

Centre for  
Doctoral Training  
in Applied Photonics

Annual Report  
**2015**

[www.cdtphotonics.hw.ac.uk](http://www.cdtphotonics.hw.ac.uk)

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## FOREWORD

Welcome to the 2015 Annual Report from the Centre for Doctoral Training in Applied Photonics. The last year has been an important one in the development of our Centre, with the second cohort of students recruited in September, and our technical and skills programmes now fully established. We've also been starting to work more closely with other CDTs, for example by mounting joint transferrable skills workshops.

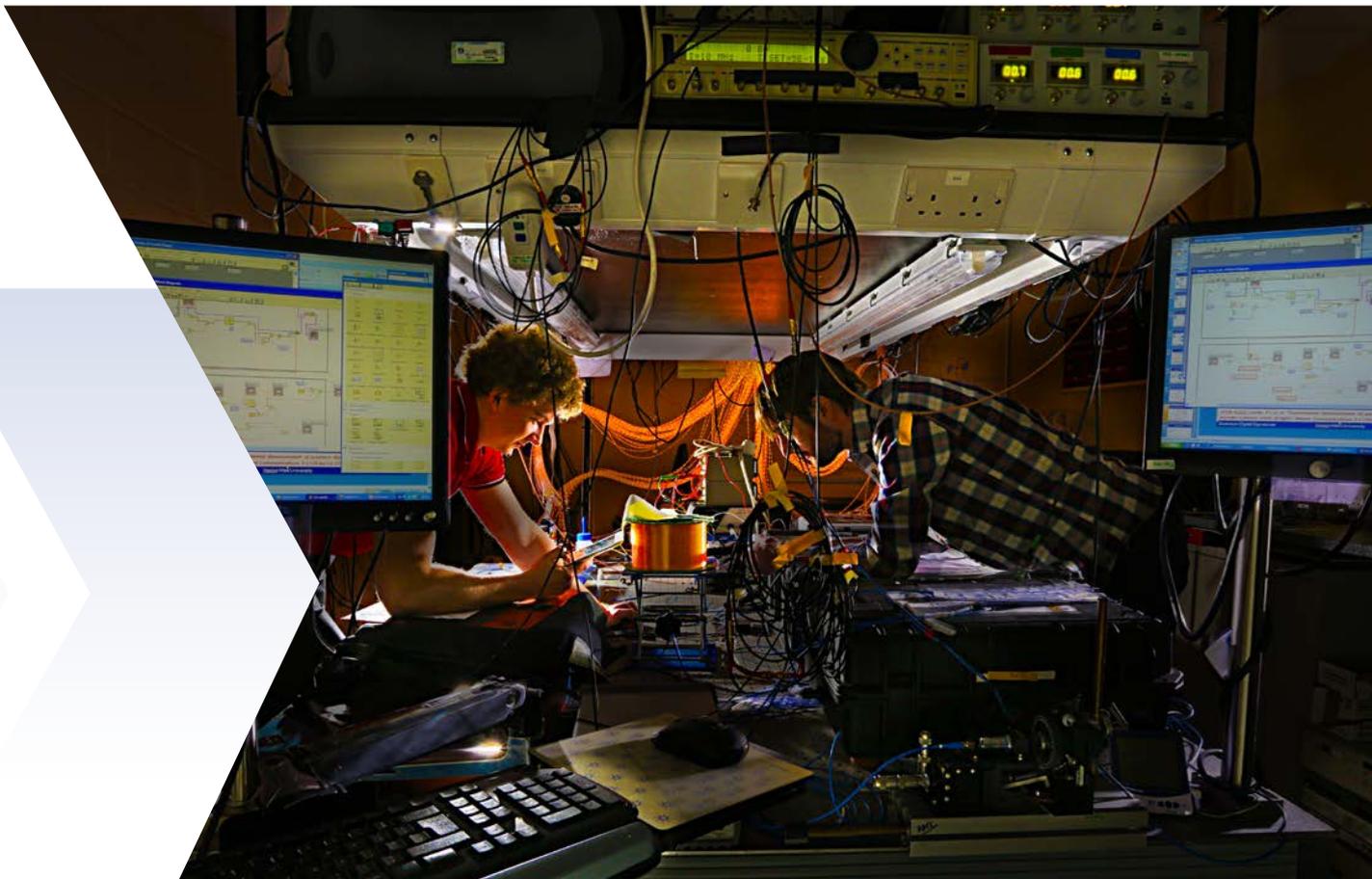
Our Centre was founded in 2001, and as one of the longest running EngD Centres in the UK we're excited to be approaching a milestone of 50 graduates, some of whom have contributed to this report to explain how the EngD degree programme prepared them for their future careers. In the Case Studies on pages 14 and 15 you can also read about the impact current EngD students are making on their host companies.

I look forward to the new challenges and opportunities which we can expect in 2016 and I would like to thank the Research Engineers, academics and industrialists and others who have contributed to our Centre's success in 2015.



**Professor Derryck T. Reid**

Director, EPSRC Centre for Doctoral Training  
in Applied Photonics



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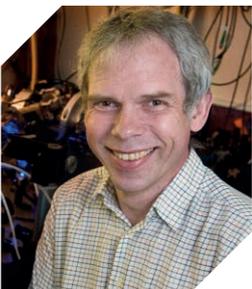
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## AT A GLANCE: THE EPSRC CENTRE FOR DOCTORAL TRAINING IN APPLIED PHOTONICS

**EPSRC**

Pioneering research  
and skills



## A DISTRIBUTED MODEL FOR PHOTONICS DOCTORAL TRAINING

Established in 2001 the CDT in Applied Photonics and its predecessors is the UK's longest running centre of doctoral training in photonics systems. The present centre, the EPSRC Centre for Doctoral Training in Applied Photonics is led by Heriot-Watt University and delivered in partnership with the Universities of St Andrews, Strathclyde, Glasgow and Dundee. Complementing this academic consortium are around 30 industrial partners, who contribute financial support to the Centre as well as substantial levels of supervision time and practical resources sustaining around 60 EngD projects.



University of St Andrews



University of Glasgow

Our consortium draws from a pool of over 100 academic supervisors, each a specialist in a unique area of Photonics. Together with our industrial partners and the Research Engineers themselves, we form a community of over 200 researchers, the largest Photonics research network in the UK.

Our academic and industrial partners meet biannually at the Centre Management Committee, which receives progress reports from the Director and includes a representative from the EngD student cohort and from the EPSRC.

### THE 2015/16 MANAGEMENT COMMITTEE COMPRISES:

<b>Susan Peacock</b>	EPSRC
<b>Derryck Reid</b>	Director, Heriot-Watt University
<b>Bill MacPherson</b>	Deputy Director, Heriot-Watt University
<b>Nick Weston</b>	Renishaw
<b>Allan Colquhoun</b>	Selex ES
<b>Barry Connor</b>	Thales Optronics
<b>Nick Hay</b>	Powerlase Photonics
<b>Scott McCulloch</b>	AWE
<b>Duncan Hand</b>	Heriot-Watt University
<b>Nigel Johnson</b>	University of Glasgow
<b>Erling Riis</b>	University of Strathclyde
<b>Hermine Schnetler</b>	STFC
<b>Adam Brunton</b>	M-Solv
<b>Calum Hill</b>	Research Engineer Representative
<b>Julian Jones</b>	Heriot-Watt University
<b>David McGloin</b>	University of Dundee
<b>Dawn Beddard</b>	CDT Academic Manager
<b>Alison Low</b>	CDT Centre Administrator
<b>Graham Turnbull</b>	University of St. Andrews
<b>Henry White</b>	BAE Systems
<b>Helen Margolis</b>	NPL

A new initiative for the CDT was the formation of an Independent Advisory Board drawn from experts in doctoral training and photonics from around the world. The Board provides a global perspective for the Management Committee. The first meeting of the Independent Advisory Board took place in April 2015. This has been particular value as we internationalize the CDT's activities with the introduction in 2016 of a summer school programme drawing participants from across the globe.

### INDEPENDENT ADVISORY COMMITTEE COMPRISES:

<b>Prof. Colin Mckinstrie</b>	Applied Communication Sciences
<b>Prof. Reinhart Poprawe</b>	Fraunhofer-Institut für Lasertechnik ILT
<b>Prof. Julie Yeomans</b>	Director - EPSRC Centre for Doctoral Training (CDT) in MiNMaT
<b>Prof. David Miller</b>	Stanford University
<b>Dr. David Spence</b>	Spectra-Physics



## SPECIALIST COURSES ADD VALUE TO THE EngD PROGRAMME

Our graduates are unique individuals, whose experience in the industrial research laboratory has been complemented by a combination of specialist courses in science, business and engineering.

All Research Engineers study 180 credits of Masters level technical and business courses. Core technical courses are delivered in two 60-credit residential blocks, the first September to December in St Andrews (Photonics and optics theory and practice) and the second from January to May in Glasgow (Electronic engineering theory and practice). Each of these blocks will comprise a set of mandatory modules but, if appropriate to a Research Engineer's background and doctoral research project, choices from other cognate modules are available.

Research Engineers progress to their industrial research project in June, taking the remaining 20-credit business courses at Heriot-Watt in 1-week intensive blocks. All Research Engineers within a given cohort re-group regularly for professional and computational skills

weekend workshops. One workshop – Communications and Media Skills – is supported by outreach activities which showcase each Research Engineer's research and develop his or her public engagement skills.

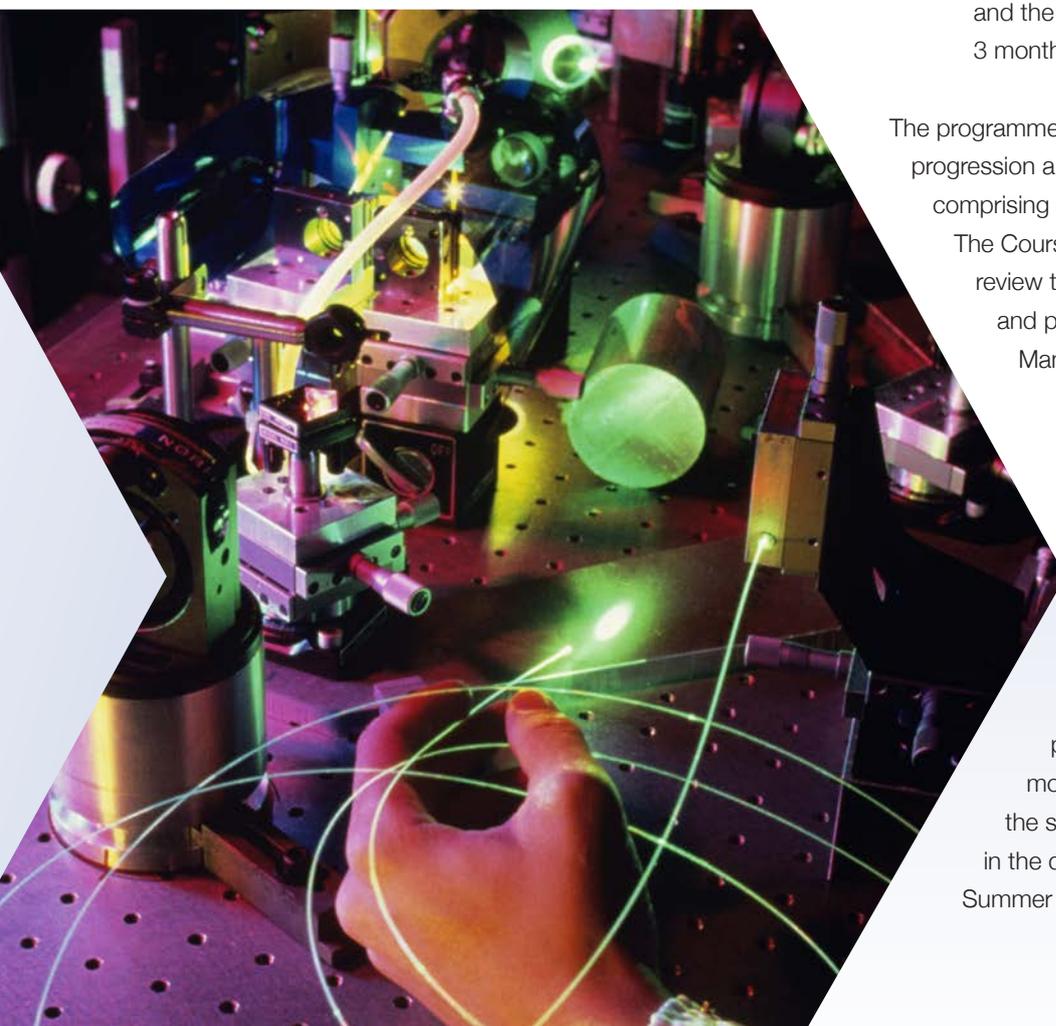
Companies with a research activity in the UK are able to engage with research projects supported by the Centre in two ways:

**EngD** Most research in the Centre continue to take the form of EngD projects, in which a company is responsible for proposing and supporting the research project at their own facility. Arrangements for EngD projects will remain essentially unchanged, with companies owning the foreground IP from the EngD project they support.

