotiv Xavier Test Bench software.

The flickers oscillating at 10 Hz of different resolutions were displayed over black and white backgrounds using iPad Pro 12.9" tablet. The signals were analysed and their amplitude and noise levels were measured using MATLAB with EEGLAB and ERPLAB plugins. Flickers with white background elicited better signals. Red and white colour combination for flicker checkerboard outperformed the standard black and white design. Decreasing the flickers' size yielded gradual increase in elicited signal peaks.

OS-2B

Systems & Information Security & Test 1

Social dogfood: A Framework to minimise Cloud field defects through crowd sourced testing.

Jonathan Dunne, Maynooth University; David Malone, Maynooth University

Delivering software for the Cloud represents a challenge for both micro teams and Small Medium Enterprises (SMEs), in part due to the rapid release methods adopted and the numerous ways in which software defects can be detected. We study field defect detection rates in a framework where these rates are used to refocus in-house test resources. Using an enterprise dataset, we address the question of what types of defects are found in the field and how soon after a system goes live defects are detected. Our framework can aid both micro teams and SMEs to minimise the number of defects found in the field by maximising internal usage through 'Dogfood' programs and by leveraging crowdsourced test methodologies.

Digital Certificate-based Port Knocking for Connected Embedded Systems

Basim Mahbooba, National University of Ireland Galway; Michael Schukat, National University of Ireland, Galway

The Internet of Things (IoT) is more vulnerable to targeted cyber-attacks than an ordinary Information Technology (IT) infrastructure, where these cyber-attacks operate on subsequent identification (i.e., port scan and exploitation of device's vulnerabilities). Port scans can be rendered useless by applying Port Knocking (PK) as information is transmitted across closed network ports by using a common secret, a device firewall hides all ports from the outside world by filtering (PK) network packets (i.e. TCP connection requests). A secure approach to authenticate IOT devices on the network is required as the current PK approaches (e.g. one-time password) suffer from security issues such as sharing secrets. Therefore, this research aims to reinforce existing port knocking methods with a digital certificate for alternative authentication among IoT devices. Such concepts will be complementary to other cryptographic concepts (i.e. shared encryption keys as adopted in ZigBee).

A Novel Approach for Secure Identity Authentication in Legacy Database Systems

Juanita Blue, University of Ulster; Eoghan Furey, Letterkenny Institute of Technology; Joan Condell, University of Ulster

Information systems in the digital age have become increasingly dependent on databases to store a multitude of fundamental data. A key function of structured databases is to house authentication credentials that verify identity and allow users to access more salient personal data. Authentication databases are frequently a target of attack as they potentially provide an avenue to commit further, more lucrative crimes. Despite the provision of industry standard best practice recommendations from organisations such as Open Web Application Security Project (OWASP), Payment Card Industry Security Standards Council (PCI-SSC), Internet Engineering Task Force (IETF) and Institute of Electrical and

Electronics Engineers (IEEE), often practical security implementations within industry flounder. Lacking or substandard implementations have cultivated an environment where authentication databases and the data stored therein are insecure.

This was demonstrated in the 2016 exposure of a breach experienced by Yahoo where approximately one billion user credentials were stolen. The global technology company was found to be using obsolete security mechanisms to protect user passwords. Dated implementations such as these pose serious threat as they render authentication data highly vulnerable to theft and potential misuse.

This paper offers a novel solution for securing authentication databases on non-compliant Apache servers. The method applies the recommended best practice mechanisms in the form of salt, one-way encryption (hashing) and iterations to both pre-existing and newly created passwords that are stored on insecure systems. The proposed solution can be implemented server-side, with little alteration to the existing infrastructure, unbeknownst to the user. It possesses the potential to improve system security, aid compliance, preserve privacy and protect users.

OS-3A

Control Systems 2

Observations of the Differences between Closed-loop Behavioral and Feed-forward Model Simulations of Fractional -N Frequency Synthesizers

Dawei Mai, UCC/Tyndall National Institute; Hongjia Mo, UCC/Tyndall National Institute; Michael Peter Kennedy, UCC/Tyndall National Institute

Conventionally, a fractional-N synthesizer is simulated using a closed-loop behavioral model and the simulations can be very time-consuming. With the analysis by Perrott et al., a more straightforward model, namely the feed-forward model, for the fractional-N frequency synthesizer is available. The feed-forward model simulations provide quick, relatively accurate evaluation of fractional-N synthesizer divider controller designs. In this work, we point out several differences in the closed-loop behavioral model simulations performed in the CppSim environment and the feed-forward model simulations and discuss their significance on the base of analysis and simulation results.

