

Faculty of Computing Health and Science

Research Unit Annual Report

RESEARCH UNIT NAME: CENTRE FOR COMMUNICATIONS ENGINEERING RESEARCH (CCER)

RESEARCH UNIT LEVEL (tick):

- | | |
|---|--|
| <input type="checkbox"/> Level I Research Group | <input checked="" type="checkbox"/> Level II Research Centre |
| <input type="checkbox"/> Level III Research Institute | <input type="checkbox"/> Centre of Excellence |

YEAR: 2010

BRIEF OVERVIEW (1-2 paragraphs outlining major activities conducted in past year)

The Centre for Communications Engineering Research (CCER) conducts applied engineering research in communication and networking technologies that have high impact on the community. Research strengths of the centre include quality of service in optical and wireless networks, wireless sensor networks, signal and image processing, multimedia communications, smart grid systems, and electromagnetic radiation control.

In 2010, the Centre's HDR student number continued to rise, which enabled the Centre to initiate new projects. These new projects include development of a wireless sensor network for bush fire detection, wireless sensor network for gas leak detection, an optimised WiFi access mechanism for VoIP and VVoIP applications, wireless safety network for vehicular communications, optimisation of renewable energy sources in a microgrid, and control of electromagnetic radiation in buildings within close proximity of a mobile tower. Outcomes from these projects are expected to make a significant contribution to the community and industry.

MEMBERSHIP (Full Title of Researchers, including staff, research students, adjuncts in the past year)

Prof Daryoush Habibi (Leader)
Associate Professor Steven Hinckley
Dr Stefan Lachowicz
Dr Douglas Chai
Dr Iftekhar Ahmad
Dr Alex Rassau
Dr Octavian Bass
Dr Ganesh Kothapalli
Dr Graham Wild
Dr Bijan Rohani (Adjunct staff)
Professor Farzad Safaei (University of Wollongong)
Dr Guoqiang Mao (University of Sydney)
Dr Joarder Kamruzzaman (Monash University)
Professor Hans Pfliederer (Ulm University, Germany)

NEW GRANTS (Identify Funding Body, Value of grant, Years funded, Chief Investigator, collaborators, title)

1. S. Hinckley, G. Wild & A. Osseiran – “Wireless Sensing in Forests for the Detection and Monitoring of Biosecurity Hazards and Forest Fires”, Nortel Development Grant (\$25,000)
2. G. Wild – SPIE Education Outreach Grant (\$3,500)
3. D. Habibi, Foundation Fieldbus End-User Council, \$100,000.

Grants Continuing from Previous Years

4. D. Habibi and I. Ahmad, "Video Networking for Central Monitoring of Security Cameras on Public Trains," Public Transport Authority, WA \$150,000, 2009-2011.
5. I. Ahmad and D. Habibi, Nortel Development Grant, \$25,000, 2010-2011.

PUBLICATIONS, REFERRED BOOKS, CHAPTERS, JOURNAL ARTICLES, CONFERENCE PAPERS, REPORTS

Scholarly Book/Book Chapter

1. H. Kato, K. T. Tan and D. Chai, Barcodes for Mobile Devices, Cambridge University Press, UK, 268 pages, 2010.
2. G. Wild and S. Hinckley, Wireless communications and power supply for in-vivo biomedical devices using acoustic transmissions. In Biomedical Engineering Trends in Electronics, Communications and Software. A.N. Laskovski (Ed). InTech Publications, 2010.
3. P. Jansz and S. Hinckley, Extrinsic Evolution of the Stacked Gradient Poly-Homojunction Photodiode Genre” in Advances in Photodiodes. Gian-Franco Dalla Betta (Ed). Intech Publications, 2010.

Journal Publications

1. K. T. Tan, D. Chai, H. Kato and S. K. Ong, "A color 2D-barcode for mobile applications: design tips," IEEE Pervasive Computing, Jul 2010.
2. G. Wild and S. Hinckley, “Spatial Performance of Acousto-Ultrasonic Fiber Bragg Grating Sensor,” IEEE Sensors Journal, 10(4), pp. 805-806, 2010.
3. G. Wild and S. Hinckley, “PSpice simulation of an electro-acoustic communications channel,” IEEE Transactions on Ultrasonics Ferroelectrics and Frequency Control, 57(4), pp. 981-985, 2010.

Patent

K. T. Tan, D. Chai, H. Kato and S. K. Ong "Data storage device and encoding/decoding method," WO Patent WO/2010/031110, 25 Mar. 2010.