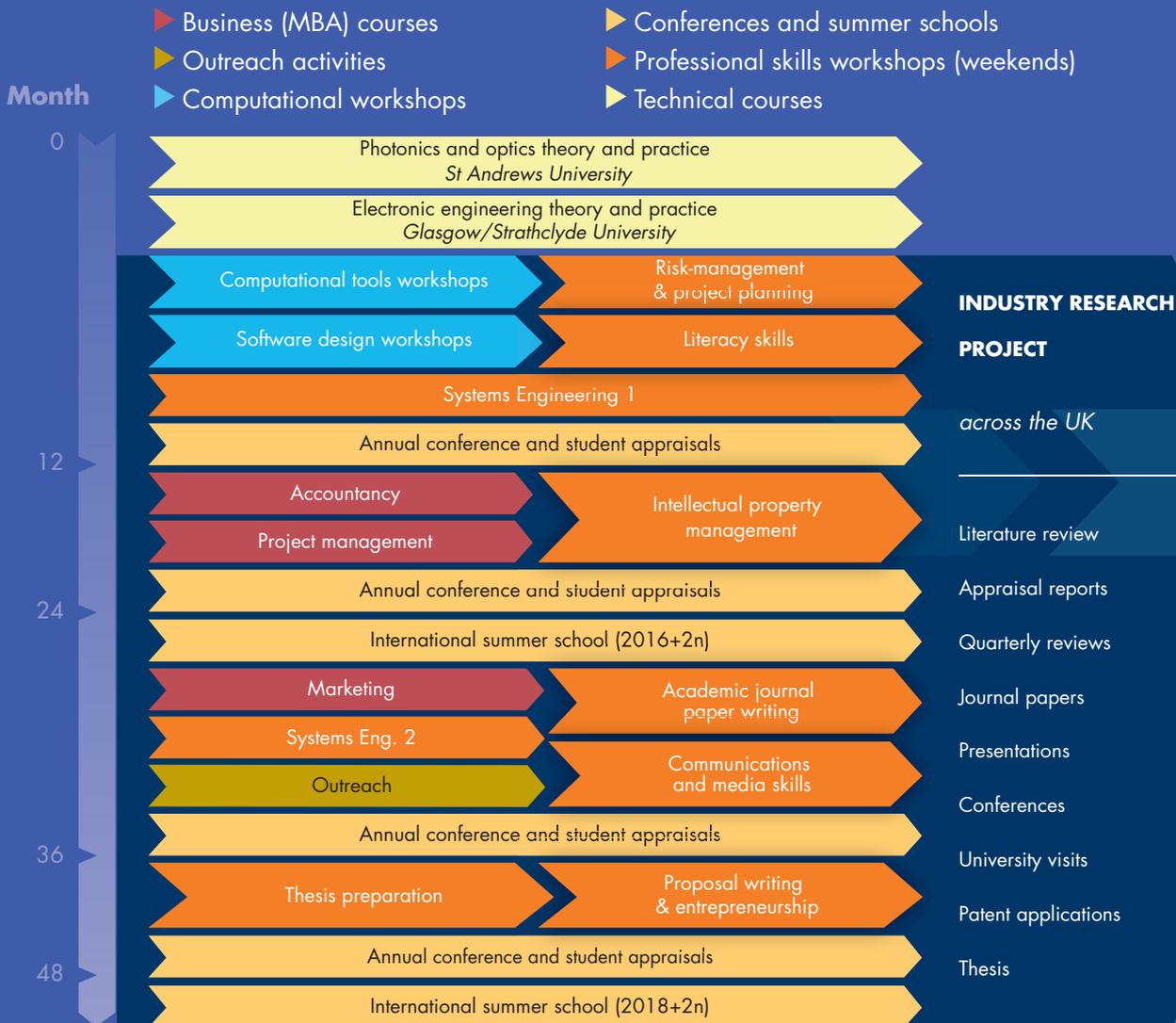
**PhD** A company can choose to support a relevant PhD research project in a university laboratory, in return gaining early access to results, the potential to exclusively license foreground IP and the right to host the student at their site for 3 months of the project.

The programme structure, course delivery and student progression are monitored by a Course Committee comprising academics from the partner universities. The Course Committee meets biannually to review the progress of each individual student, and provides a cohort-level summary to the Management Committee.

The Professional Skills programme has been developed by the Academic Programme Manager and comprises of a series of workshops, lectures and networking events for Research Engineers. In addition to this, the Academic Programme Manager also provides pastoral care and academic monitoring along with consultations with the students. This role also takes the lead in the development of the centre's biannual Summer School.



## THE CDT PROGRAMME AT A GLANCE



## PROFESSIONAL SKILLS COURSES

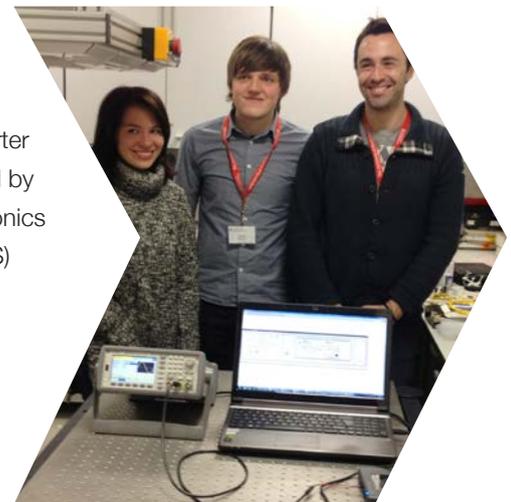
**A new development for the Centre are the professional skills courses. These are coordinated by Dr. Dawn Beddard, Academic Programme Manager who writes the following.**

The personal development of the first cohort of CDT Research Engineers was delivered through the implementation of a substantial professional and technical skills programme in the first half of 2015, with strong engagement from both providers and students.

Writing skills and reference management essential for the year 1 Literature Review were introduced

in a literature workshop arranged from Heriot-Watt's Academic and Learner Services. Following this, a starter session in LaTeX was delivered by a Heriot-Watt Institute of Photonics and Quantum Sciences (IPaQS) researcher.

William Alexander, Technical Director, Thales (Optronics UK) presented a timely session on risk-management whilst



the Research Engineers were undertaking their systems engineering projects.

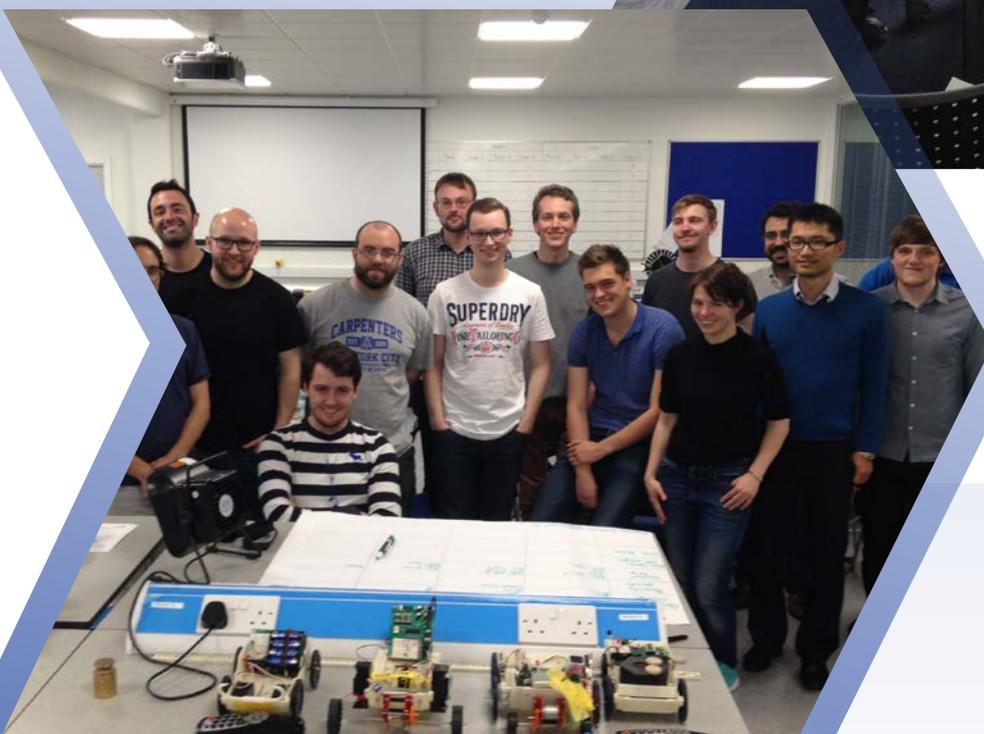
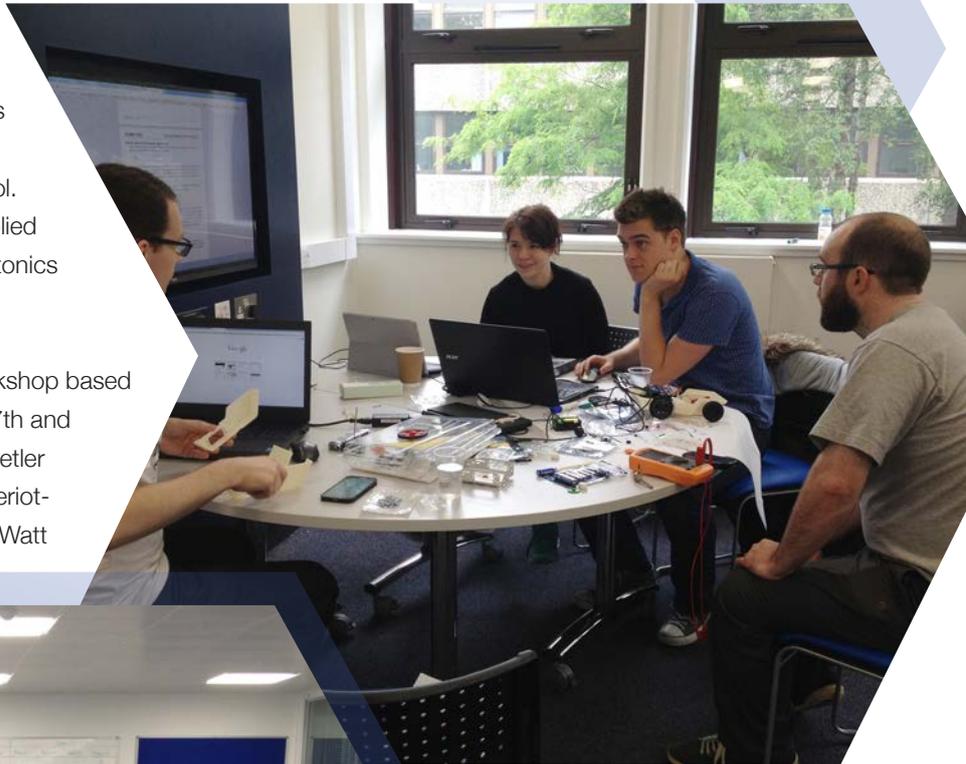
Software packages LabVIEW, MATLAB and COMSOL were targeted for the first technical training sessions. An introduction to LabVIEW through online learning enabled the Research Engineers to begin their Systems Engineering course at the University of Strathclyde with a base understanding of the tools required for their projects. Dr. Paul Dalgarno and colleagues, Heriot-Watt University, delivered a two day course on MATLAB. The material covered included matrix operations, graphing, data handling and signal processing. Exercises and challenges using the acquired knowledge consolidated the Research Engineers' learning.

COMSOL engineers hosted a dedicated workshop on 'Modelling Photonic Devices in COMSOL Multiphysics' following their introductory session on this simulation tool. This was arranged specifically for the Applied Photonics CDT and opened up to all photonics researchers in Scotland.

A cross-cohort Systems Engineering workshop based at Heriot-Watt University took place on 27th and 28th June 2015, led by Dr. Hermine Schnetler (STFC) and Dr. Aparajithan Sivanathan (Heriot-Watt University) and supported by Heriot-Watt

Mechanical Engineering Department. The Research Engineers worked in groups to implement an integrated systems approach to design remote control buggies, printing the parts with a 3D printer.

Overall, the embedded technical and professional skills training supplied throughout the last year provides a strong start to the Research Engineers career and is a foundation for success in research projects as well as dissemination of results and ideas.



## SYSTEMS ENGINEERING PROJECT

***New to the CDT is the Systems Engineering Project module, which has been developed by Dr. Gordon Flockhart who also runs the module. Gordon explains more.***



In 2013, the Industrial Doctorate Centre in Optics and Photonics Technologies responded to EPSRC's call for new Centres for Doctoral Training. As part of the re-bid process, there was an increased focus on the breadth of formal training that the Research Engineers

receive and a strong desire to increase our training provision in the area of integrative technologies. As our Research Engineers are based in industry and many work on developing the next generation of photonic systems, successful development requires integration of software, electronics, instrumentation and control systems. To help equip the new cohorts of Research Engineers in the Centre for Doctoral Training in Applied Photonics, a new purpose built teaching module was developed in the Department of Electronic and Electrical Engineering at the University of Strathclyde. The aim of the module was to provide Research Engineers with the underlying knowledge of analogue electronics and the latest programmable digital hardware and the opportunity to apply this knowledge to integrate hardware and software for photonics orientated applications.