A Linearised PV Maximum Power Tracking Controller for AC Network Integration Analysis

Colin Levis, Cork Institute of Technology; Martin Hill, Cork Institute of Technology

The maximum power available from a photovoltaic (PV) generator in many grid connected systems is extracted using a dc-dc step up converter that implements a maximum power point tracking (MPPT) algorithm. Traditional MPPT algorithms are iterative, continuously searching for the maximum power point (MPP) under varying weather conditions. Due to the non-linear time-varying nature of commonly used MPPT methods such as perturb and observe (P&O) it is not easily integrated into state-space models for AC network analysis. In this paper a linearised PV MPPT controller for AC network integration analysis is presented. The non-linear step up converter and PV array are transformed into a time invariant system by using the state space sliding averaging technique, over a single switching cycle. This allows for linear controller design and provides a computationally inexpensive model suitable for AC network integration analysis. The linearised controller robustness was assessed over the expected operating irradiance range, at a constant temperature, using the detailed switching model in MATLAB/Simulink which produced increased performance and stability when compared to P&O MPPT. The computational time using a standard operating system for a 2s simulation of the detailed switching model was 263s while the reduced small signal model was 0.4s.

The application of digital accelerometers for wired and non-wired Mechanomyography

Niall Campbell, Institute of Technology Blanchardstown; Thomas Egan, Institute of Technology Blanchardstown; Catherine Deegan, Institute of Technology Blanchardstown

The objective of this paper is to consider the use of digital accelerometers for Mechanomyographic applications. The digital outputs of the accelerometer require the consideration of additional interfacing hardware for any commercial data acquisition systems being considered. The Arduino open-source platform is shown to meet this requirement. This platform also provides access to set the data registers on the accelerometer to output data at the resolution, speed and format required. Results show that digital accelerometers provide an accurate representation of the MMG signal. The second objective of this work was to extend this digital platform to design a wireless MMG sensor. This has been completed using open-source components and libraries. The wireless sensor can provide an inexpensive accurate representation of the MMG response for distances in excess of 30 meters.

Improving Controller Performance in a Powder Blending Process using Predictive Control

Niall O' Mahony, Institute of Technology Tralee; Krishna Panduru, Institute of Technology Tralee; Daniel Riordan, Institute of Technology Tralee; Joseph Walsh, Institute of Technology Tralee

The paper will discuss the general topic of predictive control techniques for industrial applications, in particular the implementation of Kalman Filter State Estimators in such control schemes.

The paper presents the investigation of predictive control methodologies for

the control of a pilot powder blending process. This investigation was carried out in an effort to improve the performance of a closed loop control system which was limited by the inaccuracy of parameters measured by a suite of smart sensors, in this instance constituent concentration and flowrate of a two-part powder blend as estimated by statistical models analysing multi-sensor data. A number of predictive control techniques, including the addition of Kalman Filters to traditional closed loop control and Model Predictive Control, were investigated using MATLAB® Software to improve the estimation of these parameters and thus control them more precisely. The results obtained show that faster dynamic response and greater accuracy can be achieved through the implementation of Kalman filters.

OS-4A

Analogue, Digital & Mixed Signal Circuit Design 1

A Low Close-In Phase Noise Class-C Differential Clapp VCO Topology in 180 nm Si-Ge HBT Technology

Giuseppe Macera, Analog Devices International; Valerio Marotta, Tyndall National Institute

This paper reports a new improved Clapp VCO topology designed in 180 nm Si-Ge HBT technology for operations around 5 GHz. The designed topology uses a series tuned resonator, a back-to-back series varactor configuration for tuning the output frequency and a filtering tail current designed for shunting to ground the second harmonic noise component. At the supply voltage of 3.3V, and across Process, Voltage and Temperature (PVT), the resulting VCO exhibits a very low phase noise (-113 dBc/Hz at 100 kHz offset from the carrier frequency), a high tuning range (25%), a power consumption of 6 mW and a Tuning Range based Figure Of Merit (FOM) equal to 211 dB, classifying itself as a challenging VCO and suggesting the opportunity to be considered for further investigations and implementations in Si-Ge HBT Technology.

Analysis, Modeling and Implementation of a new 1.8V Pierce-Gate crystal oscillator based on the constant gm cell in 28nm CMOS technology for automotive radar applications

Giuseppe Macera, Analog Devices International

The majority of analog and digital integrated circuits with built in crystal oscillator uses the Gated Pierce design where the oscillator is built around a single CMOS inverting gate. In most applications that require a high level of precision and stability of the performances versus Process, Voltage and Temperature (PVT) variations, this design is not suitable. The inverter cell itself is very sensitive to PVT variations, negatively affecting the overall performances of a crystal oscillator. This paper shows a new Pierce-Gate crystal oscillator based on the constant gm cell, implemented in 28nm CMOS TSMC technology. The oscillator can work with any crystal frequency between 20 MHz and 100 MHz, the power supply is 1.8V and the output is a 50% duty cycle square waveform. Simulations and measurements show that the new designed crystal oscillator is superior in terms of phase noise performances (-123 dBc/Hz at 100 Hz offset at 60 MHz and -163 dBc/Hz at 1MHz offset at 60 MHz), phase noise variation over PVT, Power Supply Rejection Ratio (PSRR), output frequency and output duty cycle stability, and input impedance with respect to the state of the art counterparts. The implemented crystal oscillator is very challenging and suitable for automotive radar applications.

