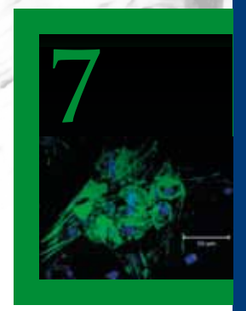
UNIVERSITY OF SURREY

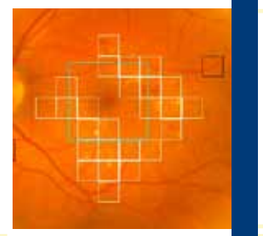
Knowledge Transfer Account

Review 2010/11

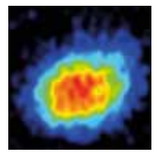
Innovation Powered.

CONTENTS





14



42

INTRODUCTION

At the University of Surrey, we think that knowledge should be improved, shared and - most importantly - used for everyone's benefit. In pursuing this aim for the last 120 years, we have carved a unique niche in British higher education.

Collaboration is at the heart of making that philosophy work, so when the Engineering and Physical Sciences Research Council (EPSRC) created the Knowledge Transfer Account programme, we were a natural choice as a partner institution.

The Surrey Knowledge Transfer Account (KTA) is a £10m programme designed to exploit the research funded by EPSRC. The KTA, which received £3.85m of funding from the EPSRC, is:

- Increasing engagement of key stakeholders with Surrey's EPSRC-funded research
- Accelerating the exploitation of Surrey's EPSRC-funded research
- Demonstrating the impact and value of Surrey's EPSRC-funded research

The Surrey KTA runs in partnership with the National Physical Laboratory (NPL), a world-leading centre of excellence in accurate measurement standards, science and technology.

The KTA draws on NPL's expertise to embed knowledge exchange in our research culture while supporting and developing the entrepreneurial endeavours of our academic community. It runs across three broad research areas or 'Innovation Platforms':

- Communication and Signal Processing
- Nanotechnology and Photonics
- Next Generation Materials and Characterisation

By bringing together industrial partners, experts in knowledge exchange and our world-leading academics, the Surrey KTA connects our research with potential users, identifies appropriate partners, and enhances research creativity.

It removes barriers to knowledge exploitation and delivers real, tangible benefits to society and the UK economy.

And it has had an extremely successful year.

"By bringing together industrial partners, experts in knowledge exchange and our world-leading academics, the Surrey KTA connects our research with potential users, identifies appropriate partners, and enhances research creativity

Professor Stephen Williamson
Deputy Vice-Chancellor, Research and Innovation

The Surrey KTA has gone from strength to strength this year, and we have been delighted to see a large increase in the number of projects funded.

Nearly 70 have now been initiated, with over £1.6m of KTA money invested in research development and collaboration. We've also achieved just under £3m in matched funding from partner organisations. In addition to this, 10 of our projects have patents filed and we've supported 5 academic and student start ups and spin outs. Some of the projects have already finished, but we are still working closely with over 100 industrial partners on continuing ventures.

But that's not to say that work stops when a project's KTA-funded period ends. Several have gone on to achieve additional funds from other sources, allowing our academics and their partners to continue developing the research. We're already achieving a gearing ratio of 2.4:1 across our portfolio of projects, and this is only expected to increase over the coming months as the follow-on funding kicks in.

You will read about many of these successes throughout this Annual Review. We've selected a variety of case studies to demonstrate the broad range of activities the University is able to collaborate on.

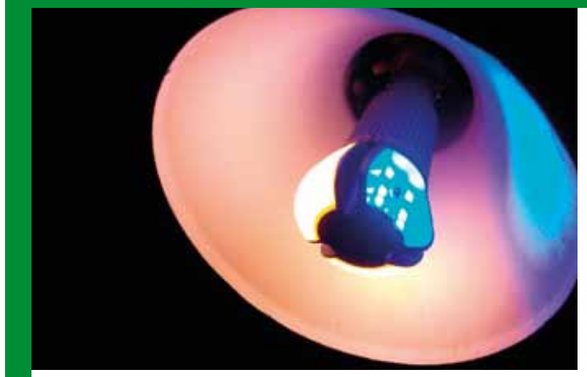
Our academic community is to be congratulated on their successes in knowledge exchange to date, and their efforts are something we are very keen to support further. This will continue even beyond the life of the KTA programme, which closes at the end of September 2012.

