At its heart, photonics is an applied science. It is defined by the objective of harnessing the fundamental properties of light to drive innovations in communications, healthcare, manufacturing, metrology, energy and defence. The partnerships between universities and industry embodied in our Centre are so effective for precisely this reason. As the UK looks increasingly to manufacturing industry to power the economic recovery, photonics has an important role to play, but companies must continually innovate to maintain their competitive position. Our 2013 Annual Report contains many examples of how our established industrial partners are realizing tangible benefits to their businesses through their engagement with the Centre. During the last year we admitted 10 new EngD Research Engineers, and began research collaborations with two new industrial partners, further widening the reach of our Centre. In the past year, eight Research Engineers were successful in their EngD viva voce examinations, a reminder that not only does our Centre support industrial research projects but also develops the next generation of industrial research leaders.

A particular focus in 2013 was to respond to the EPSRC’s call for new Centres for Doctoral Training in order to secure the renewal of our Centre’s funding for the next five years. Our bid was a truly collaborative effort, shaped by our industrial and academic partners, and I believe this was responsible for its success in a process which ultimately proved to be especially challenging for EngD-oriented renewals.

This annual report will be the last to bear the name of the Industrial Doctorate Centre in Optics and Photonics Technologies. The first cohort of the Centre for Doctoral Training in Applied Photonics will be admitted in September 2014, beginning a transition which will continue until our present Research Engineers complete their degrees in 2018.

I look forward to the new challenges and rewards which we can expect in 2014 and I would like to thank the Research Engineers, academics and industrialists who have contributed to our success in 2013.
**Principal Contacts**

**Centre Executive**
- **Prof. Derryck Reid**
  - Director
  - Tel: 0131 451 3652
  - Email: D.T.Reid@hw.ac.uk
- **Dr. Bill MacPherson**
  - Deputy Director
  - Tel: 0131 451 3733
  - Email: W.N.MacPherson@hw.ac.uk
- **Mr. Sean Farrell**
  - IT Support
  - Tel: 0131 451 3048
  - Email: S.J.Farrell@hw.ac.uk
- **Ms. Alison Low**
  - Administrator
  - Tel: 0131 451 8245
  - Email: A.H.Low@hw.ac.uk
- **Mrs. Linda Bruce**
  - Secretary
  - Tel: 0131 451 3792
  - Email: L.Bruce@hw.ac.uk

**Academic Partners**
- **Prof. Erling Riis**
  - IDC Coordinator, University of Strathclyde
  - Tel: 0141 548 3490/3371
  - Email: e.riis@strath.ac.uk
- **Dr. Tom Brown**
  - IDC Coordinator, University of St Andrews
  - Tel: 01334 46 3129
  - Email: ctab@st-andrews.ac.uk
- **Dr. Nigel Johnson**
  - IDC Coordinator, University of Glasgow
  - Tel: 0141 330 4110
  - Email: Nigel.Johnson@glasgow.ac.uk

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**AT A GLANCE:**

**The EPSRC Industrial Doctorate Centre in Optics and Photonics Technologies**

**Course Committee**
- Programme oversight

**Management Committee**
- Strategic direction

**Executive Team**
- Support & information
- Feedback

**Academic Supervisors**
- Supervision

**Research Engineers**
- Supervision

**Individual Supervisors**
- Course delivery

**Academic Partners**
- Contract arrangements
- New industrial contacts
- New supervisors
A DISTRIBUTED MODEL FOR PHOTONICS DOCTORAL TRAINING

The EPSRC Industrial Doctorate Centre in Optics and Photonics Technologies is led by Heriot-Watt University and delivered in partnership with the Universities of St Andrews, Strathclyde and Glasgow. Complementing this academic consortium are 35 industrial partners, who contribute financial support to the Centre as well as substantial levels of supervision time and practical resources sustaining around 55 EngD projects.

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 2013/14 MANAGEMENT COMMITTEE COMPRISSES:

- Susan Peacock, EPSRC
- Nigel Aldridge, BAE Systems
- Nick Weston, Renishaw
- Jon Ward, Gooch and Housego
- Allan Colquhoun, Selex ES
- Barry Connor, Thales
- Nick Hay, Powerlase Photonics
- Scott McCulloch, AWE
- Derrycy Reid, Director, Heriot-Watt University
- Bill MacPherson, Deputy Director, Heriot-Watt University
- Duncan Hand, Heriot-Watt University
- Tom Brown, St Andrews University
- Nigel Johnson, Heriot-Watt University
- Erling Riis, University of Glasgow
- Hermine Schnetler, University of Strathclyde
- Adam Brunton, UK Astronomy and Technology Centre
- Iain Rodger, M-Solv
- Research Engineer, Representative, Thales

Our consortium draws from a pool of around 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.

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.