Performance Limits for Open-Loop Fractional Dividers

Stefano Tulisi, Tyndall National Institute; Michael Peter Kennedy, UCC/Tyndall National Institute

The architecture of an Open-loop fractional divider is presented comparing the performance using different orders of DDSM to implement the Phase Error Calculator block. We show that the performance of the output clock is unconnected from the order of the DDSM and that consequently the first order structure is the most suitable for the implementation in a real device.

Design of Voltage Regulators for Automotive Applications: A Sensitivity-Driven Approach

Pasquale Napolitano, On Semiconductor Ireland Ltd.; Kevin Kelliher, On Semiconductor Ireland Ltd.

In this paper, a mathematical framework is presented, helping in the identification and selection of the components that mostly affect performance in monolithic voltage regulators. A sensitivity analysis is proposed, showing how the loop transfer function depends on the values of the components used in the compensator. The theory has been validated through behavioral and transistor level simulations, considering a single phase interleaved buck converter operated in voltage mode at 2 MHz switching frequency, supplied by a 5-V input and generating a 1 V regulated output. The presented results can be extended to other regulators exploiting Type II and Type III internal compensators.

OS-5A

Systems & Information Security & Test 2

Advanced Methodologies to deter Internal Attacks in PTP Time Synchronization Networks

Waleed Alghamdi, National University of Ireland, Galway; Michael Schukat, National University of Ireland, Galway

High accurate time synchronization is very important for many applications and industrial environments. In a computer network, synchronization of time for connected devices is provided by the Precision Time Protocol (PTP), which in principal allows for device time synchronization down to microsecond level. However, PTP and network infrastructures are vulnerable to cyber-attacks, which can de-synchronize an entire network, leading to potentially devastating

consequences. This paper will focus on the issue of internal attacks on time synchronization networks and discuss how counter-measures based on public key infrastructures, trusted platform modules, network intrusion detection systems and time synchronization supervisors can be adopted to defeat or at least detect such internal attacks.

Evaluating Password Advice

Hazel Murray, Maynooth University; David Malone, Maynooth University

Password advice is constantly circulated by standards agencies, companies, websites and specialists. But there appears to be great diversity in terms of the advice that is given. Users have noticed that different websites are enforcing different restrictions. For example, requiring different combinations of uppercase and lowercase letters, numbers and special characters. We collected password advice and found that the advice distributed by one organization can directly contradict advice given by another. Our paper aims to illuminate interesting characteristics for a sample of the password advice distributed. We also create a framework for identifying the costs associated with implementing password advice. In doing so we identify a reason for why password advice is often both derided and ignored.

One-to-Cloud One-Time Pad Data encryption: Introducing Virtual Prototyping with PSpice

Paul Tobin, Dublin Institute of Technology; Lee Tobin, University College Dublin; Roberto Gandia Blanquer, Flowcad; Michael Mc Keever, Dublin Institute of Technology; Jonathan Blackledge, Military Technological College

In this paper, we examine the design and application of a one-time pad encryption system for protecting data stored in the Cloud. Personalising security at the client-end protects data from break-ins, side-channel attacks and backdoors in public encryption algorithms. One-time pad binary sequences

derived from modified analogue chaos oscillators initiated by noise, encodes client data locally for specific ``one-to-Cloud'' storage applications. This encoder gives control to the end user and without any key distribution problems normally associated with one-time pad encryption. Development of the prototype was aided by "Virtual Prototyping" in the latest version of Cadence OrCAD PSpice and allowed the encoder prototype design to be simulated and connected to an actual microcontroller in real time. Device model interfacing established bi-directional communication between simulation and the microcontroller for storing the one-time pad sequences.

OS-5B

Analogue, Digital & Mixed Signal Circuit Design 2

Methodology for Automated and Recursive Verification of Verilog AMS Models against Schematic

Stephen Ogunniran, On Semiconductor Ireland Ltd.; Pasquale Napolitano, On Semiconductor Ireland Ltd.; Kevin Kelliher, On Semiconductor Ireland Ltd.