Then, as now, we will continue to offer a wealth of opportunities to work with Surrey's world-leading academics and research centres, so get in touch and see how we can put our expertise to work for you.

KTA CASE STUDY 01

Project title: Thermal measurements on photonic and electronic devices
Academic: Professor Stephen Sweeney

Traditional electric light sources account for a fifth of the energy currently used worldwide, and also contain dangerous pollutants such as mercury. This has driven the development of light-emitting diodes (LEDs) as a replacement, but future uptake of LED-based solid-state lighting is limited by issues connected to heating and cost.



> The market for electronic and photonic devices is substantial with lighting alone being worth over $10bn per annum

The problem is that there is no definitive method for quantifying the extent of heating in such devices, which is a major drawback. The operating temperature of an LED influences its spectral output and defines how well the colours of objects are rendered when illuminated by the LED light source. If there were some way of knowing the temperature of the LED, feedback circuitry could be used to correct and precisely control the colour balance.

The market for electronic and photonic devices is substantial (with lighting alone being worth over $10bn per annum) but LED-based lamps on the market today are expensive, largely due to the complex packaging required to dissipate the heat generated. There is clearly a commercial interest in being able to quantify the role of heating in such devices and to develop standards in quantifying its effect on electronic and photonic devices. That's where the KTA stepped in.

The Advanced Technology Institute at the University of Surrey has gained international recognition for its development and exploitation of semiconductor-based electronic and photonic devices. Using KTA funding and working in partnership with NPL (the National Physical Laboratory), we have applied new electro-optic techniques to probe high-brightness LEDs and devise a simple, ingenious and novel self-monitoring 'pump and probe' method for measuring photo-generated current as a function of temperature.

Currently, no other practical, industrially scalable system or metric exists for the new generation of solid-state lighting. The potential is enormous, and it is only with funding from programmes such as the KTA that we will be able to fulfil it. The commercial benefits and potential IP revenues are high, and further innovative work is underway to build on these results.

KTA CASE STUDY 02

Project title: Better tests, better results
Academic: Dr Richard Sear, Dr Nick Plant and Dr Alan Dalton

Advanced drug development is a high-skill, high-wage industry, but it's also an expensive and highly competitive business. Many promising drugs prove toxic when they are broken down in the liver, so it is important to investigate this as early in the drug-development process as possible with a cheap and reliable test that does not involved animal testing. Drugs that fail these early tests can be abandoned or modified before non-recoupable development costs have been ploughed into them.

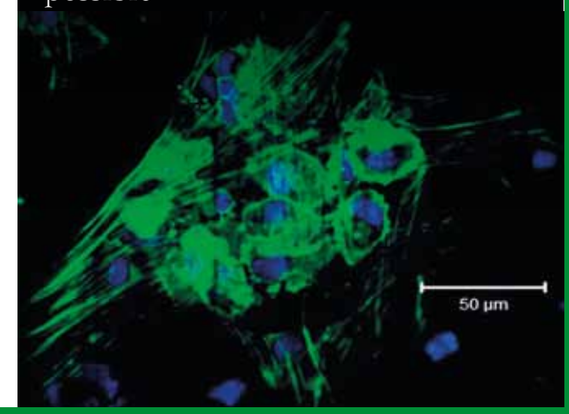
Currently this testing is done by growing liver cells in a sandwich, where the cells are the filling and a gelatine is used as the bread. This sandwich is mounted on a simple plastic surface. Unfortunately, liver cells often react to this alien plastic environment by doing less liver metabolism. If a liver cell is not making liver enzymes then the chemical reactions we want to test are not occurring, which makes them useless for liver-toxicity drug tests.