Conference Publications

1. I. Ahmad and D. Habibi, “Call Admission Control Scheme for Improved Quality of Service in WiMAX Communication at Vehicular Speeds,” in proc. IEEE Global Telecommunication Networks (Globecom), pp. 1-6, USA, 2010.
2. I. Ahmad and D. Habibi, “Call Admission Control Scheme for the IEEE 802.16e at Vehicular Speeds,” in proc. 12th IEEE International Conference on High Performance Computing and Communications (HPCC), pp. 413-418, Australia 2010.
3. I. Ahmad and D. Habibi, “High Utility Video Surveillance System on Public Transport using WiMAX Technology,” in proc. IEEE Wireless Communication & Networking Conference (WCNC’10), Sydney, Australia, 2010.
4. S. K. Ong, D. Chai and A. Rassau, "The use of alignment cells in MMCC Barcode," Tenth International Symposium on Communications and Information Technologies (ISCIT'2010), Tokyo, Japan, pp. 640-645, Oct. 2010.

5. K. T. Tan and D. Chai, "JPEG compression of monochrome 2D-barcode images using DCT coefficient distributions," Seventeenth IEEE International Conference on Image Processing (ICIP'2010), Hong Kong, Sep. 2010.
6. K. T. Tan and D. Chai, "A new perspective on first read rate of 2D barcodes in mobile applications," Sixth IEEE International Conference on Wireless, Mobile and Ubiquitous Technologies in Education (WMUTE'2010), Kaohsiung, Taiwan, Apr. 2010.
7. G. Wild, G. Allwood and S. Hinckley, "Distributed sensing, communications, and power in Optical Fibre Smart Sensor Networks for Structural Health Monitoring," Proc. ISSNIPS, Brisbane, December 2010.
8. G. Allwood, G. Wild and S. Hinckley, "Photovoltaic micro-cell for distributed power in sensor networks," Proc. COMMAD 2010, ANU Canberra. IEEE Press, 2010.
9. P. Jansz & S. Hinckley (2010), "Simulation of a Hybrid Polywell and Stacked Gradient Poly-Homojunction CMOS Photodiode," Proc. COMMAD 2010, ANU Canberra. IEEE Press, 2010.
10. G. Wild & S. Richardson, "Analytical Modelling of Interrogation Systems for Fibre Bragg Grating Sensors," Proc. 35th ACOFT, Melbourne, December 2010.
11. G. Allwood, G. Wild & S. Hinckley, "Power-over-fibre for distributed optical fibre smart sensor networks," Proc. 35th ACOFT, Melbourne, December 2010.
12. G. Wild, G. Swan & S. Hinckley, "AC electricity experiments for off-campus teaching and learning," Proc. 19th AIP Congress, Melbourne, December 2010.
13. G. Allwood, G. Wild & S. Hinckley, "Photovoltaic micro-cell design for distributed power-over-fibre optimized for 850nm & 980nm," Proc. 19th AIP Congress, Melbourne, December 2010.
14. P. Jansz, G. Wild, S. Hinckley, Y. Yang, & P.C. Duncan, "A comparison of grinding and electric discharge machining to fabricate a stepped mirror structure for a stationary optical delay line," Proc. 35th ACOFT, Melbourne, December 2010.
15. G. Wild & S. Hinckley, "Wireless Acoustic Communications and Power Supply for In Vivo Biomedical Devices," Proc. Int. Ultrasonic Symposium, San Diego, 2010.
16. P. Jansz, S. Hinckley, & G. Wild, "Effect of a polywell geometry on a CMOS photodiode array," Proc. of IEEE SoC conference, Las Vegas, 2010.
17. G. Wild & S. Hinckley, "Structural health monitoring for air transport safety," PATREC Forum and Proceedings. Perth, 2010.
18. G. Wild & S. Hinckley, "Optical fibre Bragg gratings for acoustic sensing," Proc. 20th Int. Congress on Acoustics, Sydney, August 2010.
19. G. Wild & G. G. Swan, "Acoustic education: Experiments for off-campus teaching and learning," Proc. 20th Int. Congress on Acoustics, Sydney, August 2010
20. G. Wild & S. Hinckley, "Acoustic transmissions for wireless communications and power supply in biomedical devices," Proc. 20th Int. Congress on Acoustics, Sydney, August 2010.
21. G. Kothapalli and M. Hassan, "Comparison between neural network based PI and PID controllers", in proc. IEEE 7th International Conference on Systems, Signals & Devices, Amman, Jordan, ISBN: 9781424475346, 27-30 June, 2010.
22. R. Ramraj, "Bandwidth allocation and routing information for wireless mobile Ad-Hoc networks," in Seventh International Conference on Fuzzy Systems and Knowledge Discovery (FSKD), pp. 2968-2972, 2010.