In this paper, a Verilog–AMS based methodology for automated verification is discussed. This solution is geared towards aiding the verification of behavioral models, which designers are tasked with when developing or editing a schematic. Up to now the conventional way to verify the operation of a model and how much it mimics the operation of a schematic is to visually inspect the output signals between models and schematics. The proposed methodology compares the signals and outputs a digital bit, indicating if the difference between schematic and model falls within the user defined tolerance range. The solution also prints a pass/fail error messages into a log file which can be easily reviewed by the designer. As a result a more accurate and user friendly platform is presented for verification, saving a significant amount time during the top level verification phase of a project.

A 5 W High Efficiency Class AB Power Amplifier for LTE Base Station Application

Abdulrahman Alqadami, Maynooth University; Sidath Madhuwantha, Maynooth University, Ronan Farrell, Maynooth University; John Dooley, Maynooth University

This paper presents the design of a Class AB power amplifier operating at a frequency band of 3.4 GHz - 3.7 GHz for LTE base station applications. The proposed design is targeted for a compact, low cost, high efficiency, and good linearity features. It based on GaN HEMT CGH40006P device manufactured by Wolfspeed/Cree. The design procedure and assessment of the presented power amplifier are described in this paper. The proposed input and output matching networks with stepped tapered microstrip transmission line have enhanced the transmission coefficients of the power amplifier, resulting in improvement of overall performance. The drain voltage and current waveforms are demonstrated to ensure the appropriate biasing point of class AB. At 1dB compression, the simulated results of the proposed class AB power amplifier with one tone input signal delivers power added efficiency of 59%, and 38 dBm output power. With code division multiple access (CDMA) signal, the power amplifier delivers a 51.9% of PAE, adjacent channel power ratio (ACPR) of below than -28.5 dBc at 2.25 MHz offsets, and delivers 37 dBm (~5 W) output power.

Board Parasitic Integration in the PCB Verification Process

Wilfried Wessel, Mentor Graphics; Bernhard Hoppe, University of Applied Sciences Darmstadt

In this paper we investigate computer based methods for parasitic extraction in printed circuit board designs. We developed an automated flow for annotating functional designs without affecting design integrity.

Speech Intelligibility and Quality: A Comparative Study of Speech Enhancement Algorithms

Xiaodong Xu, Athlone Institute of Technology; Ronan Flynn, Athlone Institute of Technology; Michael Russell, Athlone Institute of Technology

Mobile devices are widely used today for speech communication. The environments in which these devices are used are widely varied and often the level of background noise in the speaker's environment can be significant. The purpose of speech enhancement is to reduce the level of background noise, ideally to such a level that it is not noticed by the listener. While speech enhancement algorithms can significantly reduce the noise level in a speech signal, improving speech quality, it is widely recognized that enhancement algorithms can have a negative impact on speech intelligibility. This paper compares the effect of three different speech enhancement algorithms on the intelligibility and the quality of speech. This work is the initial phase of an investigation into mitigating the impact of speech enhancement algorithms on speech intelligibility. The speech enhancement algorithms evaluated each use different approaches for noise reduction, namely, a statistical model-based algorithm, a noise estimation algorithm and a wavelet packet decomposition-based algorithm. Two objective speech intelligibility measurements and three objective speech quality measurements are used to assess the performance of the enhancement algorithms. The results of the experiments show that all the speech enhancement algorithms in this study have a negative impact on speech intelligibility to varying degrees.

Predicting short-term wholesale prices on the Irish Single Electricity Market with Artificial Neural Networks

Pengfei Li, Ark Energy; Francesco Arci, Ark Energy; Jane Reilly, Ark Energy; Kevin Curran, Ulster University; Ammar Belatreche, Northumbria University; Yauheniya Shynkevich, Ulster University

The ability to operate effectively on electricity spot markets relies on the capability to devise appropriate bidding strategies. These in turn can benefit from the inclusion of a reliable forecast of short term system marginal prices (SMPs). In a market with an increasing percentage of renewable generators, reliable forecasts must necessarily consider additional factors such as meteorological forecasts, forecasted demand and constraints imposed by network topology. Traditional time series forecasting algorithms (e.g. based on AutoRegressive Integrated Moving Average models) can perform reasonably well in this context but rely on assumptions being made on behavior over different temporal windows to yield consistent results. Research studies have demonstrated that an adaptive or self-adaptive approach to forecasting would appear more suited to the task of predicting energy demands in territory such as Ireland. Implementing an in-house self-adaptive model should yield good results in the dynamic uncertain Irish energy market. We have identified the features that such a model demands and outline it here.