Masters-level technical courses in Photonics are provided by Heriot-Watt and St Andrews. These courses account for two thirds of the taught content in the EngD programme, and include an advanced laboratory component, designed to expose our Research Engineers to the wide variety of equipment and techniques needed to prepare them for a research career in Photonics.

To succeed in an industrial environment our Research Engineers need to gain a working knowledge of a range of applied management and business skills. One third of the taught programme is delivered by Edinburgh Business School, who provide MBA courses in subjects including project management, marketing, accountancy and strategic planning.

Photonics is a broad subject, with a dynamic range spanning sensors and imaging to laser development and manufacturing. In addition to certain mandatory technical and business courses we offer Research Engineers a choice of elective courses tailored to the requirements of their project.
Our portfolio of courses is structured thematically to make it simpler for Research Engineers to plan their coursework schedule. In 2013 we added Biophotonics as an option at St Andrews University.

### THE CENTRE FOR DOCTORAL TRAINING IN APPLIED PHOTONICS

All proposals for new Centres for Doctoral Training were required to be aligned to one or more of the EPSRC’s designated priority areas. Our proposal was directed towards the Integrative Technologies area, which was defined as the synthesis of research in photonics and electronics. Consequently the CDT syllabus has been fully redesigned with several enhancements:

1. The introduction of 60 credits of new residential taught-courses in electronics;
2. Computational workshops that introduce important methods and industry-standard software packages;
3. Professional skills workshops with some presented by our industry partners;
4. An exciting public engagement programme, with training led by Glasgow Science Centre;
5. An international summer-school;
6. The expansion of the Centre to include the University of Dundee.

Normally entering in September, all Research Engineers will study 180 credits of technical and business courses. Core technical courses will be delivered in two 60-credit residential blocks, the first until December in St Andrews (Photonics and optics theory and practice) and the second from January to April 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 will be made available.

As is currently the case, many courses will remain available in distance-learning format, allowing employees registered for the EngD to take these without spending a large amount of time off-site.

Research Engineers will progress to their industrial research project in May, taking the remaining 20-credit business courses at Heriot-Watt in 1-week intensive blocks. All Research Engineers within a given cohort will re-group regularly for professional and computational skills workshops. One workshop – Communications and Media Skills – is supported by outreach activities which will showcase each Research Engineer’s research and will develop his or her public engagement skills.

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

- **EngD** Most research in the Centre will 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.

Project proposals from companies are accepted throughout the year but are particularly encouraged by the end of December to allow recruitment to the programme in phase with the normal academic year.

For more information about the new CDT in Applied Photonics, download the new information leaflet from the Centre website, [www.cdt photonics.hw.ac.uk](http://www.cdt photonics.hw.ac.uk).

###莱斯特菲利普斯大区

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.
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 53 projects, our major research themes are:
- Photonic sensors and devices
- Lasers and non-linear optics
- Nanophotonics
- Optical metrology
- Photonic 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 35 companies across the UK.

Year 1

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Company</th>
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</tr>
</thead>
<tbody>
<tr>
<td>John Ross Atiken</td>
<td>MESL</td>
<td>Millimetre Wave Filter Technologies</td>
</tr>
<tr>
<td>Ian Baker</td>
<td>Powerlase Photonics</td>
<td>Stabilised high beam quality pulsed lasers with kilowatt average power for industrial applications</td>
</tr>
<tr>
<td>Michael Crozier</td>
<td>M-Solv</td>
<td>Development of a thin-film photovoltaic cell division and interconnection scheme</td>
</tr>
<tr>
<td>Adam Krysinski</td>
<td>NPL</td>
<td>Development of sensing technology for large area, high resolution and fast surface topography measurement</td>
</tr>
<tr>
<td>Maurice Lessing</td>
<td>NPL</td>
<td>Ultra-low-noise frequency synthesis, comparison and dissemination using femtosecond optical frequency combs</td>
</tr>
<tr>
<td>David Myles</td>
<td>M-Solv</td>
<td>Development of novel High-Density Interconnect (HDI) laser material processing techniques for high-volume manufacturing of printed circuit boards</td>
</tr>
<tr>
<td>Alison O’Neil</td>
<td>Toshiba Medical Visualization Systems Europe</td>
<td>Image analysis of noisy 3D/4D medical datasets</td>
</tr>
<tr>
<td>Agata Pawlikowska</td>
<td>Selex ES</td>
<td>High Resolution 3D Lidar</td>
</tr>
<tr>
<td>Savino Piccolomo</td>
<td>Texas Instruments</td>
<td>Integrated opto-electronic systems with quantum metrology</td>
</tr>
<tr>
<td>Paul Ross</td>
<td>Toshiba Medical Visualization Systems Europe</td>
<td>Illustrative rendering for radiology applications</td>
</tr>
<tr>
<td>Marc Smillie</td>
<td>Thales</td>
<td>Passive Q-Switching of Solid State Lasers</td>
</tr>
<tr>
<td>Gary Stevens</td>
<td>Gooch &amp; Hosego</td>
<td>High power fibre laser components</td>
</tr>
<tr>
<td>Mel Strachan</td>
<td>UKATC</td>
<td>Cost effective deformable mirror (DM) systems</td>
</tr>
<tr>
<td>Stefano Valle</td>
<td>Gooch &amp; Housego</td>
<td>Investigations into high performance Acoustic-Optic Tuneable Filters and their applications</td>
</tr>
<tr>
<td>Alexander Weir</td>
<td>NHS Greater Glasgow &amp; Clyde</td>
<td>Ambulatory Transcranial Doppler Ultrasound</td>
</tr>
</tbody>
</table>