HIGHER DEGREE BY RESEARCH LOAD (list name of candidate and degree type)

1. Mr Mahir Meghji (PhD candidate)
2. Mr Siong Khai Ong (PhD candidate)
3. Ms Kelly Eng (PhD candidate)
4. Mr Paul P. Jansz (PhD candidate)
5. Mr Biswojit Bose (PhD candidate) - research scholarship supported by CCER
6. Mr Rajesh Ramraj (PhD candidate) - research scholarship supported by CCER
7. Mr Thair Mahmood (PhD candidate)
8. Mr Waleed Alnaqbi (PhD candidate)
9. Mr Garry Allwood (PhD candidate)

10. Mr Irfan Ullah (Masters candidate) - research scholarship supported by CCER
11. Mr Sushil Dutt (Masters candidate)
12. Mr Daryoush Bayat (Masters candidate) - research scholarship supported by CCER
13. Mr Amro Qundor (Masters candidate) - research scholarship supported by CCER
14. Mr Nirav Shah (Masters candidate) - research scholarship supported by CCER
15. Mrs Natalia Kovalenko (Masters candidate)

HIGHER DEGREE BY RESEARCH COMPLETIONS (List name, degree, title of thesis)

1. Viet Quoc Phung, PhD, "Capacity design for multiple quality of protection service classes in optical mesh networks"
2. Kartinah Zen, PhD, "Design of MAC protocols to support quality of service for multimedia traffic in wireless LANs"
3. Graham Wild, PhD, "Distributed optical fibre smart sensors for Acoustic sensing in the structural health monitoring of robust aerospace vehicles"

VISITORS AND COLLABORATIONS (List the organisation's name and short summary of the nature of the collaboration. Separate into local, national and international)

The centre has established links with a number of research organisations in Australia and overseas. Links at national level include:

Public Transport Authority, WA.

(currently conducting a collaborative project on video surveillance on public trains)

Monash University, Australia.

(working with the communication network research group at Gippsland School of IT, Monash University, Australia).

University of Sydney, Australia.

(collaborating with Dr Guoqiang Mao at the School of Electrical and Information Engineering)

University of Wollongong, Australia.

(Initiated collaboration with Professor Farzad Safaie, ICT Institute).

The University of Western Australia, Australia.

(collaborating with Professor Brendan Griffin and Associate Professor Martin Saunders, Centre for Microscopy, Characterisation and Analysis, CMCA).

CSIRO, Brisbane

(collaborating with Dr Tomasz Bednarz on a joint project).

Links at international level include:

Gwangju Institute of Science and Technology (GIST), Korea

(collaborating with Associate Professor Saeed Nooshabadi, Department of Information and Communications).

Ulm University (Germany).

(collaborating with Professor Hans-Jörg Pflieger from the Institute of Microelectronics of Ulm University, Germany for a project on optimization of Direct Digital Frequency Synthesis algorithms for FPGA (Field Programmable Gate Array) implementation).

University of California, Los Angeles (UCLA).

(collaborating with Professor Gregory Carman, Active Materials Laboratory, Mechanical and Aerospace Engineering Department for projects on optical fibre sensing).

COMMUNITY ENGAGEMENT ACTIVITIES AND LINKAGES (Provide a brief overview of any significant activity)

INDUSTRY ENGAGEMENT: Foundation Fieldbus End-User Group
CCER has been collaborating with Foundation Fieldbus End-User Group (FFEUG) towards expanding ECU's teaching and research capabilities in Fieldbus technologies. A grant of \$100k has been received for the establishment of an Australian Fieldbus research and training centre.

INDUSTRY ENGAGEMENT: Perth Energy
Members of CCER have been working with Perth Energy, a major retailer of electricity in Perth metropolitan area, towards mutual areas of interest in smart grids and smart energy systems. There is a notional agreement at this stage that Perth Energy will provide PhD scholarships to support research in these areas.

INDUSTRY ENGAGEMENT: ECU Buildings and Maintenance Services
A research project was established to investigate power factor problems on the Mount Lawley Campus of ECU. The project has been successful, resulting in a set of recommendations which have been implemented and have helped reduce ECU's electricity bill for ML campus.