The Systems Engineering Project module is structured to deliver the formal taught aspect through lectures, tutorials and teaching laboratories before the Research Engineers undertake an open-ended group project. The analogue electronics content of the module introduces fundamental circuit theories and develops practical circuit analysis techniques for dc and ac circuits. Amplifier theory, equivalent circuit models and in particular the application negative feedback to design practical circuits using operational amplifiers is also covered. The teaching laboratories focus on the boundary of hardware and software. The labs have adopted National Instruments latest student orientated product myRIO. This is an embedded hardware device comprising of a Xilinx Zynq-7010 all-programmable system on a

chip with additional electronics and communications, such as built-in 3-axis accelerometers, USB and WiFi interfaces, display LEDs and a wide range of possible input and output configurations. Overall this hardware provides a processor capable of running a real-time operating system and a field programmable gate array (FPGA) which can all be programmed using LabVIEW – a graphical programming software. This hardware and software combination, known as LabVIEW reconfigurable input/output (RIO) architecture is also used in a range of National Instruments products that are targeted to industry. Therefore, the programming skills and techniques learnt are directly relevant to systems that may be in use in the Research Engineer's sponsoring companies. Another benefit of using this system is that the Research Engineers can easily access the power and flexibility of implementing signal processing in hardware using the FPGA and high-level programming functions. This allows the Research Engineers to focus on the overall functionality rather than developing advanced programming skills. The final integration of software, programmable digital hardware and analogue electronics is brought together in the systems engineering group project. The group project is mentored by a member of academic staff but is driven by the Research Engineers who define the key objectives, undertake risk analysis and prepare a project delivery plan. The group project culminates in a practical demonstration of the working system, along with an oral presentation and formal technical report. This is an excellent opportunity for students to develop their programming and electronic skills further, in addition to developing valuable problem solving and trouble-shooting skills. The Research Engineers can also access state of the art equipment such as the PXI based FlexRIO purchased through EPSRC's capital equipment call to support the new Centres for Doctoral training. We would like to thank National Instruments for the donation of the myRIO units and their valuable support provided by the academic development and field sales engineers.

## RESEARCH THEMES

The enabling nature of Photonics is clearly illustrated by the research addressed by the Centre, and our research portfolio reflects the specialist interests of our academic and industrial partners.

Across 51 projects, our major research themes are:

- Photonic sensors and devices
- Lasers and non-linear optics
- Nanophotonics

- Optical metrology
- Photonics materials
- Laser materials processing
- Biophotonics

Not only do these themes resonate with areas of photonics research excellence within the consortium universities, but they also align well to current UK research priorities in Photonics, as articulated by the EPSRC priority areas.

## OUR RESEARCH ENGINEERS AND THEIR PROJECTS

With a geographical span extending more than 500 miles, our Research Engineers are distributed in over 30 companies across the UK.



## ► Year 1

Name	Company	Project Title
Munadi Ahmad	STFC	Development of the technologies and techniques required to increase the repetition rate of high energy lasers
Neil Stevenson	Fraunhofer	High Power, Mid- and Deep-infrared Frequency Combs
Anna Michalska	Renishaw (company employee)	Precision distance measurement for a harsh environment
Vladimirs Horjkovs	Taylor Hobson	Robust high dynamic Range transducers for surface form and finish
Tom Dyer	AWE	Development & Integration of Optical Interrogated Diagnostics with Materials Ageing Experiments
Michael Reilly	Finmeccanica	High power and high energy lasers: new materials, laser device architectures and laser beam modelling
Matthew Daykin	TMVSE	Machine learning of an anatomical atlas for computed tomography medical imaging
Gabriel Reines March	NHS Greater Glasgow and Clyde	An investigation and development of techniques to improve cancer treatment through multi-modality image registration using a non-linear deformable model
Riccardo Geremia	Oxford Lasers (company employee)	Industrial Laser Microprocessing and Process Optimisation
Jonatan Crabb	Gooch & Housego	Next Generation Optical Communications for Satellites
Jack Thomas	Fraunhofer	Continuous-wave, Pump-enhanced OPOs based on SDL pump sources

## ► Year 2

Name	Company	Project Title
Jamie Foubister	Optos plc	Retinal scanning ophthalmoscope characterisation and optimisation
Aneta Lisowska	TMVSE	Machine learning from medical images: from photons to phenotype
Matthew Knights	M-Solv	Laser surface modification for control of functional materials deposited by inkjet
Calum Hill	Thales UK	Fibre Laser Technology for Challenging Applications
Dominic Hunter	Texas Instruments	Chip-Scale Atomic Magnetometer for Ultra-Low Magnetic Field Detection
Russell Gordon	Rolls Royce	Automated extraction & characterisation of 3D defects from 2D data sets
Giovanni Giuliano	BAE Systems	Underwater optical communication systems
James Brooks	Fraunhofer UK Research	Novel Dynamics in Mid-IR Lasers
Jamie Coyle	Fraunhofer UK Research	Compact and Low-cost Ultrafast Laser Sources
Benjamin Kettle	Alba Photonics	Next Generation of Diffractive and Micro-Optical Structures for Anti-Counterfeiting and Security

## ► Year 3

Name	Company	Project Title
Ioannis Bitharas	BAE Systems	Visualising and optimising shield gas flows during high-value manufacture
Michele Guastamacchia	RAL	Development and application of multifocal superresolution microscopy for cellular imaging
Luke Maidment	DSTL	Stand-off laser identification of chemical contamination (SLICC)
Iain McKeeman	EDF Energy	Photonic sensors for monitoring of prestressed concrete structures and auxiliary systems in a nuclear power plant
Tamrha Thow	Finmeccanica (company employee)	Receiver Miniaturisation using Photonic Assisted Technologies

<b>Name</b>	<b>Company</b>	<b>Project Title</b>
<b>Yili Guo</b>	Powerlase Photonics (company employee)	Non-Linear Optics for High Power Solid State Lasers
<b>Gediminas Sumskis</b>	Rofin Sinar UK	A novel ultrafast laser tool for rapid precision machining of high value materials
<b>Adam Polak</b>	Fraunhofer UK Research	Intelligent Mid-Infrared Active Laser-based Hyperspectral Imaging
<b>James Sloan</b>	TMVSE	Registration in Medical Imaging
<b>James Morris</b>	Fraunhofer UK Research	Microfabrication of photonic devices for mid infrared optical applications

## ► Year 4

<b>Name</b>	<b>Company</b>	<b>Project Title</b>
<b>David Barr</b>	UKATC	Design, development and characterisation of an affordable Real-Time Control System (RTCS) and micro-Deformable Mirror ( $\mu$ DM) for a multi-object instrument in the era of extremely large ground-based telescopes
<b>Tom Jones</b>	Merlin Circuit Technologies	Laser based filling of high aspect ratio vias in printed circuit boards
<b>Paul Mitchell</b>	Optoscribe	3D guided-wave photonics for next generation communications networks
<b>Howard Moshtael-Oskui</b>	Princess Alexandra Eye Pavilion	Vision-enhancing cameras and micro-displays in visual impairment
<b>Iain Rodger</b>	Thales	Context-driven Scene Segmentation & Optimisation
<b>James Rowell</b>	Seebyte	Video-based processing and autonomy for Underwater Robots
<b>Adam Sroka</b>	Thales	High Peak Power Solid State Laser Modelling
<b>David Webb</b>	Nanoco Technologies	The investigation and development of Heavy Metal Free Quantum Dot devices for use in the general lighting markets

## ► Writing up

<b>Name</b>	<b>Company</b>	<b>Project Title</b>
<b>John Molloy</b>	NPL	Tuneable THz sources
<b>Mel Strachan</b>	UKATC	Cost effective deformable mirror (DM) systems
<b>Stefano Valle</b>	Gooch & Housego	Investigations into high performance Acoustic-Optic Tuneable Filters and their applications
<b>Gary Stevens</b>	Gooch & Housego	High power fibre laser components
<b>David Myles</b>	M-Solv	Development of novel High-Density Interconnect (HDI) laser material processing techniques for high-volume manufacturing of printed circuit boards
<b>Agata Pawlikowska</b>	Finmeccanica	High Resolution 3D Lidar
<b>Savino Piccolomo</b>	Texas Instruments	Integrated opto-electronic systems with quantum metrology
<b>John Ross Aitken</b>	MESL	Millimetre Wave Filter Technologies
<b>Ian Baker</b>	Powerlase Photonics (company employee)	Stabilised high beam quality pulsed lasers with kilowatt average power for industrial applications
<b>Paul Ross</b>	Toshiba Medical Visualization Systems Europe	Illustrative rendering for radiology applications
<b>Marc Smillie</b>	Thales	Passive Q-Switching of Solid State Lasers
<b>Alexander Weir</b>	NHS Greater Glasgow & Clyde	Ambulatory Transcranial Doppler Ultrasound

## CASE STUDY:

### **Agata Pawlikowska**

Research Engineer



#### **The Research Engineer's perspective**

Undertaking an EngD gave me the opportunity to develop a new technology for an integrated sensor system within a production company. In addition to engineering design skills, I gained a commercial understanding of how several technologies and engineering disciplines combine to define a prototype to demonstrate a new capability or function. I also learnt how to balance business demands with academic aspects of the programme. Being able to make a recognised contribution to the company's applied research programme has provided an insight into the commercial relevance of innovation and seeing how technical knowledge is applied has made a huge difference to how I perceive my work- it was a huge source of personal satisfaction. I was consequently offered, and accepted, a permanent position with the company.

**Agata Pawlikowska,**  
Research Engineer,  
Finmeccanica.



#### **The Company's perspective**

The EngD programme provides a good balance between industry's requirements for advanced research in related areas of technology and the research engineer's aims for academic research and industrial experience. Agata has followed several successful EngD students who have been placed within Finmeccanica. Through her research into Photon-Counting technology, Agata has helped Finmeccanica to develop a test bed to assess single element and array detectors in both mono-static and bi-static transceiver designs for long-range 3D imaging lidar. This has provided a valuable understanding of the system performance, characteristics and idiosyncrasies that need to be addressed in developing new technology for next generation electro-optic sensors.

**Dr. Rodger Pilkington,**  
Principal Systems Engineer,  
Finmeccanica.



#### **The Academic Supervisor's perspective**

Being academic supervisor of Agata Pawlikowska, was quite a different experience from a more usual academic PhD project. Agata had to balance the taught course demands of the EngD against some of the pressures of working in an industrial environment. Agata's research in long-distance single-photon lidar was extremely challenging, however the industrial environment gave some advantages in delivering the complex demonstrator systems required for this work. This has given Agata an amazing experience in both industrial and academic research, providing her with an excellent grounding for a career in industrial research and development, as well as providing me, and my University, with a closer relationship with the UK's leading company in the field.

**Prof. Gerald Buller,**  
Academic Supervisor

## CASE STUDY:

### **Dave Webb** Research Engineer



#### **The Research Engineer's perspective**

So far the EngD scheme has helped considerably in the advancement of my career, providing a real emphasis on technical competency and the application of research for commercial purposes. After being in industry for 4 years after university, I was looking to further my education but was hesitant to leave the work position I had achieved. The EngD programme solved this dilemma allowing me to structure a thesis project around my current job, whilst expanding on the research aspects. In particular the additional technical and business modules from the course have helped me develop as a professional, adding in skill sets that had not been covered from my previous academic degrees. It is also very rewarding to see the real world application of research and the realisation of products after working on a problem from initial theory.

**Dave Webb,**  
Research Engineer,  
Nanoco Technologies Ltd.



#### **The Company's perspective**

From the companies perspective the EngD scheme has been a real success. First and foremost it has helped Dave develop and improve on both technical and business fronts. Dave has spent a good number of modules learning about business, accounting and project management among other more technical courses. This has given him great skill in managing his time and seeing the bigger picture of where his work makes a contribution to our end business needs. Furthermore it has helped him grow within the company whereby he has become an accomplished leader and technical expert. His project has built the foundation of what we hope will be a very successful arm of the business in the near future.

**Dr James Harris,**  
Section Head - LED & CFQD,  
Nanoco Technologies Ltd.



#### **The Academic Supervisor's perspective**

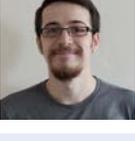
It has been a pleasure to help supervise Dave's research on quantum dots in light sources. Via this project, I have been exposed to an entirely new field of research – a welcome distraction from my usual activities. Dave has proven to be capable at making substantial progress autonomously in his research as well as completing his courses at a high standard. The research results Dave has obtained have potential to impact future lighting markets and lead to new markets for his industrial sponsor. Overall, Dave's EngD project has been a fun adventure for me and a rewarding one for him. He is on track to produce a high quality EngD thesis.

**Prof. Brian Geradot,**  
Academic Supervisor

## NEW STARTS IN 2015-16

A welcome event for the CDT's new Research Engineers took place in September 2015. Centre Director Prof. Derryck Reid, Dr. Bill MacPherson (Deputy Director), Dr. Dawn Beddard (Academic Manager) and second year research engineer Russell Gordon gave talks at the event.



	<b>Munadi Ahmad</b>	STFC	Development of the technologies and techniques required to increase the repetition rate of high energy lasers
	<b>Neil Stevenson</b>	Fraunhofer	High Power, Mid- and Deep-infrared Frequency Combs
	<b>Anna Michalska</b>	Renishaw, (company employee)	Precision distance measurement for a harsh environment
	<b>Vladimirs Horjkovs</b>	Taylor Hobson	Robust high dynamic Range transducers for surface form and finish
	<b>Tom Dyer</b>	AWE	Development & Integration of Optical Interrogated Diagnostics with Materials Ageing Experiments
	<b>Michael Reilly</b>	Finmeccanica	High power and high energy lasers: new materials, laser device architectures and laser beam modelling
	<b>Matthew Daykin</b>	TMVSE	Machine learning of an anatomical atlas for computed tomography medical imaging



**Gabriel Reines March**

NHS Greater Glasgow and Clyde

An investigation and development of techniques to improve cancer treatment through multi-modality image registration using a non-linear deformable model



**Jonathan Crabb**

Gooch & Housego

Next Generation Optical Communications for Satellites



**Jack Thomas**

Fraunhofer

Continuous-wave, Pump-enhanced OPOs based on SDL pump sources



**Ricardo Geremia**

Oxford Lasers

Industrial Laser Microprocessing and Process Optimisation

## GRADUATIONS IN 2015

The following Research Engineers graduated with an Engineering Doctorate in 2015.