### Year 4

<table>
<thead>
<tr>
<th>Name</th>
<th>Company</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Marcus Ardon</td>
<td>Renishaw</td>
<td>Flexible process for the manufacture of diffractive optical elements by laser processing</td>
</tr>
<tr>
<td>Will Cochrane</td>
<td>UKATC</td>
<td>Micro-Autonomous Positioning System (MAPS) and other miniature astronomical instruments</td>
</tr>
<tr>
<td>Anthony Corcoran</td>
<td>Optos</td>
<td>Novel Modalities in Ultra-Wide Retinal Illumination</td>
</tr>
<tr>
<td>Oliver Daniell</td>
<td>Seebyte</td>
<td>Automatic object Recognition Algorithms for Unmanned Water Vehicles</td>
</tr>
<tr>
<td>Christopher Dickson</td>
<td>Thales</td>
<td>Multi-modal sensor processing from moving platforms</td>
</tr>
<tr>
<td>John Molloy</td>
<td>NPL</td>
<td>Tuneable THz sources</td>
</tr>
<tr>
<td>Eoin Thomas Murphy</td>
<td>BAE</td>
<td>Wavelength Agnostic WDM Strategies for Avionic Telecommunications</td>
</tr>
<tr>
<td>Mathieu Rayer</td>
<td>Taylor Hobson</td>
<td>Advances in Optical gauging technology for practical non contact metrology</td>
</tr>
<tr>
<td>Joseph Thom</td>
<td>NPL</td>
<td>Microfabricated ion traps</td>
</tr>
</tbody>
</table>

### Year 5

<table>
<thead>
<tr>
<th>Name</th>
<th>Company</th>
<th>Project Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robert Campbell</td>
<td>Cascade Technologies</td>
<td>Next generation gas-sensing technology based on mid-infrared quantum cascade lasers</td>
</tr>
<tr>
<td>Matthew Currie</td>
<td>PowerProtonic</td>
<td>Advanced Design, Fabrication and Test technologies for Laser-Based Micro-Optics</td>
</tr>
<tr>
<td>Benjamin Fulford</td>
<td>Rofin Sinar</td>
<td>Picosecond solid-state lasers for industrial applications</td>
</tr>
<tr>
<td>Ryan John</td>
<td>BAE</td>
<td>The exploitation of fibre-optic sensor technology in aerospace and defence</td>
</tr>
<tr>
<td>Michael Leach</td>
<td>Roke Manor Research</td>
<td>Image processing and computer vision: detection of unusual behaviour</td>
</tr>
</tbody>
</table>

### Writing up

<table>
<thead>
<tr>
<th>Name</th>
<th>Company</th>
<th>Project Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daniel Drysdale</td>
<td>Micrstar</td>
<td>Development and characterisation of vapour phase sacrificial etching and organic deposition for MEMS fabrication</td>
</tr>
<tr>
<td>Javid Khan</td>
<td>Holoxica</td>
<td>Low-resolution holographic displays</td>
</tr>
<tr>
<td>Mhairi Martin</td>
<td>BAE</td>
<td>Photonic Crystal Fibre for High Power Distribution on Aerospace Platforms</td>
</tr>
<tr>
<td>Lucy Williamson-Hodge</td>
<td>Rutherford Appleton Laboratory</td>
<td>Development of FUM System, Picosecond Laser Diodes and LEDs, Alternative Light Sources for TCSPC and Instrumentation for Spectral Selection</td>
</tr>
<tr>
<td>Brian Flemming</td>
<td>Selex</td>
<td></td>
</tr>
</tbody>
</table>
The EngD doctorate programme has given me a unique opportunity to perform research in an industrial setting giving me an invaluable perspective on both the academic and industrial worlds. This led me to develop a wider variety of skills than I would have if I had undertaken a traditional PhD in a university department. The taught component of the program including both technical and business topics provided a solid base of knowledge which I could then apply as part of my varied workload. Working in an industrial setting with real business problems to solve helped keep my research interesting and focused which also fed back into the academic output.