INDUSTRY ENGAGEMENT: HWE
HWE are currently working with CCER members towards the development of an intelligent system to fully automate the process of changing tyres on mining trucks. Currently this process is only semi-automatic, resulting in a large number of injuries every year.

INDUSTRY ENGAGEMENT: Perth Transport Authority (PTA)
Significant progress has been made towards the establishment of a wireless video network across the rail network of PTA for live monitoring of trains through a central control room. Two PhD scholarships have been awarded from the research funds of this project, and the addition of two PhD candidates to this project has boosted our human resources to ensure good quality outcomes for PTA.

CONFERENCE PARTICIPATION AND RESEARCH PAPER PRESENTATION

1. IEEE Globecom, USA, 2010
2. IEEE WCNC, Sydney, Australia, 2010
3. DELTA 2011, New Zealand, 2010
4. ISSNIP 2010, Brisbane, Australia, 2010
5. COMMAD, Canberra, Australia, 2010
6. ACOFT/AIP Congress, Melbourne, Australia, 2010
7. International Ultrasonic Symposium, San Diego, USA, 2010
8. IEEE SoC conference, Las Vegas, USA, 2010
9. PATREC Forum, Perth, USA, 2010
10. International Congress on Acoustics, Sydney, Australia, 2010.

FUTURE PLANS AND DIRECTION (Provide an overview)

The Centre will work closely with ORI towards commercialisation of the products that have been developed at the centre. Two products for which the Centre has provisional patents have good potential to either form the basis for the formation of a company, or, be licensed to existing vendors and product developers.

In coming years, the centre will continue to train and mentor its HDR students for better research outcomes and to further strengthen its research capabilities. Members of the centre believe that progress of their on-going projects (please see Appendix A) will lead to more successes in terms of collaborative projects, community engagement and enrolment of HDR students. The centre intends to establish more linkages with local industry towards research collaboration and funding, and with various national and international research groups and organisations. The centre will put more

emphasis on the already established interdisciplinary projects, particularly in collaboration with health, and environmental science. The Centre will continue its efforts to secure competitive grants at the national and international levels. The Centre participated in the ARC discovery grant application round in the past three years. Although the centre has not been successful to secure an ARC grant, members of the centre are confident that their experience from previous rounds will assist them to secure successful ARC grants for the Centre in near future.

APPENDIX A

ARC RESEARCH GRANT APPLICATIONS LODGED IN 2010

1. Ahmad, D. Habibi and J. Kamruzzaman, "High Throughput WiMAX Communication at Vehicular Speeds," ARC Discovery Grant.
2. S. Hinckley, G. Wild and C.S. Smith, "Photonic Security Systems: Enhancement of photonic and optical fibre technology for intrusion detection systems in national infrastructure security," ARC Discovery Grant

MAJOR ON-GOING RESEARCH PROJECTS

Video surveillance network for real-time central monitoring of passenger safety and security on public trains.

Public transportation has regained its popularity over the last few years mainly due to a sharp increase in fuel price and environmental awareness. This offers a new challenge for the public transport authority to introduce an improved safety and security management. As a measure to improve the safety and security management, most of the public transport stations are now equipped with CCTVs. The issue that still remains a major research challenge is to enable CCTV on public transports when they are on the move. The aim of this project is to develop new strategies to increase uploading video data rate from moving public transports so that a centrally monitored real-time video surveillance system can be facilitated on public transports.

Development of a wireless sensor network for bushfire detection

A wireless sensor network (WSN) is a collection of sensor nodes that cooperatively monitor the environment. The advantages of WSN to other traditional sensor networks are their low cost, autonomy and low power consumption. Due to these characteristics, there are many new applications that were previously very costly, if not impossible to design. One of these applications is bushfire monitoring system. The off-the-shelf wireless sensor nodes such as MicaZ and TelosB can not be used in bushfire detection applications due to their low range. These sensors are targeted for low range applications such as medical and residential monitoring. For sensor networks to be used for bushfire detection, we want a wireless sensor network coordinator that has several kilometres of range; at the same time low power consumption. This proposal aims to address the challenges involved in designing a long range wireless sensor mote to be used for bushfire detection. The proposed device includes humidity, temperature and gas sensors connected to a microcontroller. The system utilises long range radio modem as its transceiver. Due to the long range transmission of the radio modem and its support for mesh network topology, the mote is capable of sending warning messages to hundreds of kilometres away.