<b>Rodger Fenske</b>	Heriot-Watt University
<b>Eoin Murphy</b>	University of Strathclyde
<b>Christopher Dickson</b>	Heriot-Watt University
<b>Marcus Ardron</b>	Heriot-Watt University
<b>Benjamin Fulford</b>	Heriot-Watt University
<b>Will Cochrane</b>	Heriot-Watt University
<b>Michael Leach</b>	Heriot-Watt University
<b>Mathieu Rayer</b>	Heriot-Watt University
<b>Michael Crozier</b>	Heriot-Watt University
<b>Oliver Daniell</b>	Heriot-Watt University
<b>Ryan John</b>	Heriot-Watt University
<b>Daniel Drysdale</b>	Heriot-Watt University

The following Research Engineers have had successful viva in 2015 but have not yet graduated.

<b>Matthew Currie</b>	Heriot-Watt University
<b>Maurice Lessing</b>	University of St. Andrews
<b>Anthony Corcoan</b>	University of Glasgow
<b>Joseph Thom</b>	University of Strathclyde

### Dr. Daniel Drysdale



My thesis title was ***“Vapour Phase HF and XeF<sub>2</sub> Etching Methods with Improved Selectivity for MEMS Manufacturing”***

I recently completed my EngD as a joint program between the Heriot-Watt CDT and memsstar (a company within the semiconductor manufacturing industry), which I am still an employee at post-graduation. From day one, I was placed deep in industry and working with a company who operate at a global level. This allowed me to develop research that was both relevant and of critical importance for the industry I was in as well as academia. In the course of completing the EngD, I not only got a better sense of business considerations through the MBA modules, but found myself becoming a greater independent thinker who, through the research of the EngD, was able to suggest and develop ideas that are now implemented in the work done at memsstar. The biggest challenge for me personally was work/thesis balance and making sure I kept both moving at the same pace. The work however has led to me presenting this information at conferences and working with customers in Europe, North

America and Asia regularly. The EngD to me was both the most difficult and the most enjoyable experience at the same time. It's all worth it for that sigh of relief at the end!

## Dr. Mathieu Rayer



My thesis title was ***“Chromatic confocal gauging for high precision dimensional metrology”***

This body of work has been completed with Ametek Taylor Hobson Ltd. in Leicester. It provided Ametek Taylor Hobson Ltd. with best in class chromatic confocal gauges which is now part of the product portfolio of its sister company Solartron Metrology Ltd.

My EngD is probably my best career decision so far. In fact, this unique program provided me with strong technical skills as well as in depth business knowledge and experience. Both dimensions permitted me to understand and contribute to the fast moving photonics industry.

I am now a research physicist at OSRAM AG in Munich, Germany, where the skills acquired during my EngD program are highly valued and allow me to rapidly grow within the organization.

## Dr. Joseph Thom



My thesis title was ***“An agile and stable optical system for high-fidelity coherent control of a single <sup>88</sup>Sr<sup>+</sup> ion”***

My EngD mainly focussed on developing photonic systems for quantum information processing and quantum metrology applications at the National Physical Laboratory (NPL), where I am now employed as a Higher Research Scientist. In the project, I developed a highly agile and

stable laser system, which was used to demonstrate methods of reducing the error rate of simple logic gates in a prototype trapped-ion quantum computer. Due to the broad range of disciplines involved in such a project, I was continuously acquiring new skills and knowledge throughout the entire course of the EngD, which made for a very rewarding and challenging experience. With a diverse range of research activities and a large student population, I found the NPL as whole to be a stimulating and engaging place to work, and I was never long in finding an expert who could help me with the latest technical problems. Over the course of the EngD I was given the opportunity to disseminate my work at numerous conferences and workshops at home and abroad, with a particular highlight being the International Conference on Atomic Physics, held in Washington D.C in 2014. I also attended a week long summer school on the banks of Lake Como in 2013, which offered an excellent opportunity to discuss the latest developments in trapped-ion physics with contemporaries from all over the world. Currently, I am still building on what I was proud to have achieved in my EngD, just without the additional pressure of having to write my thesis!

## Dr. Marcus Ardron



My thesis was entitled ***“Adaptable Techniques for the Manufacture of Diffractive Optical Elements by Laser Processing”***

As a senior design engineer at Renishaw I had been developing a laser processing technique; transferring this work into an EngD programme allowed me to pursue more detailed research and understanding. In both breadth and depth, my working knowledge of physics, and particularly photonics, dramatically improved from the taught courses and academic rigour of the university staff. I had not foreseen the magnitude of this growth and returned to industrial work with greater competence and confidence.

Studying MBA modules was not a welcome prospect, with the exception of choosing to take economics. Since graduating these skills have become essential parts of my R&D career, especially project management and marketing (yes, really!)

I strongly believe in the complementary collaboration of industrial drive to make quality products along with academic freedom to explore new ground. Within the EngD one can draw on these riches to accelerate one's

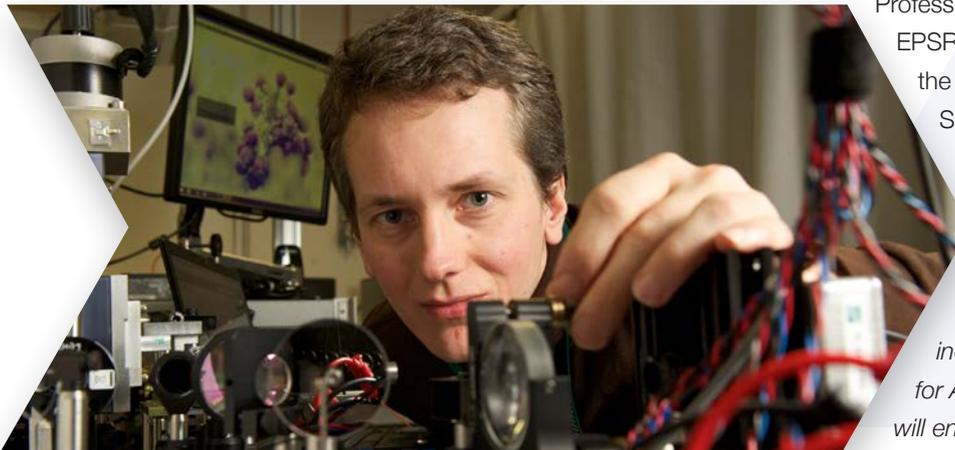
project and personal development. One has to take the reigns in an EngD and I enjoyed the demands of this self motivated trek to complete my chosen task.

## IMPACT

Research in the Centre results in impact across the academic and commercial sectors, whether in the form of traditional academic dissemination, the creation of exploitable intellectual property, or in the influence of our research findings on industrial practice.

In 2015 the Centre generated 68 published outputs, taking the form of a wide range of journal publications, talks and poster presentations at academic conferences, patent applications, EngD theses and media articles.

## NEWS STORIES



Professor Derryck Reid- Director of the EPSRC CDT in Applied Photonics and the Institute of Photonics and Quantum Sciences at Heriot-Watt University said *"Congratulations to Adam Polak, who has been awarded a prestigious Royal Commission of 1851 Industrial Fellowship. The Fellowship will be held at Adam's industrial sponsors Fraunhofer Centre for Applied Photonics in Glasgow and will enable him to develop his work on hyperspectral imaging for chemical sensing*

**Research engineer Adam Polak has received the prestigious Royal Commission 1851 Industrial Fellowship. This provides up to £80,000 funding over a three year period to develop his project 'New imaging technology for identifying hazardous hydrocarbon molecules and compounds', with applications including detecting dangerous gasses, spotting explosives and chemical weapons, and investigating art fraud. His research project is in conjunction with Fraunhofer CAP UK and Strathclyde University.**

The aim of the Industrial Fellowship is to encourage profitable innovation and creativity in British Industry – to the mutual benefit of the Fellow and his or her sponsoring company. These prestigious Fellowships are awarded to selected, exceptional graduates with the potential to make an outstanding contribution to Industry for a programme of doctoral level research.

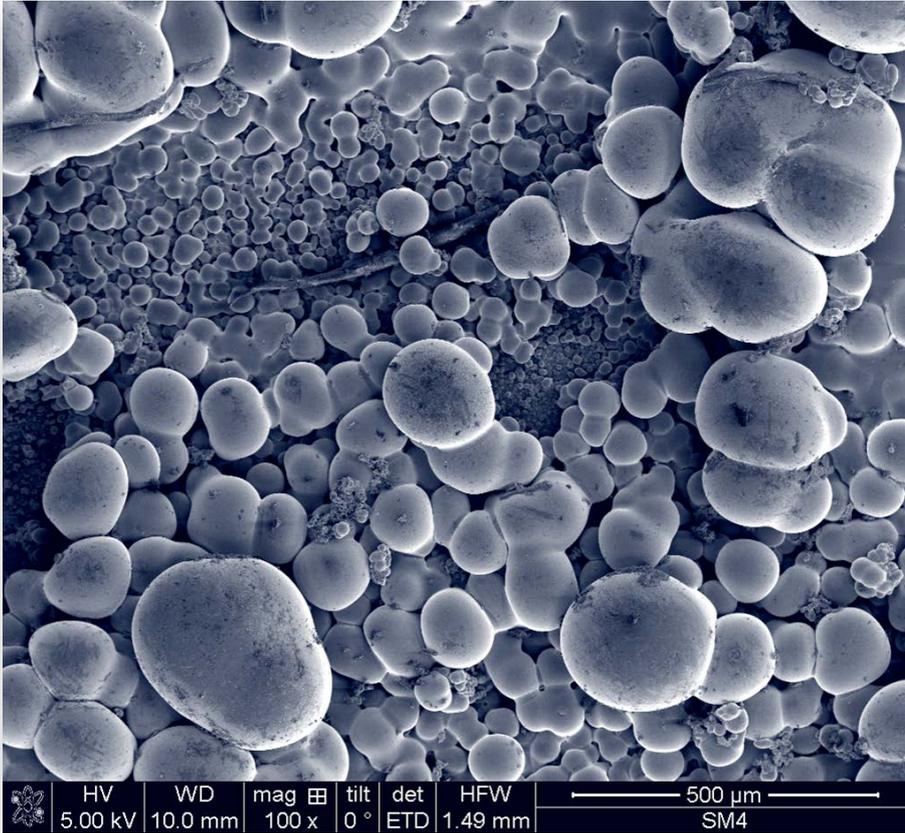
*in new directions. We wish Adam and his supervisors Steve Marshall (Univ. Strathclyde) and Dave Stothard (Fraunhofer CAP) every success as they integrate this promising photonic technology into practical real-world sensing systems."*

Adam's said *"Being awarded with an Industrial Fellowship of Royal Commission for the Exhibition of 1851 is a great honour! I'm really happy that the project I'm busy with was recognised as one of few deserving this privilege. When I started my project I perceived it as a real opportunity to be involved in integration of two sophisticated disciplines into one powerful concept. I'm glad that The Commission also saw the potential of this work and accepted me to their family. I think that joining this family – a network of skilled people from various disciplines - may be the most valuable part of this award."*



Research Engineer **Iain Rodger** has been given an early career award for his collaborative work on a paper presented at the IMA conference on Mathematics in Defence.

Research Engineer **Tom Jones** was a runner up in the Heriot-Watt EPS PGR Photography Competition 2015. His image is of micro-nodules of electro-deposited copper on top of a printed circuit board.



*"The scanning electron microscope false colour image highlights the surface topography for electrodeposited copper on top of a printed circuit board (PCB). In this example the deposition has undergone an adverse plating reaction leading to the formation of micro-nodules. Micro-nodules are unwanted in PCB manufacture as they lead to a powdery and loose copper finish, which cannot be processed in subsequent manufacturing stages. The image highlights that when the electroplating current is pushed beyond a limiting value a poor uniformity is produced."*

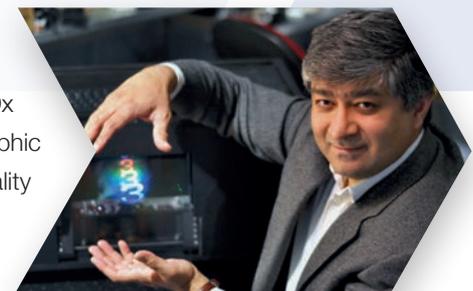
**Tom Jones**

Research Engineers **Calum Hill** and **Mickey Crozier** volunteered at Big Bang Fair with the Science Technology Facilities Council.

Four Research Engineers (2 CDT and 2 IDC), led by **Calum Hill** are involved with a charity project, REMAP, which is developing assistive technology for people with disabilities.



Alumnus **Dr. Javid Khan** gave a TEDx talk titled Holographic 3D is closer to reality than you think.



A new report by Dr. Fumi Kitagawa emphasises the importance of EngDs to UK innovation and growth, highlighting four key areas:

1. Generation of new knowledge
2. Innovation
3. Knowledge networks and collaboration
4. Human capital and skills development



The full report can be viewed by visiting the below link, or scanning the QR code.

[http://www.aengd.org.uk/files/4114/4196/1321/Understanding\\_the\\_EngD\\_Impact.v6\\_with\\_cover.pdf](http://www.aengd.org.uk/files/4114/4196/1321/Understanding_the_EngD_Impact.v6_with_cover.pdf)

EngD alumnus **Dr. Marcus Ardron** and **Dr. Chris Dickson** have been Appointed Good Practice Ambassadors for the Centre. They have both written about their experiences of the EngD and written articles with helpful information for current research engineers.



## JOURNAL PUBLICATIONS, CONFERENCE PROCEEDINGS, CONFERENCE PRESENTATIONS AND PATENT APPLICATIONS

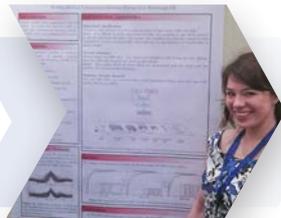
Our Research Engineers disseminate their research widely presenting their work at conferences, publishing papers and participating in outreach activities. Some examples of these are provided by our Research Engineers below. The full list is given in the Appendix.