V2Hz: Music Composition from Wind Turbine Energy using a Finite-State Machine

Mark O'Sullivan, University College Cork; Bruno Srbnovski, University College Cork; Hugh McCarthy, Cork Institute of Technology; Andriy Temko, University College Cork; Emanuel Popovici, University College Cork

The study presents a multi-disciplinary application of the Internet of Things (IoT) benefiting both the engineering and music community. A music composition algorithm based on a finite-state machine was designed to receive and

manipulate wind turbine voltage output data into a musically aesthetic composition. The algorithm adapts common western music theory and imposes these limitations on the wind turbine output voltage stream. The front-end of the system employs various transmission protocols. The data is streamed to a server on-site at the wind farm using transmission control protocol, and then received offsite via TCP/IP. The back-end of the system processes the digital signals, and finally constructs Musical Instrument Digital Interface messages, which can be routed to a host of various music synthesis software programs. The voltage output values of each wind turbine are directly represented in both the amplitude and frequency characteristics of the audio. Thus, the audio serves as an accurate real-time monitoring and maintenance tool for the wind farm data from an offsite location.

Speaker Recognition Based on MFCC and BP Neural Networks

Yi Wang, Maynooth University Department of Electronic Engineering; Bob Lawlor, Maynooth University Department of Electronic Engineering

Speaker recognition has been developed over many years and it comes with many different methods. MFCC is one of more the successful methods due to it being generally modelled on the human auditory system. It represents high success rate of recognition and strong robustness against noise in the lower frequency regions. However, in the higher frequency regions, it captures speaker characteristics information less effectively. In recent years, Artificial Neural Networks have become popular. This paper presents a speaker recognition method based on MFCC and Back-Propagation Neural Networks. Experimental studies have proven that the recognition rate is successful when the number of questionable speakers is not very larger. When the number of speakers increases, the rate of recognition decreases. The potential problems and solutions are discussed, the number of training samples must be larger than the number of network model weights, 2-10 times. When the number of speakers increases, the number of training samples required also increases significantly.

OS-6B

Information Technology and Telecommunications

An Evaluation of the UniDoodle Student Response System in a First Year Systems and Control Module

Seamus McLoone, Maynooth University; Christine Kelly, Maynooth University

UniDoodle is a multi-platform, smart device based student response system that provides a freeform-style input using sketch capabilities. This offers significant advantages over existing student response systems, such as Clickers, which are limited in their input capabilities and generally only allow for a multiple-choice selection. In contrast, UniDoodle caters for writing equations, drawing diagrams, annotating figures or any form of graphical input. The key focus of this paper is to evaluate the use of this response system in an active classroom environment over an extended period of time. Fundamentally, we wish to address the following key questions in relation to UniDoodle: do students find it easy to use; do they find it beneficial to their own learning; does the lecturer find the sketch-based student responses beneficial; and how does the use of this response system affect the typical classroom lecture? Here, UniDoodle was used in a first year Systems and Control module, in the Dept. of Electronic Engineering in Maynooth University, for the duration of an entire semester. This paper will present an outline of the UniDoodle system and its key features, details of the actual evaluation with some sample questions, and a summary of the student and lecturer feedback obtained.

Applying a MDE Approach to a Healthcare Environment: a case study of an AE Dept

Joseph Timoney, Maynooth University; Hao Wu , Maynooth University; Hussein Gannud, Maynooth University

One of the main challenges of Healthcare services is to find a suitable way of managing limited resources within a highly demanding environment. This challenge can now be tackled by deploying reliable software systems that are

supported by Software Engineering practices. In this paper, we present a Model Driven Engineering (MDE) approach that, by way of an example, is applied to an Accident and Emergency (AE) department. This approach works by designing a UML class diagram annotated with a set of OCL constraints. These constraints formally express restrictions on interactions between various elements of the system. We formally evaluate our model by using a logic solver. This approach lays the foundation of our intentions to further develop a more complete health care system. We report the valuable lessons learned from the work and explain the limitation we observed.

A ZigBee Honeypot to assess IoT Cyberattack Behaviour

Seamus Dowling, National University of Ireland Galway; Michael Schukat, National University of Ireland Galway; Hugh Melvin, National University of Ireland Galway

Wireless Personal Area Networks (WPAN) allow for the implementation of applications such as home automation, remote control services, near-field technologies and personal health care management. Security is a critical requirement of the standards and protocols for these environments. One suite of layered protocols within WPAN is ZigBee. ZigBee is a low bit rate protocol utilised in Wireless Sensor Networks (WSN). Attacks such as physical, crypto key interception, injection and replay are perpetrated on ZigBee networks. These attacks can be instigated and controlled within the physical ZigBee WSN location or via a gateway. This paper creates a Honeypot that simulates a ZigBee gateway. It is designed to assess the presence of ZigBee attack intelligence on a SSH attack vector. It captures all attack traffic for retrospective analysis. It sandboxes attacks of interest to determine if any attempts are targeting ZigBee specifically. Finally it concludes that all captured mass attacks are mainstream DDoS and bot malware, whereas individual attackers were attracted to and interacted with the ZigBee simulated Honeypot.