The idea of this KTA project was to test surfaces made from carbon nanotubes as improvements on the current plastic surfaces. The carbon-nanotube surfaces have aligned grooves a few tens of nanometres across (a nanometre is 1 billionth of a metre). These surfaces mimic some aspects of real organs. In our livers, the cells sit on a matrix made of strands that are also nanometres across. The cells are aligned such that they take in molecules from the blood at the top, metabolise them, then output the waste products at the bottom. If our surfaces can induce liver cells to behave more like liver cells do in our bodies, then the surfaces could enable better, more reliable testing of drugs for liver toxicity.

PhD student Azura Che Abdullah performed tests of liver-cell health and liver enzyme function in cells growing on carbon-nanotube surfaces of a type that had been used with different types of cells in earlier work funded by the EPSRC. She found that liver cells were very healthy on our surfaces and, crucially, that the activity of one liver enzyme in particular was higher on our surfaces than on the industry-standard plastic surfaces.

We have already passed these early results on to our partners at the Health Protection Authority. Though preliminary, they do show how the industry-standard test can be improved, hopefully leading to better drug development and a more competitive UK pharmaceutical industry.

> Many promising drugs prove toxic when they are broken down in the liver, so it is important to investigate this as early as possible"



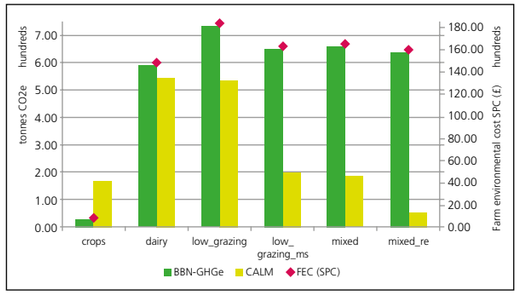
Project title: Bayesian Networks to Support Greenhouse Gas Emission Reduction in the Agricultural Sector (BaNGAS)

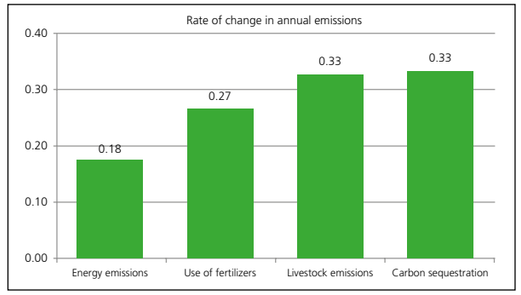
Academic: Professor Paul Krause and Dr Elena Pérez-Miñana

With increased public pressure for action on global warming, reductions in greenhouse gases will be required from all sectors of the economy. This is a particular problem for agriculture because there are often high levels of uncertainty associated with the measurement of many of the variables involved in farming, and with assessing their impact on the biosphere.

The government is proposing to invest significantly in regional and national studies of the agricultural sector's impact, but it is also important to model this at the farm level in order to enable farmers to both assess the environmental impact of their business and identify appropriate interventions to reduce that impact without threatening the economic viability of their farm. This will become particularly important if the government confirms their commitment to make it compulsory for businesses in the UK to record and publish their greenhouse-gas emissions or carbon footprint.

To address this issue, during the last three years Dr Elena Pérez-Miñana and Prof. Paul Krause have been developing a Bayesian Network model called BaNGAS (Bayesian Networks to Support Greenhouse-Gas Emission Reduction in the Agricultural Sector) for the assessment of greenhouse-gas emissions on farmland. Bayesian probability has been widely used in medicine and other domains where there is a significant level of uncertainty involved in modelling important problems. Our choice of technology has been dictated by the need to explicitly handle the uncertainties involved and provide a graphical representation of the causal influences in order to explain simply the relevance of any proposed intervention.