### **Iain Mckeeman** International Conference in Optical Fibre Sensors, Curitiba, Brazil.

Poster presentation on temperature calibration technique for fibre optic strain sensors.

*"I came away from the conference with some new ideas and found it renewed my motivation when I returned to the UK."*



### **Aneta Lisowska** International Conference on Computer Vision, Santiago, Chile.

Poster presentation on Fall detection.

*"The audiences showed interest in my work and gave me useful suggestions for further research."*



### **Russel Gordon** Rolls-Royce Engineer Doctoral Conference, Derby.

Presentation on 'Automated extraction and characterisation of 3D features from 2D data sets'.

*"The conference gave me an excellent insight into the wider current research of Rolls-Royce."*



### **Iain Rodger** Institute of Mathematics & its Applications (IMA) Conference on Mathematics in Defence, Oxford.

Award winning paper published with supervisors in the conference proceedings.  
*"It is especially pleasing for the work of this collaboration to be recognised."*

## FEEDBACK FROM OUR INDUSTRIAL PARTNERS

Statements provided in 2015 by our industrial partners, illustrate the profound and positive impact that the focused doctoral training provided by the EPSRC Centre for Doctoral Training in Applied Photonics is having on UK companies.

**TOSHIBA**  
Leading Innovation >>>

"[The Research Engineer] is doing excellent work. She has already delivered a substantive project (fall detection) to our Toshiba sponsors, going well beyond expectation for a Student Research Engineer so early in her placement. This work has also generated her an early potential publication (submitted for review). I look forward to her contributing to abnormality detection CT imaging, in the coming months."

[dstl]

"I have been particularly impressed by [his] confidence to take the lead on the aerosol project, and also his responsiveness to my application focussed suggestions. The excellent correlation between results he has obtained and those in the literature is very encouraging and exciting! The implementation of an OPGaP OPO to access the LWIR spectral region could prove to be a landmark experiment for chemical sensing."

 **Fraunhofer**  
UK

"[The Research Engineer] continues to excel in his role here at FCAP, developing not only the technology under his charge but, perhaps more impressively from a personal development point of view, forging new relationships and collaborations with external research groups and organisations. We are delighted with his progress, and the valuable contribution he continues to consistently make."

 **Gooch & Housego**  
ENABLING PHOTONIC TECHNOLOGIES

"[The Research Engineer's] contribution to Gooch & Housego has been significant. Being outside of the mainstream, he has been able pick up mini projects without the company having to disrupt ongoing programmes; he has genuinely taken on (and completed) tasks which would otherwise not have been done. As he has gained in experience (of the company's systems and operating procedures) he has become more and more "useful" to the extent that for the past year he has been (and is) regarded as a regular and experienced employee. He is now a valued member of the team. This has extended on more than one occasion to direct customer support."

 **M-SOLV**  
Limited

"[The Research Engineers] input into developing SMI technology has been crucial, and we have become dependent on his input into the project. Apart from the obvious technical progress, he represents the company excellently at public events and helps boost the reputation of the company."

**NANOCO**  
TECHNOLOGIES 

"[The Research Engineer] has had another very productive quarter. The mini project went well and produced a good luminaire concept demonstrating the use of quantum dots to produce high quality lighting. The use of his simulator tool developed earlier in the program has been invaluable."

 **POWERLASE**

"[The Research Engineers] work has enabled Powerlase to release new products and product enhancements that have been an important part of the Powerlase development roadmap. The technology that he has developed has been used in key components of systems with a value of ~£2M. These sales would not have been possible without his work."

## AN INDUSTRIAL PERSPECTIVE

AWE Plc is a unique national asset and its primary purpose is to support the UK's nuclear security needs by providing stewardship of the UK's nuclear warheads and supporting the Government's policy of Continuous At Sea Deterrence (CASD).

Within the Materials & Analytical Science area at AWE, we have a need to develop new optical sensor technologies and spectroscopic techniques that can be deployed within our own experiments and trials to obtain, otherwise unobtainable, data. The niche nature of our work often means that commercially available technologies rarely meet our requirements or are often not compatible with systematic constraints. Therefore it is essential that AWE has access to highly trained, versatile scientists and engineers who are able to assess the technical challenges that we face and develop appropriate solutions in a cost and time effective manner.

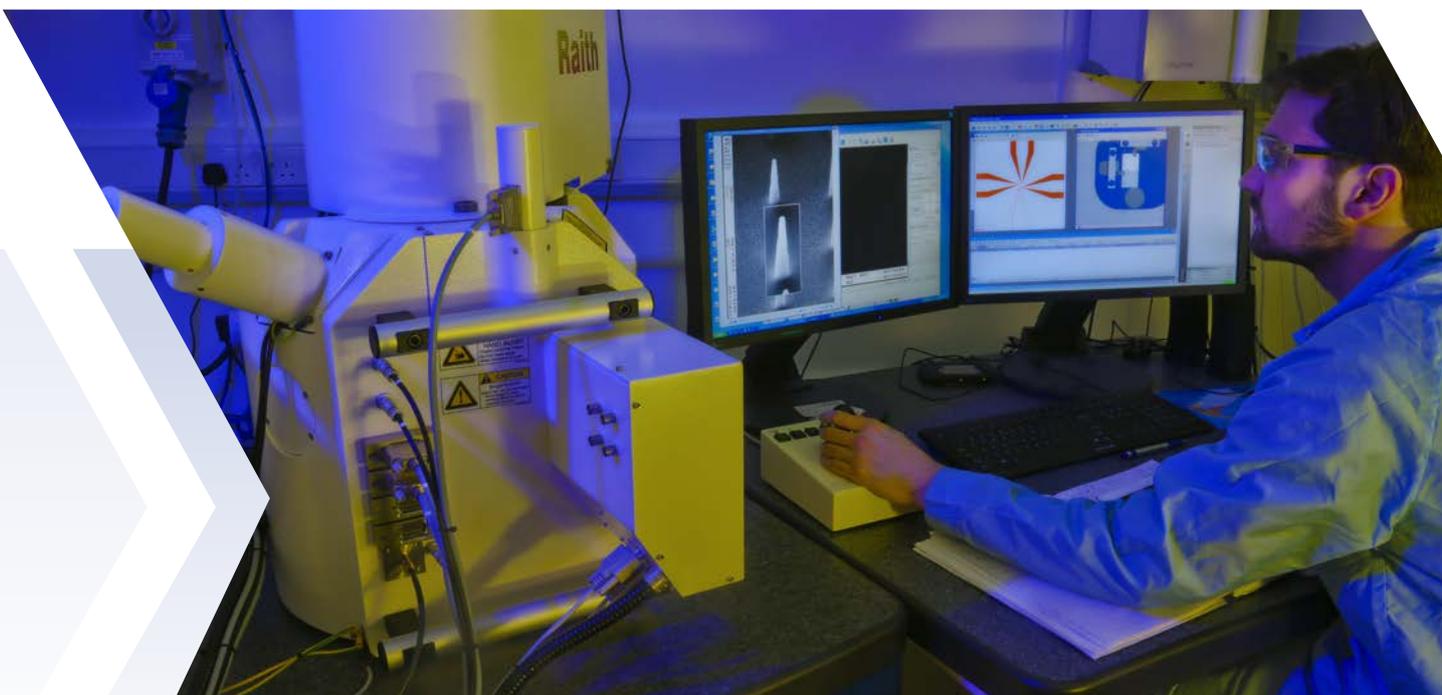
The EngD course in Applied Photonics offers AWE an excellent route by which the company can bring in high calibre individuals to focus on the development of bespoke technologies and novel approaches to address these unique challenges.

A significant benefit to AWE having an EngD candidate working on site for extended periods is that outputs from the candidate's work can be fed directly into core programme activities and the flexibility within the project can help meet emerging company requirements. From the student's perspective, working at AWE provides the opportunity to get involved in exciting and technically demanding projects, whilst having access to cutting-edge equipment and facilities. Furthermore working within multi-disciplinary research groups provides the opportunity to develop key skills within a specialised area whilst also gaining an appreciation of other facets of research performed at AWE.

AWE has increased its level of interaction with the CDT, both in terms of EngD and PhD projects as we realise the significant mutual benefits for the company, academia and early career scientists and engineers. Engaging with the CDT in Applied Photonics in this manner ensures that AWE continues to have an active involvement in the technological advances in the field of photonics, whilst enhancing our relationship with a world leading collaboration of institutions.



**Scott McCulloch**  
AWE



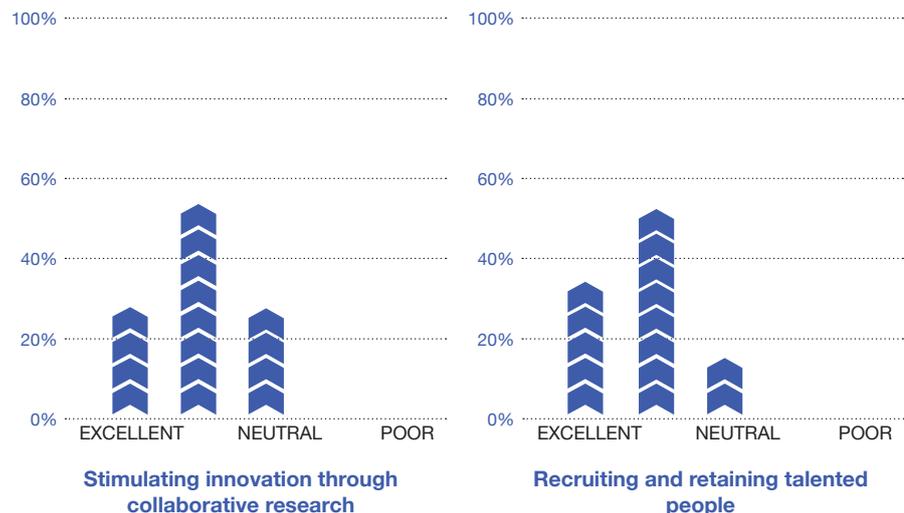
## OUR INDUSTRIAL PARTNERS

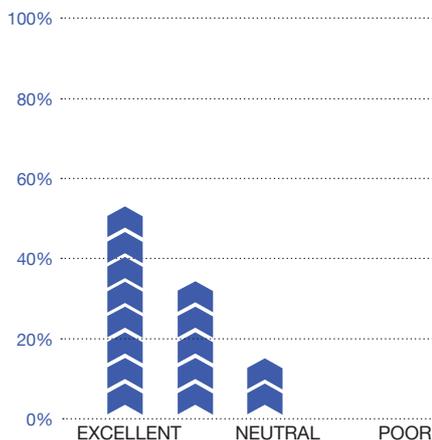
The EPSRC Centre for Doctoral Training in Applied Photonics gratefully acknowledges the support of the following companies in the delivery of the EngD programme.

We are pleased to add Oxford Lasers as new industrial partner to the centre in 2015.

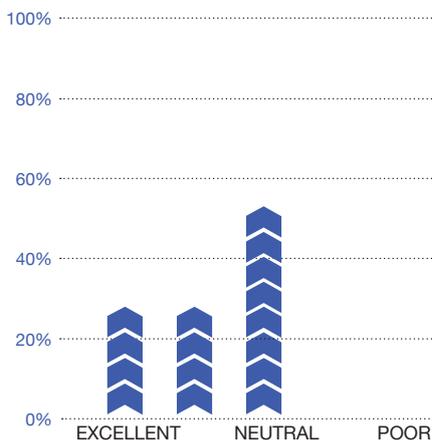
## INDUSTRIAL SPONSORS SATISFACTION SURVEY

The CDT's Industrial Sponsors were asked to complete a survey to indicate their satisfaction with the Centre. The responses are shown on the adjacent graphs and indicate a high level of satisfaction amongst sponsors.

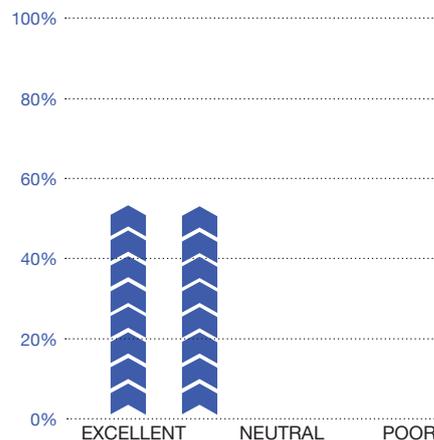




Developing technical, business and personal leadership skills



Having access to a broad range of photonics expertise within the CDT



Is the EngD good value for money?