New strategies to improve throughput in mobile WiMAX and LTE-A communications

The IEEE 802.16 standard, also known as WiMAX, has emerged as an exciting technology for broadband wireless communications with potentials to offer high throughput and support high bandwidth demanding applications. WiMAX however, has yet to prove its effectiveness when the end terminals are not fixed and have the capacity to move from one place to another at different speeds. Multipath fading that causes high bit error rate at the receiver end is a key reason for low throughput at high speed. In this project, we aim to propose new techniques to improve throughput in Mobile WiMAX

communication. This research will have significant impacts on diverse wireless applications starting from the Internet facilities on moving vehicles to video surveillance applications on public transports.

Medium access control protocol for guaranteed quality of service of (QoS) voice and video in wireless local area networks

The media access control (MAC) layer is responsible for controlling which node of the wireless network is allowed to access the shared channel and how nodes communicate with each other, hence it is directly responsible for the throughput, delay and jitter characteristics observed at each node. Many different wireless MAC schemes have been developed to support a wide variety of services whilst trying to ensure that QoS is guaranteed. The existing MAC schemes however, are not efficient in terms of throughput and QoS guarantee. The aim of this project is to improve throughput and QoS of end applications in wireless communications.

A MAC protocol to provide efficient mobility in wireless sensor networks

The aim of this research is to enhance the MAC protocol for mobile sensor networks based on the standard IEEE 802.15.4 so that it can overcome the synchronization, association and collisions problems due to the movement of the nodes. The current standard only supports static wireless sensor networks and the protocol is believed to degrade the network performance if it is applied in mobile sensor networks. The main objective of this research is to make sure that the enhanced protocol maintains the throughput and consumes minimum energy when operates in mobile sensor networks environment. The synchronization, re-association and association problems will be improved by making the node aware of its position whether it is moving away or towards to its original coordinator.

2D barcode design for mobile phone applications

The project investigates the design of a novel color 2D barcode optimized for camera-enabled mobile phone platform. The integration of 2D barcode technology and camera phone technology provides general users with interesting and convenient applications. Examples of such applications include web link, online shopping and e-ticketing. Captured on a camera phone, the information encoded in the format of a 2D-barcode is decoded and used to perform certain applications. Considering that mobile phones have become a part of many daily lives and are always within reach, people can use such mobile applications according to their convenience. This research also aims to establish a standard 2D barcode, on which the third party software vendors and manufactures can develop new functions and applications. This will, in turn, provide general users with more available mobile applications.

A commercial energy framework for medium size enterprises microgrid

This research aims to develop a management strategy for achieving economical and market participant energy generation for medium size enterprise's Microgrids. The research is proposed to develop a commercial framework based on artificial intelligence and multi-agent systems technology. The control objectives of the proposed framework are to achieve best economical decision on a source of generation depending on the availability of energy sources and cost of generation variation. Basically, the proposed framework is assigned to achieve multiple task operations based on the information provided about the instantly varied consumption and generation cost. Each of the proposed tasks will be controlled by an autonomous agent, and each of the assigned agents will be communicating with other agents to perform reports sending and situation analysing. Edith Cowan University's Microgrid is the targeted project to be a real case study for results analysis and verification of the this management strategy.

Optimal control of power quality for microgrids using artificial intelligence

The recent development in small scale of power generation is moving energy sector into new era of the modern power grid. However, modern electric power networks have to respond to a number of challenges such as significant growth in load demand and load changes. As a result, many projects in US, Europe and Australia started to develop new technologies that depend on the high exploitation of distributed generation units (DGs). A microgrid is new concept that depends on high penetration of DGs. The majority of DGs interface to the utility grid or load via dc-ac PWM-VSI system to meet the extension in the load demand in order to maintain the reliability of electric power supply. Therefore, these interfaces introduce new issues that affect power quality supply such as voltage sag, swell, dip, harmonic distortion, and active and reactive power control. This research is to design an optimal control strategy to ensure high power quality injecting in an example of microgrid. The control strategy will depend on droop controller, power controller, and current control method. In addition, estimation of interfacing parameters and grid voltage will be based on artificial intelligent algorithm in order to optimise the control loop. Furthermore, system stability will be analysed based on the Lyapunov function to evaluate the control performance. Finally, simulation analysis will be done by using Matlab/Simulink interfacing with DIQSILENT programme to achieve the control objectives for both operation modes; autonomous and grid-connected.