Abstracts (Posters)

Voice Conversion based on Continuous Frequency Warping and Magnitude Scaling

Yuhang Ye, Athlone Institute of Technology; Bob Lawlor, Maynooth University

In this paper, we present a novel spectrum mapping method – Continuous Frequency Warping and Magnitude Scaling (CFWMS) for voice conversion under the Joint Density Gaussian Mixture Model (JDGMM) framework. JDGMM is a mature clustering technique that models the joint probability density of speech signals from paired speakers. The conventional JDGMM-based mapping methods morph the spectral features via least square optimization. However, the speech quality is degenerated as the converted spectrums are extravagantly blurred by statistical smoothing and the discontinuous conversions between adjacent frames cause noticeable distortion. To this end, CFWMS proposes a two-fold frame-level spectrum mapping method – Frequency Warping and Magnitude Scaling (FWMS) which directly operates on signals in the frequency domain without statistical smoothing. Then we introduce a trajectory limitation strategy to avoid the discontinuities between adjacent frames. Note that, the proposed solution does not require global information of sentences, making it feasible for low latency (e.g. real-time) applications. The experimental results show that the proposed solution significantly improves the quality and perceptual identity of converted speech.

Neural Networks to Aid the Autonomous Landing of a UAV on a Ship

Padraic Moriarty, Institute of Technology Tralee; Rob Sheehy, Institute of Technology Tralee; Pat Doody, Institute of Technology Tralee

This paper proposes to examine the possible uses of Artificial Neural Networks (ANN) to aid the landing of an Unmanned Aerial Vehicle (UAV) on a ship. Three distinct phases are proposed. The dataset required for training and testing was produced by simulating a ship's motion at sea using Unity.

Phase 1 converts video images from a UAV on-board camera to numeric data.

Phase 2 utilizes Phase 1 data and calculates the current relative orientation and distance of the UAV to the landing platform. Co-ordinate pairs representing screen positions of particular areas of a ship's landing pad were normalized and used to train the Phase 2 ANN. Orientation has been calculated to an accuracy of $\pm 1\%$ and distance $\pm 2\%$.

Phase 3 determines future landing windows. Phase 3 uses the orientations produced in Phase 2 and calculates future periods when a landing, within a time limit, could be attempted. This paper proposes strategies and current research into Phases 1, 2 and 3 and suggests development of an indicator of optimal landing times for Manned Aerial Vehicles (MAV).

Bitwise Operations of Cellular Automaton on Gray-scale Images

Karttikeya Mangalam, IIT Kanpur; Venkatesh Subramanian, Indian Institute of Technology Kanpur

Cellular Automata (CA) theory is a discrete model that represents the state of each of its cells from a finite set of possible values which evolve in time according to a pre-defined set of transition rules. CA have been applied to a number of image processing tasks such as Convex Hull Detection, Image Denoising etc. but mostly under the limitation of restricting the input to binary images. In general, a grayscale image may be converted to a number of different binary images which are finally recombined after CA operation on each of them individually. We have developed a multinomial regression based weighed summation method to recombine binary images for better performance of CA based Image Processing algorithms. The recombination algorithm is tested for the specific case of denoising Salt and Pepper Noise to test against standard benchmark algorithms such as Median Filter for various images and noise levels. The results indicate several interesting invariances in the application of the CA such as the particular noise realization and sub-sampling of pixels to determine recombination weights. Additionally, it appears that simpler algorithms for weight optimization which seek local minima work as effectively as those that seek global minima such as Simulated Annealing.

Integrated Sensors Kit for Investigation of Perishable Produce Shelf-Life Extension

Padraic Moriarty, Institute of Technology Tralee; Pat Doody, Institute of Technology Tralee

This paper details the process of designing, testing and developing an integrated sensors kit for recording a range of environmental parameters within a newly developed transportation unit called FreshBox. It has been designed to extend product shelf life as well as other improvements on conventional food storage and transportation. The sensors kit is transported within the FreshBox container and monitors the ambient environmental features to which the produce is exposed. CO₂, O₂, temperature and humidity levels are all recorded locally on a memory card and uploaded to the cloud at a later stage via a smart phone app. The unit has been tested during transportation of fresh fruit and vegetables between Spain and Germany.

Development of a low-cost, hand-held, remote vacuum profile monitoring system

Amruta Awasthi, Institute of Technology Tralee; Krishna Panduru, Institute of Technology Tralee; Anshul Awasthi, Institute of Technology Tralee; Daniel Riordan, Institute of Technology Tralee; Joseph Walsh Institute of Technology Tralee

Vacuum technology is a very widespread area. Nowadays, a broad variety of applications can be found to be using vacuum and vacuum related monitoring. Vacuum profile for different applications can be different, but whatever that may be, monitoring it is an essential part of any such application. Thus, this paper describes the development of one such vacuum profile monitoring system that can be re-purposed to be used in testing a wide range of systems. The main aim is to develop a device that is low cost, app-based and precise with a very small form-factor such that it can be hand-held for greater portability and ease-of-use. The intention here is to develop a generic device which can be used in any vacuum monitoring application, hence, the focus will not be on any specific application, but instead, in this paper, the focus will be on the development of the device itself.