## **We are very pleased with the feedback from our industrial sponsors, here are some of the comments we received:**

*"[The] main impact is through training engineers to produce academic level R&D, analysis and reporting along with broader business and management training. EngD students at [the company] have developed systems that have opened new markets and made significant impact on sales figures."*

*"Accessing a pool of excellent research candidates has allowed us to pursue research goals we would otherwise not have been able to undertake."*

*"Applied photonics is fundamental to the company business."*

*"It gives us (as in the students) access to high-level training in relevant disciplines. Also, access to a significant "reservoir" of expertise."*

## **ANNUAL CONFERENCE**

The Centre for Doctoral Training in Applied Photonics first Annual conference took place on 26 June 2015 with around 100 delegates attending. The conference attracted registrations from current Research Engineers, industrial and academic supervisors, company representatives and other interested academics. Invited speakers were:

**Prof. Harold Haas**, Chair of Mobile Communications at the University of Edinburgh,

**Dr. Alex Ward**, Razorbill Instruments,

**Dr. Stephen Webster**, M Squared Lasers.





Prof. Harold Hass



Dr. Alex Ward



Dr. Stephen Webster

Research Engineers in their first year prepared a group poster based on the Systems Engineering projects that they had been working on at the University of Strathclyde. The Group prize winners were Jamie Coyle, Calum Hill and Russell Gordon for their project on *'Closed Loop Control of Optical Fibre Interferometer Using myRIO/PXI Hardware for Optical Sensing Applications.'*



James Morris

Second year Research Engineers prepared a poster and also gave a one minute pitch on their poster. The winner of the Best Poster prize was James Morris for his poster on *'Microfabrication of Photonic Devices in Chalcogenide Glass Substrates.'*



David Webb

Oral presentations comprising the core of the conference were given by third year Research Engineers covering topics from micro-optics, quantum control, laser machining, optical sensing and metrology, and terahertz generation. The winner of the Best Presentation prize was David Webb for his presentation on *'Quantum Dot Applications in Lighting.'*



## WEB UPDATE

The new CDT Applied Photonics website has been updated and includes the facility for Research Engineers to add files, pictures, publications and other information to their personal profile page. The website focuses on the integration of photonics with electronic systems, which is fundamental to the work of the CDT.

The site can be found at:  
[www.cdtphotonics.hw.ac.uk](http://www.cdtphotonics.hw.ac.uk)

**Centre for Doctoral Training in Applied Photonics**

**News**

- Bolton-Boyes Engineer Doctoral Conference
- Intellectual Property Workshop
- International Conference on Computer Vision
- More recent news
- Follow @cdtapi

**About the Centre**

Established in 2001, we are the UK's longest running centre of doctoral training in photonics by comprising 100 academic research groups in five universities, we work with industry to deliver engineering problems and provide advanced technical and business training to future industrial entrants by year and associated University

**Entrants by year and associated University**

2001: Photonics EngD Centre  
2005: CTA Microsystems & Photonics  
2009: IDC Optics and Photonic Technologies  
2013: EPSRC CDT in Applied Photonics

For more information, download our [leaflet](#) or contact us by [email](#).

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Centre Director: Prof. Derryck Reid, Tel: +44 (0)131 451 3652  
Heriot-Watt University, Edinburgh, Scotland - Scottish registered charity number: SC030279  
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Centre Director: Prof. Derryck Reid, Tel: +44 (0)131 451 3652  
Heriot-Watt University, Edinburgh, Scotland - Scottish registered charity number: SC030279  
Follow @cdtapi

## NEW EMAIL NEWSLETTER

In December we launched our first email newsletter which was distributed to students, alumni, academic supervisors, industrial partners and other interested parties. By switching to this format, we have been able to increase our publication of the newsletter from two to four times per year.

The new format allows us to better understand the reach of our newsletter. The headlines in the newsletter are links to the main articles on our webpage to increase the usage of the site.

Centre For Doctoral Training in Applied Photonics  
Newsletter December 2015

**Centre for Doctoral Training in Applied Photonics**

**December 2015**

Welcome to the new format newsletter, signalling the CDT's increasing use of electronic and social media. You may notice that we now have a [Twitter](#) feed, and we are tuning up our Linked In profile to help us keep in touch with current and former students. Our website has also received some attention, with the content being reviewed and updated.

**Prof. Derryck Reid**  
Director, EPSRC Centre for Doctoral Training in Applied Photonics

**More...**

**1851 Industrial Fellowship**  
Research Engineer Adam Polak has been awarded the prestigious Royal Commission 1851 Industrial Fellowship

**More...**

**Viva Success!**  
Congratulations to the following research engineers who recently had a successful viva:

**Matthew Currie**  
**Joseph Thom**  
**Tony Conroy**

## SOCIAL MEDIA

The centre has increased its use of social media in 2015.

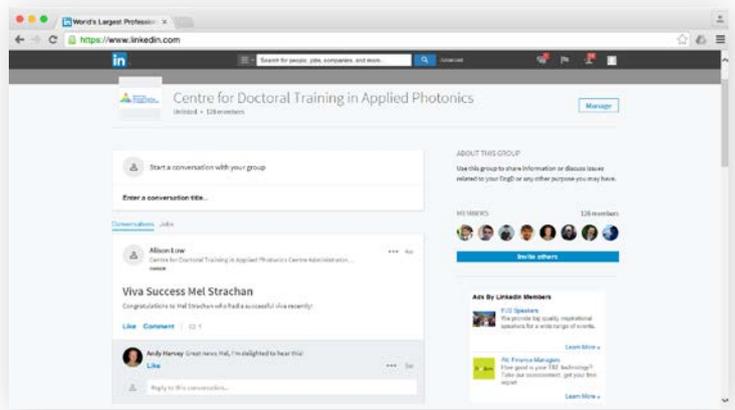


We can now be followed on **twitter** using the handle **@cdtap**.

We use Twitter to post Centre news and announcements as well as our latest CDT vacancies.



We have increased the use of our **LinkedIn** group to inform our members of our Research Engineers success, post project vacancies and for discussion amongst to our membership which is in the region of 130. If you would like to join our **LinkedIn** group, email **engd@hw.ac.uk** and we will send you an invite.



## ALUMNI

The following have graduated with Engineering Doctorates from the Centre for Doctoral Training and from its predecessors the Industrial Doctorate Centre and the EngD Centre.

<b>Dr. Daniel Drysdale</b>	<i>Heriot-Watt University, 2015</i>	Technologist and Process Development Engineer, Memmstar
<b>Dr. Michael Crozier</b>	<i>Heriot-Watt University, 2015</i>	Technologist, M-Solv
<b>Dr. Oliver Daniell</b>	<i>Heriot-Watt University, 2015</i>	Seebyte
<b>Dr. Will Cochrane</b>	<i>Heriot-Watt University, 2015</i>	STFC
<b>Dr. Michael Leach</b>	<i>Heriot-Watt University, 2015</i>	Engineer, Roke Manor
<b>Dr. Mathieu Rayer</b>	<i>Heriot-Watt University, 2015</i>	Optical Design Physicist, OSRAM GmbH
<b>Dr. Benjamin Fulford</b>	<i>Heriot-Watt University, 2015</i>	Laser Engineer, Rofin-Sinar
<b>Dr. Eoin Murphy</b>	<i>University of Strathclyde, 2015</i>	Powerphonic
<b>Dr. Marcus Ardron</b>	<i>Heriot-Watt University, 2015</i>	Renishaw

<b>Dr. Christopher Dickson</b>	<i>Heriot-Watt University, 2015</i>	Graduate Algorithms Engineer, Thales UK
<b>Dr. Ryan John</b>	<i>Heriot-Watt University, 2015</i>	Founding Engineer, Yavi
<b>Dr. Rodger Fenske</b>	<i>Heriot-Watt University, 2015</i>	Chief Operating Officer, Edinburgh Instruments
<b>Dr. Lucy Williamson Hodge</b>	<i>Heriot-Watt University, 2014</i>	Biosensor R&D Scientist, Abbot Diabetes Care
<b>Dr. Andrew White</b>	<i>Heriot-Watt University, 2014</i>	Senior Laser Design Engineer, Coherent Scotland
<b>Dr. Javid Khan</b>	<i>Heriot-Watt University, 2014</i>	CEO, HoloXica
<b>Dr. Mhairi Martin</b>	<i>Heriot-Watt University, 2014</i>	Laser Development Engineer, Coherent Scotland
<b>Dr. Viktor Granson</b>	<i>Heriot-Watt University, 2014</i>	R&D Scientist, Trumpf, San Diego, California, USA
<b>Dr. Brian Flemming</b>	<i>Heriot-Watt University, 2014</i>	Principal Systems Engineer, Selex ES
<b>Dr. Marcus Perry</b>	<i>University of Strathclyde, 2013</i>	Postdoctoral Researcher, University of Strathclyde
<b>Dr. James Downing</b>	<i>University of Glasgow, 2013</i>	Optical Engineer, ST Microelectronics
<b>Dr. Margaret Anyaegbu</b>	<i>Heriot-Watt University, 2013</i>	TES Electronic Solutions
<b>Dr. Cat Fitzpatrick</b>	<i>Heriot-Watt University, 2013</i>	Senior Engineer, Cambridge Consultants
<b>Dr. Jochen Deile</b>	<i>Heriot-Watt University, 2013</i>	Laser Systems Engineering Manager, Raydiance Inc, USA
<b>Dr. Yves Lacrotte</b>	<i>Heriot-Watt University, 2013</i>	Design Engineer, Renishaw
<b>Dr. James Beedell</b>	<i>Heriot-Watt University, 2013</i>	Laser Engineer, Selex ES
<b>Dr. Veronika Tsaturian</b>	<i>Heriot-Watt University, 2013</i>	Postdoctoral Researcher, Aston University, Birmingham
<b>Dr. James Bain</b>	<i>University of Strathclyde, 2012</i>	Project Manager, M Squared Lasers
<b>Dr. Thomas Legg</b>	<i>University of Strathclyde, 2012</i>	Research Engineer at Gooch and Housego
<b>Dr. Paul Harrison</b>	<i>Heriot-Watt University, 2012</i>	Principal Engineer, Product Applications, SPI Lasers
<b>Dr. Gerald Wong</b>	<i>Heriot-Watt University, 2012</i>	Electro-Optics Systems Engineer, Selex ES
<b>Dr. Gordon McKenzie</b>	<i>Heriot-Watt University, 2012</i>	Research Associate, Heriot-Watt
<b>Dr. Patrick Harding</b>	<i>Heriot-Watt University, 2012</i>	Postdoctoral Researcher at University of Frankfurt
<b>Dr. Suzanne Costello (nee Millar)</b>	<i>Heriot-Watt University, 2011</i>	Development Scientist at MCS
<b>Dr. Michael Poulter</b>	<i>University of Strathclyde, 2011</i>	Principal Engineer at SPI Lasers
<b>Dr. Charles Ward</b>	<i>Heriot-Watt University, 2011</i>	Project Co-ordinator, Turner Construction Company, Vietnam
<b>Dr. Richard Dunn</b>	<i>Heriot-Watt University, 2010</i>	Founder at Platform Science & Technology Ltd.
<b>Dr. Paul Black</b>	<i>University of Strathclyde, 2010</i>	Development Manager at Cascade Technologies

<b>Prof. Daniel Esser</b>	<i>Heriot-Watt University, 2010</i>	Professor, Heriot-Watt University
<b>Dr. Yvonne Huddart</b>	<i>Heriot-Watt University, 2010</i>	Design and development engineer, Renishaw
<b>Dr. Peter Thomas</b>	<i>St Andrews University, 2010</i>	
<b>Dr. David Mitchell</b>	<i>Heriot-Watt University, 2010</i>	Field Integration Engineer at Coherent
<b>Dr. Clare Dillon</b>	<i>Heriot-Watt University, 2009</i>	Systems Engineer at Selex ES
<b>Dr. Tiina Delmonte</b>	<i>Heriot-Watt University, 2008</i>	Strategy and Planning, R&D, Doosan Babcock
<b>Dr. Trefor Sloanes</b>	<i>St Andrews University, 2008</i>	Scientist – DSTL Sensors and Countermeasures Dept
<b>Dr. David Faichnie</b>	<i>Heriot-Watt University, 2007</i>	Senior Research Engineer at FMC Technologies
<b>Dr. John Wooller</b>	<i>Heriot-Watt University, 2007</i>	Applications Engineer, Fibercore Limited
<b>Dr. Daniel Purchase</b>	<i>Heriot-Watt University, 2006</i>	Project/Process Engineer at Rayner Intraocular Lenses
<b>Dr. Ian Armstrong</b>	<i>St Andrews University, 2005</i>	Research Fellow, Strathclyde University

## ALUMNI NEWS

The Centre's alumni community continues to grow and now numbers nearly 50. Some of our alumni share their news.

### Dr. Javid Khan

*CEO, Holoxica*



"Holoxica won a €1.28M grant to build a holographic 3D display for medical imaging; and we're seeking another £1M from investors to build products and do trials in hospitals. We're funding 1 EngD and a PhD on the back of this."

### Dr. Suzanne Costello

*Development Scientists, MCS*

Suzanne became the first woman to become chair of IMAPS - International Microelectronics Assembly & Packaging Society -UK.



### Dr. Brian Flemming

*Principal Systems Engineer, Finmeccanica*



- Session chair, outdoor lasers, International Laser Safety Conference organised by the Laser Institute of America, Albuquerque, March 2015.
- Industrial supervisor for a new HW EngD Student (Michael Reilly).
- Member of scientific advisory panel for Risk Analysis 2016 (May 2016) organised by Wessex Institute of Technology.
- "In 2014 I was awarded Chartered Mathematician (C.Math) status and was elected Fellow of the Institute of Mathematics and its Applications (FIMA). I was already a Chartered Engineer (C.Eng) when I started my EngD."

## ALUMNI PROFILE

### **Dr. Ryan John**



I undertook an EngD project rather than a more traditional PhD because I felt it was time to leave a purely academic setting and start getting experience in a commercial environment. The other thing that attracted me to the programme was the ability to

take MBA modules from the Edinburgh Business School. I took full advantage of this and took the maximum available, 5 modules, as I was sure I wanted my career to break out of pure research and I wanted to be able to understand and influence the wider business context of any technical work I was a part of.

My project was with BAE Systems Advanced Technology Centre developing fibre-optic sensor systems for structural health monitoring applications focusing on detecting impacts such as birdstrikes to aircraft wings. As the project progressed I found myself being drawn to any parts of the project which involved programming such as writing code to analyse large amounts of data. I also implemented a neural network in Matlab to determine where an impact had occurred given time-of-flight information from several sensors. In addition, I developed an algorithm which took in an acoustic signal from a carbon fibre panel during an impact, performed some signal processing and then looked for specific characteristic features to determine if it was likely that the impact had damaged the panel.