Ryan John, Research Engineer, BAE Systems

The Research Engineer’s perspective

Industrial research is primarily focussed on resolving application based questions. Working with Ryan during his EngD placement here at BAE Systems allowed many of these questions for Structural Health Monitoring technologies to be properly probed and extended beyond the point that would not have been possible without him. This broad remit presented Ryan with numerous technical challenges and ultimately resulted in several peer reviewed publications: thereby raising the profile of both BAE Systems and Heriot-Watt University. The flexibility of the EngD thus allowed Ryan to build-up a portfolio of work that was both extremely valuable to BAE Systems and academically credible.

Ian Read, Principal Scientist BAE Systems, Advanced Technology Centre

The Company’s perspective

Working with Ryan during his placement at BAE SYSTEMS offered an unparalleled insight into the research needs of our industrial collaborators. With this enhanced understanding the project was able to develop in directions that were of mutual benefit to Ryan, BAE SYSTEMS, and my own research interests. It was pleasing to see solutions being developed to support ongoing programmes within BAE SYSTEMS, while at the same time allowing us the flexibility to explore some more speculative areas. It was also particularly exciting to be involved in such a wide range of technologies in this collaboration, certainly more so than might normally be encountered in more traditional University based PhD research project.

Bill MacPherson, Academic Supervisor and Deputy Director IDC Optics and Photonics Technologies

The IDC’s perspective

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Bill MacPherson, Academic Supervisor and Deputy Director IDC Optics and Photonics Technologies

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GRADUATIONS IN 2013

The following Research Engineers graduated with an Engineering Doctorate in 2013.

Dr. Marcus Perry, University of Strathclyde
Dr. James Downing, University of Glasgow
Dr. Margaret Anyaegbu, Heriot-Watt University
Dr. Cat Fitzpatrick, Heriot-Watt University
Dr. Jochen Deile, Heriot-Watt University
Dr. Yves Lacrotte, Heriot-Watt University
Dr. James Beedell, Heriot-Watt University
Dr. Veronica Tsatourian, Heriot-Watt University

Marcus Perry

My thesis title was “Optical Fibre Sensors for Monitoring Prestressed Concrete Structures in Nuclear Power Plants”

The industrial sponsor for my EngD was EDF Energy. I now work on a diverse range projects (not just within optics) at Frazer-Nash Consultancy in Bristol. The EngD was a fantastic experience with a strong community of talented people. Having that balance between cutting-edge research and business kept me interested throughout the four years. At the end of it, you walk away not just with your technical knowhow, but with an ability to learn quickly on the job, communicate with a variety of audiences and appreciate the commercial impact of your decisions. This stands you in good stead no matter what you decide to do.
James Beddell

My thesis title was “Nd:YAG based laser sources for targeting applications”

I carried out the EngD programme as an employee of Selex ES, after achieving the MSc Photonics prior to my employment, which allowed me exemptions to the technical modules. The EngD programme provided an excellent personal development opportunity, which taught me to carry out research in a structured, well documented manner. I enhanced many skills especially during the thesis writing stage, not least time management and self-discipline! As an EngD student, I had the opportunity to carry out a variety of interesting research topics, many of which have greatly benefited the company. During my research, I was given the chance to attend international conferences and present my work to the wider scientific community. I enjoyed attending the EngD conference at Heriot Watt University, and learning about the work being carried out by EngD students in other companies. The business modules were a great way of gaining a valuable insight into aspects of business that I would not normally encounter as a research engineer, such as economics and project management. In addition, they provided a great opportunity for working and networking with other EngD students outside of my company. The much enjoyable away weekends also provided additional personal development and a social gathering of EngD students, while participating in outdoor activities together.

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 2013 the Centre generated 30 published outputs, taking the form of a wide mixture of journal publications, talks and poster presentations at academic conferences, patent applications, EngD theses and media articles.

MEDIA COVERAGE

John Molloy
Terahertz Fashion

John Molloy, a Research Engineer based at NPL, recently caught the attention of the fashion world: The Terahertz Fashion story featured on over 100 webpages in over 20 different countries including Jennifer Ouellette’s blog “Cocktail Party Physics” on Scientific American, Latvian Cosmopolitan, and the Chinese Government SME development agency. John explains below.

The UK’s clothing industry, known worldwide for its style and quality, is worth around £37 billion annually. However, it’s estimated that counterfeiting costs designer brands, retailers and the exchequer approximately £3.5 billion/year. Beyond the monetary cost, counterfeiting has social and environmental impact, through the financing of organized crime, job losses and increased wastage. National Physical Laboratory’s recent innovations in natural and synthetic fibre identification by Terahertz Spectroscopy could make an extraordinary impact in countering this fraud.

Terahertz spectroscopy is usually implemented in transmission, where you compare the spectrum of light that is passed through the material under test, against the emitted spectrum of your light source. Comparing these two spectra, you see that for the light which passed through the sample, certain wavelengths have had their energy attenuated or filtered out completely. This loss in energy is due to absorption of light by the material under test. The pattern of absorption and the wavelengths at which it occurs is an identifying characteristic each material.