Functional safety and Industrie 4.0

Tom Meany, Analog Devices

Functional safety is that part of safety which deals with confidence that a system will carry out its safety related task when required to do so. For instance that a motor will shut down quickly enough to prevent harm to an operator who opens a guard door, that a robot that should operate at a reduced speed and force when a human is nearby and to ensure that networked data arrives in the correct order, without corruption and on time. Industrie 4.0 is the next evolution of manufacturing plants promising increased flexibility and reduced costs. In these factories of the future safety will be critical. This paper will explore some of the implications of functional safety for Industrie 4.0. The implications include requirements for networks, security, robots/cobots and software.

Artificial Calf Weaning Strategies and the role of Machine Learning - A Review

Sukumar Reddy Katam Reddy, Institute of Technology Tralee; Daniel Riordan, Institute of Technology Tralee; Pat Doody, Institute of Technology Tralee

Research in Machine Learning has increased dramatically over the past couple of decades, with applications greatly benefiting industry. These applications vary widely in the fields of space exploration technologies, transportation, robotics, agriculture, animal husbandry, medicine and finance. However, the agricultural and animal husbandry related applications are relatively few when compared to other fields. This paper reviews the past and present calf weaning strategies mainly focusing on the incorporation of Machine Learning techniques in classifying the behavioural responses in cattle and makes an attempt to extend the scope of machine learning classification applications related to calf weaning. This review further discusses the integration of relevant sensors (sensor fusion), deep learning and the improvement of prediction accuracy.

Adaptive Sliding Window Load Forecasting

Judith Foster, Queen's University Belfast; Xueqin (Amy) Liu, Queen's University Belfast; Sean McLoone, Queen's University Belfast

Small-scale, renewable generation which is embedded in the distribution network is causing previously unseen fluctuations in demand. In Northern Ireland this new generation, which is not visible to, or controllable by, the system operator, is presenting major challenges for accurate load forecasting. Currently deployed load forecasting methods are struggling to cope due to the rapid growth in this new generation, and its weather dependent nature. In this paper linear load forecasting methods are investigated within a sliding window parameter updating framework, which is adopted to address the non-stationarity of the problem. Initially, models are built using historical load terms selected based on correlation analysis of recorded load data. Then, Forward Selection Regression is used to choose the most important variables from a candidate set, consisting of historical load variables and a range of weather related parameters. Model performance is evaluated on load data for the period 2015-2016. A 7-input model, with parameters updated on the basis of a 5-day sliding window of historical data, is shown to yield optimal results, with a mean absolute percentage error of 2.4%.

Low Power IoT Platform for Vital Signs Monitoring

Simon Coulter, University College Cork; Massimiliano Mostes, University College Cork, University of Genoa; Gordon Lightbody, University College Cork; Emanuel Popovici, University College Cork; William Fennell, Cork University Hospital

Recent years have witnessed tremendous advances in wearable technology with many applications ranging from health and fitness, sports, security, and more recently augmented reality. Classical body area networks have been reduced to small, wearable devices such as smart watches where signal acquisition is accompanied by processing or streaming to a more powerful device such as a smart phone (or “fog”), or directly to the Cloud. We present a system based around EPIC electric potential sensors which are capable of acquiring bio-electric signals, including an electrocardiogram-like signal (ECG).

The paper compares a set of validation algorithms for the extraction of Heart Rate (HR) and Respiratory Rate (RR) suitable for use on EPIC sensor data acquired with the proposed system. These algorithms are evaluated in terms of precision and the estimated robustness and variance. The system is of particular relevance in the field of Augmented and Virtual Reality, in which such a miniaturised, wireless platform becomes a necessity [1].

Maximising the Efficiency of a Class-D Audio Amplifier Output Stage

Robert Bakker, NUI Galway; Maeve Duffy, NUI Galway

This paper investigates different methods for improving the power efficiency of Class-D audio amplifier output stages. A standard half-bridge design is analysed and the effects of using Gallium Nitride (GaN) and Silicon Carbide (SiC) devices are considered. A new 2-phase interleaved output stage is proposed, and the advantages of this are discussed. The effect of the output low-pass filter parameters on power loss is also analysed. Simulation results of power efficiency of all of the proposed designs are presented. It is concluded that there is significant room to improve on the standard half-bridge Class-D amplifier design.