Coupled with the realisation that I wanted to do more programming came a desire to be involved in a faster moving industry which is always changing. So, in my spare time, I started learning to code in earnest, learning object-oriented programming and Java in particular so that I could make mobile apps for my Android smartphone. Being able to come up with an idea, create it in code and then see the results in front of you is immensely rewarding.

When I came to the end of my project I was lucky enough to find a great company that helped me make the transition from someone who could code to an actual software engineer. Kotikan was an app development agency which made apps used by millions of people for companies such as Skyscanner, Standard Life and Fanduel. Eventually, I became involved in an internal project at the company which had Scottish Enterprise funding to develop a technique for taking a picture of a rota and then extracting and interpreting the data so that the shift information could be understood. This IP led to a spin-out called Yavi which I joined as a founding engineer. Yavi aims to become the digital home for shift workers allowing them to communicate more effectively with both their employers and their co-workers. Taking inspiration from the huge success of consumer messaging apps we can deliver a similar experience but with the added context of knowing when the user is working and with whom. This makes it easy for a worker to organise their lives and find someone to swap or cover their shift if they need to.

Although my job is very different to what I was doing during my EngD it still prepared me well. Analytical thinking and problem solving are the most crucial skills in my job and the business knowledge I acquired through the MBA has given me tools to see the wider picture as I carry out my work. Building a high-growth consumer facing startup is really tough, there are so many aspects to consider at once and lots of competing priorities along with scarce resources. The EngD showed me that I could throw myself into a subject I knew little about and, through time and effort, learn to be an expert in at least a narrow field. It's never too late to take a passion for learning new skills and dive into a different career!

## OUR RESEARCH-PROJECT SUPERVISORS

We are indebted to the many academic and industrial project supervisors who are fundamental to the success and direction of the research undertaken in the Centre.

### **Academic supervisors**

Prof. Derryck Reid<sup>1</sup>

Prof. Andy Harvey<sup>3</sup>

Prof. Brian Gerardot<sup>1</sup>

Dr. Robert Thomson<sup>1</sup>

Dr. Gordon Flockhart<sup>2</sup>

Prof. John Marsh<sup>3</sup>

Prof. Walter Johnstone<sup>2</sup>

Dr. Bill MacPherson<sup>1</sup>

Dr. Changhai Wang<sup>1</sup>

Dr. Paul Dalgarno<sup>1</sup>

Prof. Stephen Marshall<sup>2</sup>

Prof. Mike Chantler<sup>1</sup>

Dr. Paul Record<sup>1</sup>

Prof. Ian Underwood<sup>5</sup>

Prof. Erling Riis<sup>2</sup>

Prof. Marc Desmulliez<sup>1</sup>

Dr. Neil Robertson<sup>1</sup>

Prof. Alan Kemp<sup>2</sup>

Prof. Jason Hong<sup>1</sup>

Dr. Alex Belyaev<sup>1</sup>

Dr. Nigel Johnson<sup>3</sup>

Prof. Duncan Hand<sup>1</sup>

Prof. Howard Baker<sup>1</sup>

Dr. Pawel Niewczas<sup>2</sup>

Prof. Iain Thayne<sup>3</sup>

Dr. Craig Michie<sup>2</sup>

Prof. Andrew Moore<sup>1</sup>

Dr. Paul Siebert<sup>3</sup>

Prof. Mohammed Taghizadeh<sup>1</sup>

Dr. Tom Brown<sup>4</sup>

Prof. Ajoy Kar<sup>1</sup>

Prof. Alan Kemp<sup>2</sup>

Prof. Yvan Petillot<sup>1</sup>

Dr. Jon Shephard<sup>1</sup>

Prof. Gerald Buller<sup>1</sup>

Prof. Cheng-Xiang Wang<sup>1</sup>

Dr. Theo Lim<sup>1</sup>

Prof. Denis Hall<sup>1</sup>

Dr. Mathini Sellathrai<sup>1</sup>

Dr. Jonathan Leach<sup>1</sup>

Prof. Malcolm Dunn<sup>4</sup>

Prof. Daniel Esser<sup>1</sup>

Dr. Tony Kelly<sup>3</sup>

Dr. Yves Wiaux<sup>1</sup>

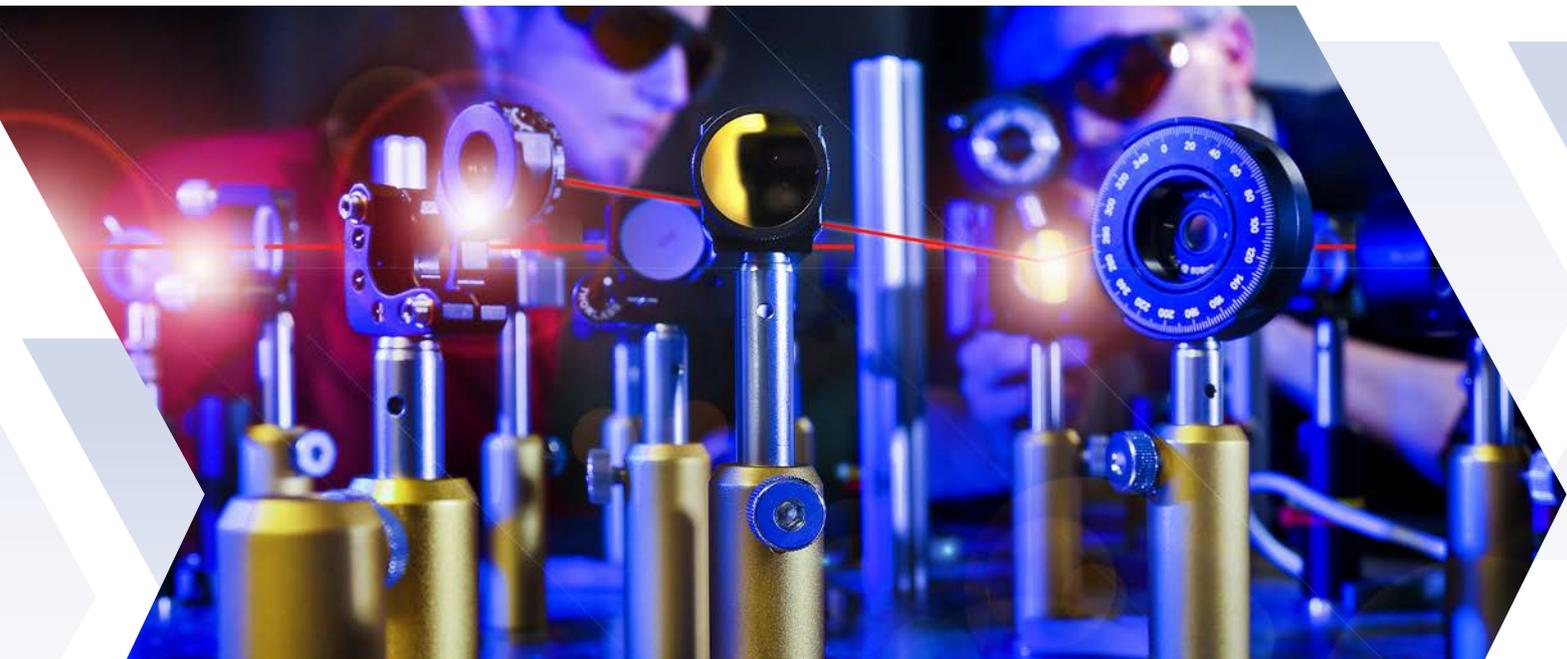
<sup>1</sup> Heriot-Watt University

<sup>2</sup> University of Strathclyde

<sup>3</sup> University of Glasgow

<sup>4</sup> University of St Andrews

<sup>5</sup> University of Edinburgh



## **Industrial supervisors**

Dr. Helen Margolis (NPL)

Dr. James Harris (Nanoco Technologies)

Dr. Noah Schwartz (UKATC)

Dr. Jonathan Evans (SeeByte)

Dr. Xianyan Ju (NHS Greater Glasgow & Clyde)

Dr. Adam Brunton (M-Solv)

Dr. Ian Poole (TMVSE)

Dr. Duncan Rowe (BAE Systems)

Dr. Hermine Schnetler (UKATC)

Dr. Mira Naftaly (NPL)

Mr. Daniel Mansfield (Taylor Hobson)

Dr. Henry White (BAE)

Dr. Paul Miller (Cascade)

Dr. Ed Sparks (Roke Manor)

Dr. Brian Flemming (Finmeccania)

Dr. David Mckendrick (Renishaw)

Dr. Tony O'Hara (Memsstar)

Dr. Alexander Lagatsky (Fraunhofer)

Dr. Stephen Lee (Thales)

Dr. Terry Dyer (Texas Instruments)

Dr. David Stothard (Fraunhofer UK Research)

Dr. Chris Howle (DSTL)

Dr. Keith Goatman (TMVSE)

Dr. Andrew Waddie (Alba Photonics)

Mr. James Fortune (Rolls Royce)

Dr. Bob Bennett (Taylor Hobson)

Dr. Simon Brooks (AWE)

Dr. Dimitris Karnakis (Oxford Lasers)

Dr. Jon Ward (Gooch and Housego)

Prof. Nick Weston (Renishaw)

Dr. Nick Psaila (Optoscribe)

Dr. Mark Silver (Thales)

Dr. Barry Connor (Thales)

Prof. Bal Dhillon (NHS Lothian)

Dr. Stuart Parks (NHS Greater Glasgow & Clyde)

Dr. David Milne (M-Solv)

Dr. Roger Pilkington (Selex ES)

Dr. Bobby Davey (TMVSE)

Dr. Jano van Hemert (Optos)

Dr. Scott Reed (SeeByte)

Dr. Alastair Sinclair (NPL)

Dr. Andrew Robertson (Gooch & Housego)

Dr. Jozef Wendland (Powerphotonics)

Dr. Jason Lee (Rofin-Sinar)

Dr. Michael Johnston (EDF Energy)

Dr. Henry Bookey (Fraunhofer UK Research)

Dr. Stephen Webb (RAL)

Dr. Neil Raphael (Finmeccanica)

Dr. Ian Musgrave (STFC)

Dr. Douglas Roy (BAE Systems)

Dr. Matthew Beadel (Merlin Circuit Technology)



# APPENDIX

## LIST OF PUBLICATIONS, PROCEEDINGS, PRESENTATIONS AND PATENTS

In 2015 our Research Engineers published 8 journal publications, 20 conference proceedings, gave 18 conference presentations, 17 poster conference papers, were involved in 2 patent applications and had 3 articles published.

### Journal Publications

*Names of Research Engineers are underlined.*

H. Moshtael, T. Aslam, I. Underwood, B. Dhillon, **“High Tech Aids Low Vision: A Review of Image Processing for the Visually Impaired,”** *Tran Vis Sci Tech* **4**(4):6 (2015)

Z. Tiegies, A. Stiobhairt, K. Scott, K. Suchorab, A. Weir, S. Parks, A. MacLulich, **“Development of a smartphone application for the objective detection of attentional deficits in delirium”**. *International Psychogeriatrics*, 1-12, 2015

D. Barr, A. Basden, N. Dipper and N. Schwartz, **“Reducing adaptive optics latency using Xeon Phi many-core processors.”** *Monthly Notices of the Royal Astronomical Society*, 454(3), 3222-3233 (2015)

T. Jones, M. P. Y. Desmulliez, D. Price, A. Cobley (2015). **“Implementing new surface pre-treatment processes in the PCB industry through the application of acoustic agitation”**. *Journal of the Institute of Circuit Technology*, **8**, pp. 10-17

Schiavone, G., Jones, T., Price, D., M, Rachael, Jiang, Y., Qiu, Z., Meggs, C., Mahboob, S. O., Eljamel, S., Button, W. T., Demore, C. E. M., Cochran, S. & Desmulliez, M. P. Y. (2015). **“A highly compact packaging concept for ultrasound transducer arrays embedded in neurosurgical needles”**. *Springer, Microsystems Technologies*, **22**, pp. 1 - 11

D. T. E. Myles, M. Ziyenge, J. D. Shephard, D. C. Milne, **“Scanned Mask Imaging Solid State Laser Tool for Cost Effective Flip Chip – Chip Scale Package Manufacture,”** *Journal of Laser Micro/Nanoengineering* **10** 1, p106 (2015)

I. Bitharas, S.W. Campbell, A.M. Galloway, N.A. McPherson, A.J. Moore, **“Visualisation of alternating shielding gas flow in GTAW”**, *Materials & Design* **91**, 5 February 2016, pp. 424-431

J. R. Aitken and J. Hong.: **“Design of millimetre wave diplexers with relaxed fabrication tolerances,”** *IET Microwaves, Antennas Propag.*, 2015, **9**, (8), pp. 802-807

### Conference Proceedings

H. Moshtael, L. Fu, I. Underwood, B. Dhillon, **“Quantifying the ability of individuals with macular disease to see and read content on virtual and augmented reality devices,”** *SID Symposium Digest of Technical Papers* **46**(S1) pp. 34 (2015)

L. Maidment, Z. Zhang, C. R. Howle, S. T. Lee, A. Christie and D. T. Reid, **“Stand-off detection of liquid thin films using active mid-infrared hyperspectral imaging,”** *Proc. SPIE* **9648**, 964804 (2015)

A.J. Weir, R. Sayer, C-X. Wang, S. Parks, **“A wall-less poly(vinyl alcohol) cryogel flow phantom with accurate scattering properties for transcranial Doppler ultrasound propagation channels analysis,”** *Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Milano, Italy, Aug. 2015*