We integrate information from our environmental-impact model into a farm's economic profile in order to monetise the impacts of the greenhouse gases emitted. Our statistical model of the causal interdependencies between the relevant economic and environmental factors then shows how they affect one another. In this way, the stakeholders are able to hypothesise different production scenarios and then use the model to predict the environmental and economic impact each one has. We can thus use the model to identify pre-emptive actions that have a minimal (or even a positive) impact on the economic viability of an agricultural unit.

Funding from the KTA has enabled us to engage widely with the farming community in southeast England to evaluate the model, with an extremely positive response. Indeed, all the farmers who have liaised with us are interested in continuing the collaboration and engagement with the farming community continues to expand. We have been working with the rural estate management consultancy Smiths Gore to help them evaluate the model for routine use with their clients. DEFRA have also been helping us evaluate the model by providing us with an extensive data set from the Farm Business Survey.

We are now building a website to help us engage even more widely with the agricultural community, and we will make the model available as a service through this website. We believe that our model is now at a sufficient level of maturity that we can initiate its development into a self-sustainable service.

KTA CASE STUDY

Project title: Managing space and time

Academic: Professor Paul Krause in partnership with Georgios Michalakidis and Aaron Mason

For most organisations, activities no longer take place solely in one centralised physical space. Staff, property, premises and transactions are now routinely spread across countries, continents, even the world, with much of their interaction taking place online. Coordinating, managing and monitoring this dispersed network of real and virtual assets has always been a headache, but Thoughtified Ltd may have the answer.

Its directors, Georgios Michalakidis and Aaron Mason, are graduates of the Department of Computing at the University of Surrey. They designed a product called ManagePlaces as a cloudbased solution for remote management of land, expanding on a previous idea for a business management and intelligence product by adding participatory sensing elements and location awareness.

"ManagePlaces allows you to simplify management of any task that needs to be performed in spaces that you maintain or manage, anywhere in the world," says Georgios. "It takes the pain out of reporting, with intelligent dashboards, visualised KPIs (Key Performance Indicators) and document libraries. You simply geo-tag your assets using GPS-enabled devices, and your teams are notified on their laptops, smartphones and tablets of pending activities and deadlines. It even generates reports automatically for your organisation and any external auditors."

Funding from the KTA enabled Thoughtified to make a societal impact by enhancing the social, economic and environmental value of the system. "We managed to get large organisations and governmental bodies on board," says Aaron, "and refine the system based on their guidance and feedback by developing a tailored solution for the conservation sector.

"Currently, we are in the process of commercialising ManagePlaces and selling the product as an easy-to-use web and mobile tool that compares well to competitors' software in ease of set-up, infrastructure requirements, accessibility, features, scalability and cost/ROI. This would not have been achieved without help from the University of Surrey and the EPSRC."

The University of Surrey and the EPSRC funded a pilot study after the initial development and deployment of a working prototype of the system. With ever-growing interest in location-aware/GPS-enabled applications, as well as a rise in the popularity of SaaS (Software-as-a-Service), the EPSRC fund boosted the product's R&D and placed Thoughtified ahead of the competition.

ManagePlaces' next step is to make an impact by reducing habitat-management costs for target organisations (including Natural England and selected wildlife trusts) and providing collaborative features for their remotely deployed teams.

With help from the KTA, EPSRC and the University of Surrey, Thoughtified are turning ManagePlaces into a highly scalable project, with applications not just for a handful of SMEs but also for any other organisation that has physical locations to maintain, handle, control and develop.

thoughtified

04

"Funding from the KTA enabled Thoughtified to make a societal impact by enhancing the social, economic and environmental value of the system"

THE VIEW FROM INDUSTRY

Every KTA project is a collaboration, so we asked three of our project partners to share their experiences of working with us.

Communications and Signal Processing

SMITHSGORE

Jason Beedell
Head of Research, Smiths Gore

What is Smiths Gore's business?
We are one of the UK's largest rural property managers, so we're interested in how policy and other changes - including climate change - will affect our clients in the UK.