With this information we can determine what an unknown fabric or other material placed in the spectrometer is made from. Terahertz spectroscopy for testing fabrics has several advantages compared with existing test methods, as it is nondestructive, quantitative, cheaper and faster.

Our work has attracted widespread attention in the both online and in print from the scientific and fashion press. We are currently working with world leading weavers and THz manufacturers in the UK and Europe to bring this technology to market.

Javid Khan
Interactive Holographic 3D Display

Javid Khan, a Research Engineer and CEO of Holoxica, has received coverage of his company’s technological developments in a number of media articles during 2013.

The company’s Interactive Holographic 3D Display was featured on the Gadget Show on Channel 5, this broadcast had an audience of over a million viewers. See the broadcast on http://gadgetshow.channel5.com/gadget-show/blog/future-special-holoxica.

A full length human anatomy hologram designed for teaching medical students at Edinburgh University received press coverage in The Scotsman, The Sunday Herald and the STV news. An article written by Javid was published in the July 2013 edition of Laser Focus World on the application of digital 3D holograms to biomedical applications.

Special mention should also be made that Javid was winner of the best paper on “actual EngD impact” in the AEngD Writing Competition. He gave a talk on his paper “Holographic volumetric 3D displays” at the AEngD conference held in November 2013.

John has recently won £25K of internal funding for a proof of concept field trials with a leading manufacturer to evaluate the THz-TDS as a means to identify textile composition.
BOOK PUBLISHED

Industrial Doctorate Centre in Optics and Photonics Technologies alumna, Dr. Suzanne Costello and her academic supervisor, Professor Marc Desmulliez recently had a book published, “Hermeticity testing of MEMS and Microelectronic Packages.” Suzanne and Marc provide the background to publishing the book.

JOURNAL PUBLICATIONS, CONFERENCE PROCEEDINGS, CONFERENCE PRESENTATIONS AND PATENT APPLICATIONS

In 2013, our Research Engineers published 10 journal publications, 6 conference proceedings, gave 12 conference presentations and were involved in 2 patent applications. The full list of these is given in Appendix 1.

FEEDBACK FROM OUR INDUSTRIAL PARTNERS

Statements provided in 2013 by our industrial partners, illustrate the profound and positive impact that the focused doctoral training provided by the EPSRC Industrial Doctorate Centre in Optics and Photonics Technologies is having on UK companies.

**Rofin**

“The Research Engineer’s research has underpinned a further development which is expected to be the basis for a future product range to be manufactured in the UK.”

**M-Solv**

“The impact of the Research Engineer’s work is very high. We are now in discussion with major [industrial] players on commercialisation and the Research Engineer has been instrumental in making this possible.”

**Toshiba**

“The Research Engineer has shown determination and initiative... she has applied her skills in probabilistic graphical models (learned from an online course), greatly improving accuracy in the [specific imaging] problem...”

**NPL**

“The Research Engineer’s research forms an integral part of our programme to develop a new generation of highly accurate atomic clocks [with applications ranging from sensitive tests of general relativity and measurements of fundamental physical constants to improved satellite navigation systems and better tracking of deep space probes]...”

**SeeByte**

“The Research Engineer has provided novel image processing algorithms that the Company will look to commercialise. The work ... is of high interest in the offshore commercial market.”

After finishing my EngD and graduating in 2011, my supervisor (Professor Marc Desmulliez, Heriot-Watt University) and I began to consider writing a book on the subject of my EngD thesis: Hermeticity testing of MEMS and microelectronic packages. Shortly after beginning my research work, it became clear that the subject of my studies was not particularly well understood in industry and, excepting a few good journal articles and conference proceedings, poorly documented. Due to the ever-decreasing size of electronic devices and the development of new technologies leading to new device types, the requirements of device packaging to protect these devices has changed significantly over the past few decades. Standards first written during the Second World War are still being used to regulate leak testing of electronic packages. The standards are at best out-of-date and in some cases misleading. Marc and I therefore decided to write a book for industry to highlight the limitations of traditional hermeticity test methods. The focus was to define the range in which the test methods are applicable and to suggest new test methods for package types and/or volumes that cannot currently be tested effectively. Our book was published by Artech House at the end of last year.

I am now working for MCS Ltd, the sponsors of my EngD, as a Development Scientist. As part of my job at MCS, I conduct materials and failure analysis to help solve problems for companies covering a wide base of industries including electronics, oil and gas and pharmaceuticals. I interact with customers when they come across manufacturing issues, problems during product development or testing and with field returns. Since joining MCS I have gained experience using analytical equipment such as broad ion beam cross-sectioning, field emission SEM with EDX and FTIR in order to determine the root-cause of failure and hence identify practical solution to customers problem. I have a very interesting and diverse role which allows me to be involved directly in investigations in the lab as well as being involved in development of the business.