Wireless acoustic communications for autonomous agents in structural health monitoring sensor networks

In this project, we demonstrate wireless acoustic communications methods that include both electro-acoustic and acousto-optic communications. The communications methods are intended for use by autonomous robotic agents in the Non-Destructive Evaluation (NDE) of structures containing a distributed acoustic emission sensor network. The acoustic emission sensors can be based on either piezoelectric or optical fibre sensors. Distributed acoustic emission sensors are used in Structural Health Monitoring (SHM) for the detection of impacts and/or strain, in real time. Secondary damage may result from the initial impact or strain. This damage may include surface pitting, erosion, or cracking. These types of secondary damage may not be detectable, and hence may not be able to be monitored by the SHM system; specifically in optical fibre based sensing systems. The integration of NDE by robotic agents into a SHM sensor network enables the detection and monitoring of a wider variety of damage. Acoustic communication represents a wireless communication method that does not require any additional hardware, as piezoelectric transducers are commonly used in the NDE of materials. Various modulation methods are being investigated for the communications channel. These include Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), and Phase Shift Keying (PSK). Successful communication was achieved using both the piezoelectric and optical fibre receivers. The optical fibre sensor is based on a Fibre Bragg Grating (FBG).

A transmit reflect detection system for fibre Bragg grating photonic sensors

Traditional Fibre Bragg Grating (FBG) sensing systems acquire data about the measurand via the spectral response of the FBG. Edge filter methods are also used in the acquisition of data from FBGs. In edge filter systems, the spectral shift in the FBG due to the measurand is converted into an optical power change. This optical power change can then be easily measured using conventional optoelectronic devices. In this research, we have developed a Transmit Reflect Detection System (TRDS) for Fibre Bragg Grating (FBG) sensors. The TRDS is in essence a dual edge filter detection method. In conventional edge filter detection schemes, the reflected portion of the incident spectrum is monitored to determine the change in the measurand. In the TRDS, both the transmitted and reflected portions of the input spectrum, from a narrow band light source, are utilised. The optical power of the transmitted and reflected signals are measured via two separate photoreceivers, where each generates a single edge filter signal. As the spectral response of the FBG shifts due to the measurand, the transmitted power will increase, and the reflected power will decrease, or vice versa. By

differentially amplifying the transmitted and reflected components, the overall signal is increased. This results in improved sensitivity and efficiency of the photonic sensor.

A novel microphotonic structure for generating true time delays for application to optical coherence tomography

Conventional time domain Optical Coherence Tomography relies on the detection of an interference pattern generated by the interference of backscattered light from the sample and a reference Optical Delay Line (ODL). By referencing the sample interference with the scan depth of the ODL, constructive interference indicates depth in the sample of a reflecting structure. Conventional reference ODLs require some physical movement of a mirror to scan a given depth range. This movement results in instrument degradation. Also in some situations it is necessary to have no moving parts. Stationary ODL include two discrete step types: dual reflective Spatial Light Modulator (SLM) systems and single transmissive SLM with match-arrayed-waveguide systems. In this research, we are developing low cost stationary ODLs based on a novel Stepped Mirrored Structures (SMS) structures.

eForest – Acoustic wireless sensing network for biosecurity and forest applications

In this project, the BugFinder module is being developed as the basis of a remote wireless sensing network using acoustic sensing to monitor and assess biosecurity risks and hazards in forests and other timber related installations (including power poles in electricity transmission networks).

Photonic sensing for intrusion detection in security systems

In this project, fibre Bragg grating based optical sensors are being developed, in collaboration with UCLA, for intrusion detection in security systems for critical infrastructure.

Laser irradiation effects on seeds and plants

In this project, novel low coherence optical interferometry (LCI) is being developed as a technique to determine the effect of laser irradiation on plant and seed germination and growth. LCI provides techniques for 3D non-destructive in-vivo imaging of plant and seed structure before, during and after laser irradiation. The goal of this project is to determine whether laser irradiation has an effect on seed germination and growth.

Minimising potential hazards of radiation from mobile towers

The issue of establishing the safe level of radiation at microwave frequencies, eg. from mobile phones and mobile communication towers, is highly controversial. Mobile towers are typically placed in densely populated areas to maximise their population coverage. The purpose of this research is to design simple and practical microwave filters which can be integrated cost effectively into the fabric of the buildings. These filters will substantially attenuate signals at frequencies which are identified as having power flux above safe levels. For instance, in buildings that are less than 500 meters away from the mobile towers, these filters will reduce the power flux to what would normally be measured at distances of 2km and above from the tower.