I. Rodger, B. Connor and N. M. Robertson, **“Multi-modal object detection via contextual foreground regions,”** *4th Institute of Mathematics and its Applications (IMA) Conference on Mathematics in Defence, November 2015*

I. Rodger, B. Connor and N. M. Robertson, **“Recovering Background Regions In Videos Of Cluttered Urban Scenes,”** *IEEE International Conference on Image Processing (ICIP), Proceedings*, pp 4097 – 4101

I. Mckeeman, P. Niewczas, and M. Johnston, **“Identifying fabrication defects of metal packaged fibre Bragg grating sensors for smart pre-stressing strands,”** in *Environmental, Energy and Structural Monitoring Systems (EESMS), 2015 IEEE Workshop on*, 2015, pp. 61–65

I. Mckeeman, G. Fusiek, M. Perry, P. Niewczas, and M. Johnston, **“In-situ temperature calibration procedure for temperature and strain fibre Bragg grating sensors for monitoring pre-stressing strands,”** in *SPIE 9634, 24th International Conference on Optical Fibre Sensors, 2015, vol. 9634, pp. 963451–963451–4*

M. Perry, G. Fusiek, **I. McKeeman**, P. Niewczas, and M. Saafi, **“Metal-packaged fibre Bragg grating strain sensors for surface-mounting onto spalled concrete wind turbine foundations,”** SPIE 9634, 24th International Conference on Optical Fibre Sensors, 2015, vol. 9634, pp. 963466–963466–4

**David Myles**, David Milne, Jonathan D Shephard, **“Scanned Mask Imaging Ablative DPSS UV Laser Process for 2 $\mu$ m L/S RDL,”** IMAPS Additional Conferences (Device Packaging, HiTEC, HiTEN, & CICMT): January 2015, Vol. 2015, No. DPC, pp. 000554-000589

D. Milne, **D. Myles**, P. Rumsby, **“SMI: a new method to allow low cost, high resolution micro-machining using UV solid state lasers,”** Proc. SPIE 9657, Industrial Laser Applications Symposium (ILAS 2015)

D. Milne, **D. Myles**, **“Scanned mask imaging: The economical approach to high resolution micro-machining using UV solid state lasers,”** Proceedings of Lasers in Manufacturing 2015

**S. Valle**, J. Ward, C. Pannell, N. P. Johnson, **“Acousto-optic tunable filter for imaging application with high performance in the IR region”**. Proc. SPIE 9359, Optical Components and Materials XII, 93590E (March 16, 2015); doi:10.1117/12.2077610

P. C. Shardlow, J. Ward, C. Pannell, **S. Valle**, and W. A. Clarkson, **“Null-frequency-shift acousto-optic tunable filter for wavelength tuning of a Tm fibre laser,”** in 2015 European Conference on Lasers and Electro-Optics - European Quantum Electronics Conference, (Optical Society of America, 2015), paper CJ\_14\_6

**S. Valle**, J. Ward, C. Pannell, N. Johnson, **“Imaging AOTFs with Low RF Power in Deep-UV and Mid-IR”**, Physics Procedia, Volume 70, 2015, Pages 707-711, ISSN 1875-3892, <http://dx.doi.org/10.1016/j.phpro.2015.08.096>

R. Kaiser, B. Gomez Saavedra, G. Cincotti, M. Irion, **P. Mitchell**, N. Psaila, G. Vollrath, M. Schell, **“Integrated All-Optical 8-channel OFDM/Nyquist-WDM Transmitter and Receiver for Flexible Terabit Networks”**, in International Conference on Transparent Optical Networks (ICTON 2015)

Rameez Asif, Hao Hu, **Paul Mitchell**, John Macdonald, Francesco Da Ros, Nicholas Psaila, Feihong Ye, Leif Katsuo Oxenløwe and Toshio Morioka, **“Experimental Demonstration of 6-Mode Division Multiplexed NG-PON2: Cost Effective 40 Gbit/s/Spatial-Mode Access Based on 3D Laser Inscribed Photonic Lanterns”**, in European Conference on Optical Communication (ECOC 2015)

**J. R. Aitken** and J. Hong.: **“Design of millimeter wave substrate integrated waveguide diplexers”**. Proc. 1st URSI Atlantic Radio Science Conference, Gran Canaria, Spain, May 2015

**Alison O’Neil**, Sean Murphy and Ian Poole. **“Anatomical landmark detection in CT data by learned atlas location autocontext”**, Medical Image Understanding and Analysis 2015

**A. Lisowska**, G. Wheeler, V. Ceballos Inza, and I. Poole. **“An Evaluation of Supervised, Novelty-Based and Hybrid Approaches to Fall Detection Using Silmee Accelerometer Data.”** In Proceedings of the IEEE International Conference on Computer Vision Workshops, pp. 10-16. 2015

**D. Barr**, A. Basden, N. Dipper and N. Schwartz, **“Reducing adaptive optics latency using many-core processors.”** In Proceedings of the fourth AO4ELT Conference, (2015)

## Conference Presentations

**L. Maidment**, Z. Zhang, C. R. Howle, S. T. Lee, A. Christie and D. T. Reid, **“Stand-off detection of liquid thin films using active mid-infrared hyperspectral imaging,”** Proc. SPIE **9648**, 964804 (2015)

**A. Lisowska**, G. Wheeler, V. Ceballos Inza, and I. Poole. **“An Evaluation of Supervised, Novelty-Based and Hybrid Approaches to Fall Detection Using Silmee Accelerometer Data.”** Presented at the IEEE International Conference on Computer Vision Workshops, 2015

**H. Moshtael**, L. Fu, I. Underwood, B. Dhillon, **“Quantifying the ability of individuals with macular disease to see and read content on virtual and augmented reality devices,”** presented at EuroDisplay 2015, Ghent, Belgium, 21-23 September 2015

**D. Barr**, A. Basden, N. Dipper and N. Schwartz, **“Reducing adaptive optics latency using many-core processors.”** Presented at the fourth AO4ELT Conference, (2015)

**D. T. Webb**, J. A. Harris, B. D. Gerardot, **“Quantum Dot Applications in Lighting”** presented at EngD Annual Conference, Edinburgh, UK, 26 Jun. 2015

**D. T. Webb** **“Quantum Dot Applications in Lighting,”** presented at Rank Prize Funds Symposium on Electroluminescent and Photovoltaic Effects in Nanocrystal Quantum Dots, Grasmere, UK, 16-19 Nov. 2015

**J. R. Aitken** and J. Hong.: **“Design of millimeter wave substrate integrated waveguide diplexers”.** Proc. 1st URSI Atlantic Radio Science Conference, Gran Canaria, Spain, May 2015

**P. Mitchell**, N. Psaila, and A. Kar, **“Photonic Integration in Optical Transceivers”** in IDC Conference 2015

**H. Moshtael**, I. Underwood, B. Dhillon, **“The Potential for Head-Mounted Displays as Low Vision Aids,”** presented at 15th EURETINA Congress, Nice, France, 17-20 September 2015

**Tom Jones**, **“Acoustic surface treatment process in the Printed Circuit Board industry”**, presented at the Industrial Doctorate Centre, at Heriot-Watt University on the 17th July

**D. Myles**, J. D. Shephard, D. Milne, **“UV Solid State Laser Scanned Mask Imaging System for Cost Effective Laser Embedded Circuitry,”** presented at IMAPS MicroTech 2015, Rutherford Appleton Laboratories, Oxford, UK, 5th March 2015

**D. T. E. Myles**, J. D. Shephard, D. C. Milne, **“Scanned Mask Imaging Ablative DPSS UV Laser Process for 2 $\mu$ m L/S RDL,”** presented at IMAPS 11th International Conference and Exhibition on Device Packaging, Scottsdale, Arizona, USA, 17th March 2015

**A. Weir**, **“Challenge and Opportunity: Medical App Development at the MDU,”** Health Facilities Scotland, IRIC Conference, Glasgow, UK, May 2015

**A. Weir**, **“The Medical Devices Directive: A Force for Good in Mobile Health Applications?”** IEEE Prime Conference on PhD Research in Microelectronics and Electronics, Glasgow, UK, Jun. 2015

**R. M. Gordon**, **“Automated extraction and characterisation of 3D features from 2D Data sets”** Rolls Royce Doctoral conference 2015, Derby

**I. Rodger**, B. Connor and N. M. Robertson, **“Multi-modal object detection via contextual foreground regions,”** 4th Institute of Mathematics and its Applications (IMA) Conference on Mathematics in Defence, November 2015

**I. Rodger**, B. Connor and N. M. Robertson, **“Recovering Background Regions In Videos Of Cluttered Urban Scenes,”** presented at the IEEE International Conference on Image Processing (ICIP), 2015

**I. Mckeeman**, P. Niewczas, and M. Johnston, **“Identifying fabrication defects of metal packaged fibre Bragg grating sensors for smart pre-stressing strands,”** in Environmental, Energy and Structural Monitoring Systems (EESMS), 2015 IEEE Workshop on, 2015

## Poster Conference Paper

**A. Lisowska**, G. Wheeler, V. Ceballos Inza, and I. Poole. **“An Evaluation of Supervised, Novelty-Based and Hybrid Approaches to Fall Detection Using Silmee Accelerometer Data.”** Presented at the IEEE International Conference on Computer Vision Workshops

**L. Maidment**, Z. Zhang, C. R. Howle, S. T. Lee, A. Christie and D. T. Reid, **“Stand-off detection of liquid thin films using active mid-infrared hyperspectral imaging,”** presented at CLEO 2015, San Jose, USA, 5-10 May. 2015

**L. Maidment**, Z. Zhang, C. R. Howle, S. T. Lee, A. Christie and D. T. Reid, **“Stand-off detection of liquid thin films using active mid-infrared hyperspectral imaging,”** presented at CDT Annual Conference, Edinburgh, 26 June. 2015

S. J. Ingelby, P.F. Griffin, A. S. Arnold, S.R. Chanu, R. Elvin, V. A. Henderson, **D. Hunter**, M. Jardine, J. P. McGilligan, E. Riis, **“Optically Pumped Magnetometry for Unshielded Applications,”** presented at UK National Quantum Technologies Showcase, The Royal Society, London, 11 Nov. 2015

**J. C. E. Coyle**, C. H. Hill, R. Gordon and G. Flockhart, **“Closed Loop Control of Optical Fibre Interferometer Using myRIO/PXI Hardware for Optical Sensing Applications,”** Annual CDT Conference (2015)

**A. Polak**, S. Marshall, D. Stothard, **“Use of hyperspectral imaging for artwork evaluation”**

G. Giuliano, D. Hunter, **A. Lisowska**, **“Spectral analysis of discretely sampled periodic signals”** CDT conference (June 2015)

**M. G. R. Guastamacchia**, S. E. D. Webb, P. A. Dalgarno, **“Diffraction multifocal microscopy for super-resolved 3D localisation of single particles”**, poster presented at the EngD conference of the Centre for Doctoral Training in Applied Photonics, Heriot-Watt University, Edinburgh, UK, 26th June 2015

**M. G. R. Guastamacchia**, **“Axial super-resolution multifocal microscopy”**, poster presented at the student at Harwell poster competition in the Medical Research Council, Harwell campus, Harwell, UK, 25th October 2015

**I. Mckeeman**, **“Towards the development of an in-situ photonic monitoring system for steel pre-stressing strands,”** Poster at Annual CDT in Applied Optics Conference, 26th Jun. 2015

**T. Thow**, **“Optoelectronic Oscillators Based on Semiconductor Lasers,”** presented at EngD Annual Conference, Edinburgh, June 2015

**Tom Jones**, **“Megasonic (1MHz) acoustic enhancement of the Copper plating of through-hole via interconnects,”** Presented poster at 9th Innovative electronics Manufacturing Research Centre (IeMRC), at Loughborough University

**Tom Jones**, Presented poster on research at the 2015 Defence and Security Equipment International (DSEI) exhibition at the ExCel centre in London

C. H. Hill, J. C. Coyle, **R. M. Gordon**, **“Closed loop control of optical fibre interferometer using myRIO/PXI hardware for optical sensing applications,”** Presented at the CDT Conference 2015

**I. Bitharas**, N. MacPherson, D. Roy and A. J. Moore, **“Visualisation of shielding gas flows during high-value manufacture,”** CDT Optics & Photonics conference, 2015

**B. Kettle**, **“Comparison of design algorithms for phase-only diffractive optical elements,”** presented at CDT Applied Photonics Annual Conference, Edinburgh, Scotland, 26 Jun. 2015

**J. R. Aitken** and J. Hong.: **“Millimetre wave diplexer for future satellite communications systems operating at Q/V band”**. IET Enterprise Workshop, Edinburgh, UK, March 2015

## Patent Applications

**Ross, P.**, **“Deferred and Smoothed Curvature Shading for Detail Enhancement in Smoothed Ultrasound Volumes,”** Patent filed. To be submitted as journal paper in 2016

Patent: **“Vascular tree from anatomical landmarks and a clinical ontology”** US 9,189,866  
Inventors: Ian Poole, Colin Roberts, Paul Norman and **Alison O’Neil**

## Articles Published

Trade magazine article: **D. Myles**, D. Milne, **“UV Solid State Laser Ablation for Embedded Fine Scale Circuitry,”** Chip Scale Review **19** 1, p32 (2015)

Trade magazine article: D. Milne, **D. Myles**, **“Scanned Mask Imaging: The economical approach to high resolution micro machining using UV solid-state lasers,”** commercial micro manufacturing international **8** 5, p20 (2015)

Chinese trade magazine technical article (translated by Irene Wang): **D. Myles**, D. Milne, **“利用紫外固態激光器蝕刻埋入式小尺度電路,”** Journal of the HKPCA **56**, p22 (2015)

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