Following the excellent work that Suzanne did in her thesis, covering all aspects of hermeticity testing and finding new methods to push the limits of existing techniques, it became quickly apparent that a book would help all who were interested in this field. We had spent so much time finding the right sources that we wanted to avoid a similar fate to our peers. Writing the book was hard but Suzi and I worked as real partners, sharing the load and negotiating terms and conditions with the Publisher, as well as asking for more time for the few chapters left to write. I will definitely write another book provided that I find someone as hard working and dedicated as Suzanne.

Dr. Suzanne Costello

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“The Research Engineer has been vital in the early stages of the commercialization of a new product, which we aim to bring to market in 2014.”

“The Research Engineer’s work had a big impact on the company activity. [The service they developed] is up and running, and the Company is getting orders through this service.”

“The Research Engineer’s efforts fit into an on-going body of work concerned with assessing and monitoring the structural health of high value assets. He has made a significant contribution in understanding the potential of impact detection systems and how these can be implemented using fibre optic sensing systems.”

“Is the EngD value for money?”

“The Research Engineer’s impact to the company is significant, he displays excellent academic and excellent practical abilities. He is able to execute his work program with minimal direction and is willing and able to perform tasks that I would generally consider appropriate for a more experienced engineer. The direct benefit from his work has been a shortening of technical design cycle of product development programs and this is critical in maintaining competitiveness in our industry.”

AN INDUSTRIAL PERSPECTIVE

Powerlase Photonics Ltd is a UK based manufacturer of high average power pulsed solid state lasers for high throughput industrial processing. We design and manufacture laser systems at our Crawley headquarters in the South East of England where we currently employ a team of 40 people supporting a global network of distributors and customers. To succeed we rely on innovative technology and applications development and world-class engineering and product design.

As an SME, our involvement with the EPSRC Industrial Doctorate Training Centre in Optics and Photonics has given us efficient and cost-effective access to a broad range of emerging technologies and networking opportunities within university research groups and partner companies. The breadth of access and exposure is much greater than that of a typical university collaboration.

We expect these benefits to be enhanced with the new EPSRC Centre for Doctoral Training in Applied Photonics which will expand the already excellent pool of academic supervisors available and add the ability to access and efficiently support low TRL research through PhD doctorates.

We currently have one member of staff entering his third year of Engineering Doctorate research and another just starting. In previous years two further members of staff have been awarded Engineering Doctorates through the IDC.

Our past and continuing experience is that the Engineering Doctorate programme provides outstanding training for young engineers who wish to enhance their technical and business skills. These members of staff have become innovation leaders within the organisation, gaining practical and theoretical skills that have enabled them to generate new intellectual property, improve the performance and competitiveness of the Powerlase Photonics product portfolio, and broaden the range of applications and markets that these products can address globally.

The story so far at Powerlase Photonics has been that of a ‘chain of inspiration’ where the experiences of one EngD student, at an extremely well run and rewarding doctoral training centre, have inspired the next student to begin. We are looking forward to this continuing with the new EPSRC Centre for Doctoral Training in Applied Photonics.

Dr Nick Hay, Director, Product Management and Advanced R&D, Powerlase Photonics, offers his perspective on the EPSRC Industrial Doctorate Centre in Optics and Photonics Technologies.

Dr Nick Hay
Powerlase Photonics

INDUSTRIAL SPONSORS SATISFACTION SURVEY

We asked our Industrial Sponsors to complete a satisfaction survey; the responses are shown below and indicate a high level of satisfaction amongst our Industrial Sponsors. We are very pleased to see for the question “is the EngD value for money?” that 77% of those that answered thought it was excellent value for money, which is a rise from 50% who thought it was excellent value in the 2012 industrial satisfaction survey.

1. How would you rate the satisfaction survey; the responses are shown below and indicate a high level of satisfaction amongst our Industrial Sponsors.

2. Our involvement with the EPSRC Industrial Doctorate Training Centre in Optics and Photonics has given us efficient and cost-effective access to a broad range of emerging technologies and networking opportunities within university research groups and partner companies. The breadth of access and exposure is much greater than that of a typical university collaboration.

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6. Dr Nick Hay, Director, Product Management and Advanced R&D, Powerlase Photonics, offers his perspective on the EPSRC Industrial Doctorate Centre in Optics and Photonics Technologies.

Dr Nick Hay
Powerlase Photonics
OUR INDUSTRIAL PARTNERS

The EPSRC Industrial Doctorate Centre in Optics and Photonics Technologies gratefully acknowledges the support of the following companies in the delivery of the EngD programme.
EVENTS

Research Engineers’ Weekend

In March 2013 the Centre held its annual weekend for Research Engineers, combining personal / professional - development sessions with social activities. This took place at the Firbush Outdoor Centre at Loch Tay. Professional workshops that took place were

• Leading Lean Six Sigma Change and Visual Leadership
• Professional Registration and How to Tackle It

Outdoor events included cross country skiing and kayaking.