How did you get involved with the University of Surrey's KTA?
We saw a reference to a Surrey project called BaNGAS (Bayesian Networks to Support Greenhouse Gas Emission Reduction in the Agricultural Sector) in a climate change newsletter. We thought it might be something we could use, so we contacted Dr Elena Pérez-Miñana and Professor Paul Krause at the Department of Computing to talk about the model they are developing. The relationship started there.

Is this your first experience of working with a university?
No, we have worked with several other universities in the past. However, this is the first time that we have been involved with a university in developing a new product.

What was different about Surrey's approach?
Surrey bring a range of skills and experience that companies may not have in-house, and also provide a refreshingly different way of thinking. Having Elena and Paul on the project has allowed us to work towards something unique.

Paul's knowledge of web applications and programming also gives us the opportunity to develop a user-friendly interface that is available to all farmers, so the project could have a very wide reach. We would not have been able to develop such an interface in-house.

What have been the benefits of your collaboration with Surrey?
We had wanted to develop a tool allowing land managers and farmers to estimate and reduce their greenhouse gas emissions, but we would not have been able to fund its development alone. Therefore the greatest benefit has been carrying out the project - at all.

We view the project as a joint effort, but it is being led by Elena and Paul. Their modelling experience has worked really well with our practical understanding of agriculture and the kind of tools that would appeal to farmers.

Would you recommend working with the University of Surrey's KTA?
Yes, 100%. It has been challenging and enjoyable.

Nanotechnology and Photonics

M-SOLV

Phil Rumsby
CEO, M-Solv Ltd

We make laser and printing equipment used in the manufacture of capacitive touch panels. These products are made using sheets of glass with coatings of indium tin oxide (ITO) on both sides. Because of its scarcity and processing cost, we wished to replace the ITO with an alternative material.

We came to Surrey to utilise the skills of Dr Alan Dalton from the Department of Physics, who has expertise in the use of carbon nanotubes (CNTs) and other nanoparticles for making thin transparent conducting films of the type we need.

We have worked with various universities on a range of R&D projects, but we found Surrey to be very responsive, very commercially minded and very flexible. They have given us access to know-how and measurement equipment that we do not have, and we have been able to use their expertise in other areas of our business, notably CNT-based composite materials. We are now funding a project at Surrey in this area. We are also employing Alan Dalton as a consultant and sponsoring two Surrey EngD students to work on research projects associated with the KTA.

Being able to collaborate via the KTA with a commercially aware and industry-biased academic institution like Surrey benefits small UK companies such as M-Solv by allowing us to expand our R&D activities and giving us access to the advanced equipment, knowledge and IP that we lack.

We definitely plan to continue the relationship that has formed and would recommend working with Surrey. We have extended our KTA for a further 6 months and we are funding another project with them

Next Generation Materials and Characterisation

YOUR M&S

Lee Harper
Product Development Technologist, Marks & Spencer

How did you get involved with the University of Surrey KTA?
Our project grew out of a very successful Innovation Forum Meeting, held at the University in November 2010, which brought together staff from across Marks & Spencer's business units to discuss new technology with Surrey researchers. We first learned about Surrey's new technology at this meeting. We were keen to set up a collaboration to help us to start exploiting it.

What have been the greatest benefits of your collaboration with Surrey?
We have gained access to expertise in materials processing that we didn't otherwise have, and we have learnt about a new coatings technique pioneered at Surrey.

Our discussions with Surrey researchers have injected new ideas that are highly promising for the development of new products.

What was the most useful aspect of Surrey's approach?
The Surrey research team, led by Professor Joe Keddie in the University's Soft Matter Physics Group, has been very responsive to our interests and worked hard to help us meet our business objectives.

Professor Keddie has introduced me to other industrial partners, including a materials manufacturer and a materials processor, which has allowed us to build up a strong network to make new products and technology a reality.

Would you recommend working with the University of Surrey?
I recommend collaborating with the University of Surrey as a great way to gain access to new developments in technology that can be used by the public.