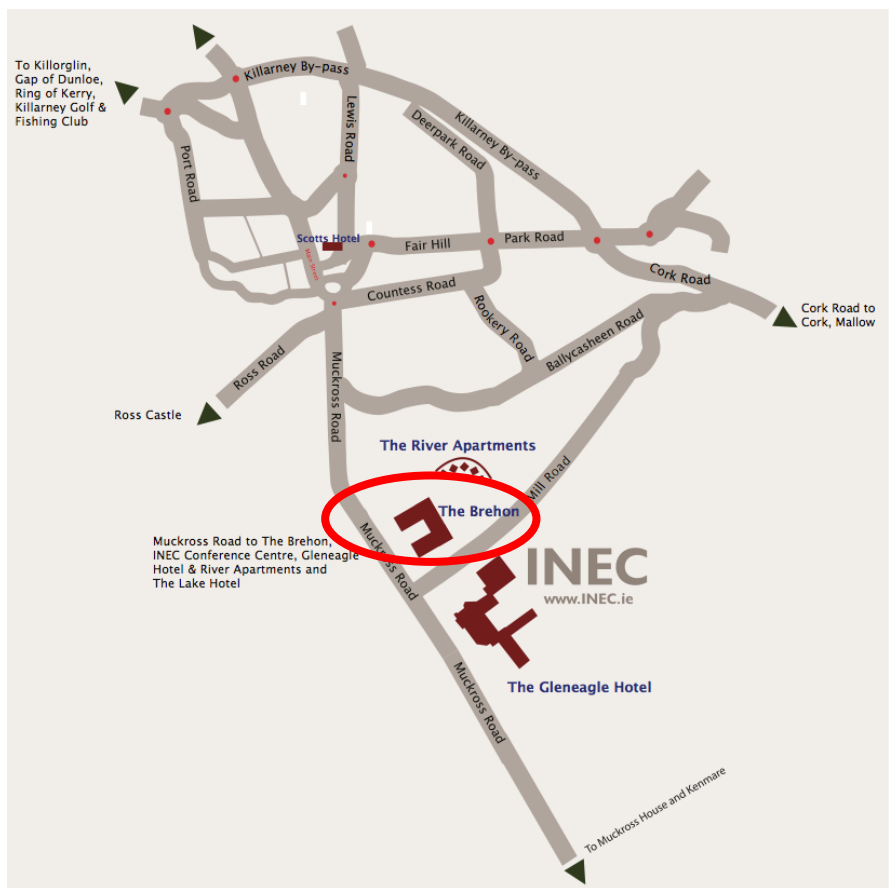
Identity Document Authentication using Steganographic Techniques: The Challenges of Noise

Juanita Blue, University of Ulster; Joan Condell, University of Ulster; Tom Lunney, University of Ulster

The term ‘steganography’ encapsulates the practice of secretly embedding data into digital mediums including video, image and audio files. Although steganography is often associated with nefarious activities, conceptually it asserts several characteristics that render it useful in contemporary security applications. Not just a mechanism for criminals to communicate secret information over a digital channel, steganography is also used as a legitimate

method of ensuring integrity of digital media artefacts and for identification of same. This application of steganography allows for identification images storing additional information to verify both the identity of the subject as well as the authenticity of the image. Developed methods of steganography invoke various spatial domain techniques that are successful in covertly concealing data within 'innocent' carrier images. The techniques include linear methods such as those which replace the least significant bit (LSB) of the bytes in an image and frequency domain methods including discrete cosine transform (DCT), discrete wavelet transform (DWT) and discrete Fourier transform (DFT). The success of a steganographic algorithm is hinged on the method's ability to successfully embed data, so that the data remains concealed within a carrier image; and also to successfully extract the same data uncorrupted. Often modern image coding formats include lossy compression in the frequency domain; this can result in data loss, corruption and noise within the image when carrier images are re-encoded. To ensure data extraction is successful, error correction functions must be invoked to counteract noise and ensure embedded data is extracted without any loss or corruption. In exploring steganographic software, the functionality and reliability of a novel steganographic application 'Intelligent Identity Authenticator' (IIA) was assessed. IIA invokes the use of steganography to conceal real-time identity information within images on identity cards. The functionality of IIA is based on a unique algorithm that utilizes DWT to embed a string of characters within an identity image. When data is extracted, it provides a link to further documentation relating to the data subject, allowing for verification of the claimant's identity and authenticity of the identity card. The embedding and extraction functions executed by IIA were found to be mostly reliable, except where data had been embedded within a carrier image that was characterized by a large proportion of black pixels. In these cases, the extracted data string experienced significant loss and corruption, thus preventing access to the identity verification documentation. This paper explores the potential cause of this specific corruption and discusses extensive testing conducted on control images. The results are analysed to identify an improved solution that could rectify the issue, with an aim to improving both the functionality and reliability of the IIA system.

Venue—The Brehon Hotel Killarney



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