Annual Conference

The annual conference in July 2013 attracted over 90 registrations from Research Engineers, industrial and academic supervisors, company representatives and other interested academics.

The poster session contained presentations by 8 first - year Research Engineers, whose posters were assessed by the academic and industrial supervisors attending the conference. The prize for the best poster was awarded to Howard Moshtael-Osuki, for his poster, “Electronics, head mounted, low vision aides.”

The keynote speaker for the conference was Tim Holt, Executive Director, Fraunhofer UK Research Ltd.

The oral presentations comprising the core of the conference were given by 24 second and third-year Research Engineers, and covered topics from micro - optics, quantum control, laser machining, optical sensing and metrology, and terahertz generation. Mickey Crozier received the prize for the best oral presentation for his talk entitled, “One step thin - film PV interconnection process using laser and inkjet.”

REGIONAL GROUPS

A new regional group has been created for Central England with Tom Jones taking on the role of Regional Coordinator. This is in addition to the existing Scotland West, Scotland East, SE England and SW England Groups.

ALUMNI

The following have graduated with Engineering Doctorates from the Industrial Doctorate Centre and it’s predecessor the EngD Centre.

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>Date</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Marcus Perry</td>
<td>University of Strathclyde</td>
<td>2013</td>
<td>Engineering Consultant,Frazer-Nash Consultancy</td>
</tr>
<tr>
<td>Dr. James Downing</td>
<td>University of Glasgow</td>
<td>2013</td>
<td>Optical Engineer, ST Microelectronics</td>
</tr>
<tr>
<td>Dr. Margaret Anyaegbu</td>
<td>Heriot-Watt University</td>
<td>2013</td>
<td>TES Electronic Solutions</td>
</tr>
<tr>
<td>Dr. Cat Fitzpatrick</td>
<td>Heriot-Watt University</td>
<td>2013</td>
<td>Senior Engineer, Cambridge Consultants</td>
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<tr>
<td>Dr. Jochen Deile</td>
<td>Heriot-Watt University</td>
<td>2013</td>
<td>Trumpf US</td>
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<tr>
<td>Dr. Yves Lacrotte</td>
<td>Heriot-Watt University</td>
<td>2013</td>
<td>Renishaw</td>
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<tr>
<td>Dr. James Beedell</td>
<td>Heriot-Watt University</td>
<td>2013</td>
<td>Laser Engineer, Selex ES</td>
</tr>
<tr>
<td>Dr. Veronika Tsatourian</td>
<td>Heriot-Watt University</td>
<td>2013</td>
<td>Postdoctoral Researcher, Aston University, Birmingham</td>
</tr>
<tr>
<td>Dr. Gordon McKenzie</td>
<td>Heriot-Watt University</td>
<td>2012</td>
<td>Research Associate, Heriot-Watt</td>
</tr>
<tr>
<td>Dr. Patrick Harding</td>
<td>Heriot-Watt University</td>
<td>2012</td>
<td>Luxembourg Research</td>
</tr>
<tr>
<td>Dr. Suzanne Costello</td>
<td>Heriot-Watt University</td>
<td>2011</td>
<td>Development Scientist at MCS</td>
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<tr>
<td>Prof. Daniel Esser</td>
<td>Heriot-Watt University</td>
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<td>Professor, Heriot-Watt University</td>
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<td>2009</td>
<td>Systems Engineer at Selex ES</td>
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<tr>
<td>Dr. Tiina Delmonte</td>
<td>Heriot-Watt University</td>
<td>2008</td>
<td>Strategy and Planning, R&amp;D, Doosan Babcock</td>
</tr>
<tr>
<td>Dr. Trefor Sloanes</td>
<td>St Andrews University</td>
<td>2008</td>
<td>Scientist – DSTL Sensors and Countermeasures Dept</td>
</tr>
<tr>
<td>Dr. David Faichnie</td>
<td>Heriot-Watt University</td>
<td>2007</td>
<td>Senior Research Engineer at FMC Technologies</td>
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<td>Applications Engineer, Fibercore Limited</td>
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<tr>
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<td>Heriot-Watt University</td>
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<td>Project/Process Engineer at Rayner Intraocular Lenses</td>
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<tr>
<td>Dr. Ian Armstrong</td>
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</table>
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 Reid1
Prof. Andy Harvey3
Prof. Brian Gerardot1
Dr. Robert Thomson1
Dr. Jenny Roe1
Dr. Gordon Flockhart2
Prof. John Marsh1
Prof. Walter Johnstone2
Dr. Nigel Langford3
Dr. Bill MacPherson1
Dr. Changhai Wang1
Dr. Andrew Wallace1
Dr. Paul Dalgarro1
Prof. Stephen Marshall2
Dr. Tom Brown1
Dr. Erling Riis2
Prof. Marc Desmulliez1
Dr. Neil Robertson1
Prof. Jason Hong1
Dr. Alex Belyaev3
Dr. Nigel Johnson3
Prof. Duncan Hand1
Prof. Howard Baker1
Dr. Pawel Niewczasz2
Prof. Alan Greenaway1
Dr. Craig Michie1
Prof. Andrew Moore1
Dr. Paul Siebert1
Dr. Jony Kar1
Dr. Alan Kemp2
Prof. Yvan Pettitot1
Dr. Jon Shephard1
Prof. Gerald Butler1
Prof. Cheng-Xiang Wang1
Dr. Theo Lim1
Prof. Denis Hall1
Prof. Gavin Gibson1
Prof. Robert Hadfield3
Prof. Malcolm Dunn1
Prof. Daniel Esser1