The KTA Demonstrator project has been a great boost to our product-development work, and we are grateful to have benefited from the investment of EPSRC in Surrey's Knowledge Transfer Account.

KTA CASE STUDY

Project title: Eyes on the prize
Academic: Dr Lilian Tang

A common complication of diabetes is diabetic retinopathy (DR), an eye disease that is one of the major causes of blindness for adults under the age of 65. Diabetic retinopathy is a progressive condition, so diagnosing it at early stages provides time to treat the disease and to allow for maintenance of good vision. In the UK, this is done through a national screening programme which has been in place for about 10 years now.

In any DR screening programme about two thirds of images are normal. However, on average, it takes a human expert about 50 per cent longer to decide an image is normal than to recognise an obviously abnormal image; separating normal from abnormal images thus saves an estimated 80% of the overall image reading time. This is a conservative estimate as it does not take into account that all abnormal images and 10% of normal images are double graded, then any discrepancy is adjudicated by a third person independent of the first two graders.

In the UK alone, there are an estimated 2.8 million people suffering diabetes. Typically, each patient requires a minimum of four retinal images for screening resulting in close to 11 million images each year needed to be graded by human graders. There is therefore a need for an automated system that can separate images of normal retinas from those showing early signs of DR.

Once an automated system can detect DR accurately and efficiently, it can be employed as a routine and cost effective tool for early detection of retinopathy at a substantially reduced cost with potentially human graders carrying out quality control and final grading on those that the system was unable to grade or on those who have other diseases that the system was not trained to identify.

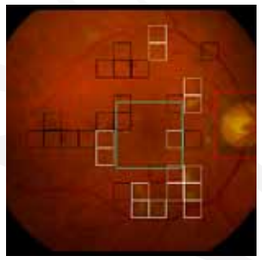
Reading images is a highly skilled process, and in places where readers are in short supply automation removes one of the barriers to setting up a screening programme, allowing resources to be allocated to other parts of the treatment and monitoring pathway. The successful implementation of such an automated system has the potential to have revolutionary impact on eyecare, given the ever-increasing number of diabetic patients.

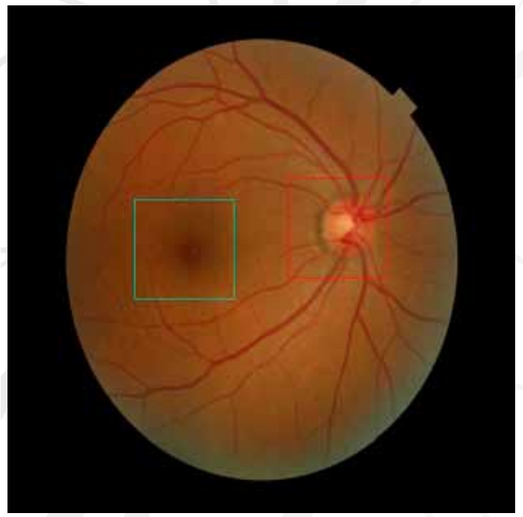
KTA funding is allowing us to develop the automated system further in the Automated DiAbetic retinoPatHy screening of Normal imagEs (A-DAPHNE) project. We are working closely with ophthalmologists on real patients' screening images, and comparing our results with clinical gradings.

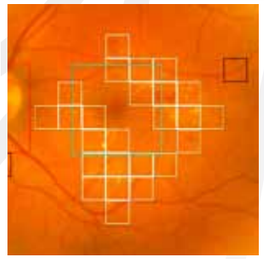
> “There is a wealth of relevant experience and a strong collaborative team at Surrey – this has allowed me to bring several concepts to the University that we were then able to drive forward and see through to fruition.”
>
> Mr George Saleh, Consultant Ophthalmic & Oculoplastic Surgeon, Moorfields Eye Hospital

Working in collaboration with Moorfields Eye Hospital, we have tested the system on 1,747 previously unseen images taken from 420 patients. Among all the images that our system categorised as normal, 99% were confirmed as normal according to the double manual grading results. The system was further tested on another randomly chosen 3,300 images from different populations, with similar results. This demonstrates that our automated system is able to filter out the majority of normal images with an accuracy that the Reading Centre at Moorfields Eye Hospital has considered as excellent.

Our automated system has generated significant interest, with eye-study groups in Europe keen to collaborate. One group has sent their clinically graded images for our system to examine, and we are working with Bedfordshire Retinal Screening Service and Moorfields Eye Hospital to run testing on a much larger scale of data while continuing to improve the system.



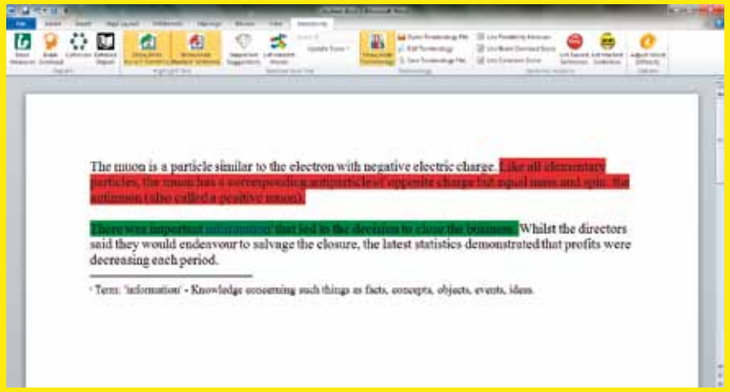


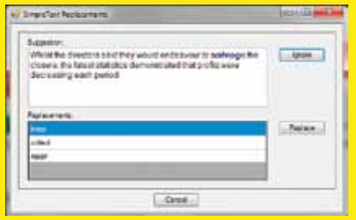


KTA CASE STUDY

Project title: Easy Reader
Academic: Dr Lee Gillam

The ever-increasing amount of written information on the internet puts emphasis on speed of communication, often to the detriment of text clarity. In contrast to developments in natural language processing, current software applications offer little to assist authors.





Most word processors offer spellcheckers and grammar checkers, but limited support for improving the written content itself. Some, such as Microsoft Word, offer readability analysis using certain common but simple readability measures. While these measures offer a quick indication for an entire document, this does not assist in improving the readability of individual sentences, and in any case there has been much debate regarding the reliability and usefulness of such measures. Editing a text to improve a readability score may not improve the actual clarity of the text. By themselves, these measures cannot provide the kind of informed feedback that authors need.

In previous research, we had established a new set of readability measures that could provide authors with specific feedback to help them improve their writing. Our newly devised readability measures address some of the issues with text clarity that have been identified by psychologists as problematic, but which have not yet generally been addressed by text-readability research. We demonstrated the results of our research in a plugin for the Open Office word-processor program, which was made available on the Open Office website and has since been downloaded over 11,000 times.

but equ nd spin: the antimuon (also

The information[i] that led to the decision to close the business.

W id they would try to salvage the company, the latest statistics

de fits were decreasing each period.

[i] Ter - Knowledge concerning such things as facts, concepts, objects,

events, ide

> “Our newly devised readability measures address some of the issues with text clarity that have been identified by psychologists as problematic, but which have not yet generally been addressed by text-readability research”

Through the KTA, we began to address our next aim. We wanted to expand the potential userbase quite considerably by implementing a Microsoft Office version of the Open Office plugin. The resulting Word version - which appears as a Ribbon - includes additional features for technical and scientific writers, such as the ability to create your own terminology collection. This software is available via the Microsoft Pinpoint website, and has received top marks and favourable reviews from initial users.

The KTA also helped to confirm the relationship between readability and reading speed by using the Dundee eye-tracking corpus (which contains reading times over a series of passages). Our familiarity-based readability measures are demonstrably highly correlated with reading speeds, which is a further improvement over existing readability formulas.