1 Heriot-Watt University
2 University of Strathclyde
3 University of Glasgow
4 University of St Andrews

Industrial supervisors

Prof. Robert Lamb (Selex ES)
Dr. Helen Margolis (NPL)
Dr. James Harris (Nanoco Technologies)
Dr. Dennis Price (Merlin Circuit Technologies)
Dr. Noah Schwartz (UKATC)
Dr. Jonathan Evans (Seeflyte)
Dr. Sandy Duncan (MESL)
Dr. Adam Brunton (M-Solv)
Dr. Ian Poole (TMV/SE)
Dr. Phil Hiskett (Selex ES)
Dr. Hermine Schnettler (UKATC)
Dr. Mira Naftaly (NPL)
Mr. Matthew Mansfield (Taylor Hobson)
Dr. Henry White (BAE)
Dr. Matthew Kitchin (Thales)
Dr. Paul Miller (Cascade)
Dr. Ken Lipton (Rofin-Sinar)
Dr. Ed Sparks (Roke Manor)
Dr. Francisco Villareal (Trumpf)
Dr. Andrew Murray (ST Microelectronics)
Dr. Tony O’Hara (Memsstar)
Dr. Henry White (BAE)
Dr. Eraz Huq (RAL)
Dr. Steven Lee (Thales)
Dr. Terry Dyer (Texas Instruments)
Dr. David Stothard (Fraunhofer UK Research)
Dr. Chris Howle (DSTL)
Dr. Norman McPherson (BAE)
Dr. Keith Goatman (TMV/SE)

Dr. Jon Ward (Gooch and Housego)
Prof. Nick Weston (Renishaw)
Dr. Nick Psailia (Optoscribe)
Dr. Mark Silver (Thales)
Dr. Barry Connor (Thales)
Prof. Bal Dhillon (NHS Lothian)
Dr. Nick Hay (PowerLase Photonics)
Dr. David Mine (M-Solv)
Dr. Roger Pilkington (Selex ES)
Dr. Bobby Davey (TMV/SE)
Dr. Stuart Parks (NHS Greater Glasgow & Clyde)
Dr. Jano van Hemert (Optos)
Dr. Scott Reed (Seeflyte)
Dr. Alistair Sinclair (NPL)
Prof. Des Smith (Edinburgh Instruments)
Dr. Josef Wendland (Powerphotonic)
Dr. Jason Lee (Rofin-Sinar)
Dr. Michael Johnston (British Energy)
Dr. Stephen Harding (Selex ES)
Dr. William Berrie (TES)
Dr. Gavin Hall (Selex ES)
Dr. Richard Dunn (Microvisk)
Dr. Nigel Aldridge (BAE)
Dr. Richard Leach (NPL)
Dr. Ian Read (BAE)
Dr. Neil Raphael (Selex ES)
Dr. Stephen Webb (RAL)
Dr. Henry Bockey (Fraunhofer UK Research)
In 2013 our Research Engineers published 10 journal publications, 6 conference proceedings, gave 12 conference presentations and were involved in 2 patent applications.

**Journal Publications**
Names of Research Engineers are underlined.


**Conference Proceedings**


**J. Molloy**, M. Naftaly, “THz characterization of textiles”, UCMMT.2013, Rome, Italy. (2013) DOI:10.1109/UCMMT.2013.6641542


Conference Presentations


Adam Brunton, Philip Adamson, Mickey Crozier, Dimitrios Fantanas, Simon Henley, Meng Jiang, Marta Kozak, Matt Large, Taku Sato, “Status and future prospects for hybrid laser/inkjet tools for large area electronics” – LAMF2013 The 6th International Congress on Laser Advanced Materials Processing


E. Murphy, “Power Saving Technique Suitable for DWDM-PON on aircraft”, presented at IDC Photonics Conference, Heriot Watt, Edinburgh, 18th July. 2013


Patent Applications