Development of this plugin has helped us to devise further readability experiments in which we ask people to read a series of short passages and answer a few simple questions about them (such as how well they understood the passage and how interested in the passage they were). Results show that a text-based measure by itself is not sufficient, and our incorporation of other text and reader attributes offers a more suitable way to describe text difficulty.

KTA CASE STUDY 07

Environment YES

Surrey is one of the most entrepreneur-friendly universities in the UK, and we take every opportunity to pass this passion on to our students.

Environment YES (Young Entrepreneurs Scheme) is an innovative competition for researchers working in natural environmental sciences. Its aim is to increase the level of entrepreneurial awareness in the science community, and is aimed at individuals such as PhD students or young post-doctoral researchers who are in the early stages of their research career.

Environment YES runs as a series of three-day residential workshops. In the morning of the first two days, participants attend presentations from leading figures in industry on all aspects of technology transfer and the commercialisation of science ideas.

This knowledge is then used by participants to prepare an oral business-plan presentation for an imaginary environmental or environmental technology start-up company. The team prepares the plan in the afternoon of the first two days, with each member assuming a different role within the 'company'.

On the final day the participants make a formal presentation to a panel of real business, financial and academic experts taking the role of venture-capitalist 'dragons'.

Participants gain an insight into the process of innovation-related business, and get the chance to network with members of industry and business experts.

The KTA saw Environment YES as an opportunity to introduce Surrey researchers to the business world and develop entrepreneurial behaviour early in the careers of science investigators.

There was significant interest from Surrey, and ten individuals formed two teams to attend the three-day intensive workshop. The KTA's Materials Platform Knowledge Exchange Director has acted as a mentor for both Environment and Biotechnology YES over the last three years and has been coaching the Surrey teams.

"The Environment YES workshop was an intense adrenaline and caffeine-fuelled three-day learning experience," remembers Mike Merchant. "Whilst I learnt much about IP protection, entrepreneurship and corporate structure, the Environment YES workshop also brought out my competitive side and served as a powerful teambuilding experience."

"The Biotechnology YES workshop was fascinating," said participant Weronika Swiech. "I have gained lots of knowledge about creating a business - financial planning and cash flow, IP and patents, researching markets and competitors, and also how specific and accurate the plan has to be to have any chance of success. Before the workshop I had no idea about the financial side of the business and I was quite afraid of that part but the way the workshop is designed made it so accessible and easy to absorb."

KTA CASE STUDY 08

Project title: SP-ARK: The Sally Potter Archive
Academic: Dr Janko Calic

The UK's creative industries are a genuine success story, employing two million people and contributing £60bn to the economy each year (or 7.3 percent of UK GDP).

The global presence of digital content, the proliferation of digital media devices and the increasing influence of user-generated content have opened many opportunities in the digital and creative arenas. In order to exploit these opportunities, the UK media sector has become a hub for innovation and investment, bringing large content providers together with digital media SMEs, ICT technology and academia.

To build on this, the KTA became involved in the SP-ARK project, which set out to develop a web-based tool giving access to a unique resource that makes available the full range of assets related to the film production process (from initial sketches to launch and film-festival presentations).

This collaboration with Adventure Pictures Ltd - the film production house of renowned British director Sally Potter - combines the state-of-the-art content-management technology developed at the I-Lab in the Centre for Vision, Speech and Signal Processing, University of Surrey with a unique film archive.

The collaboration delivered a globally accessible digital asset management platform and the required core media-processing engines, and enabled intuitive access to this vast archive for a wide range of users. In order to develop a platform that would facilitate commercial exploitation and extend the research testbed, the SP-ARK KTA project focused on delivering effective interaction through a web interface to the SP-ARK archive. This activity enabled further research and development by both partners, as well as attracting potential users and maximising the licensing potential of the platform.

Not only were these objectives fully achieved, but also the project attracted more funding towards new developments of SP-ARK. Adventure Pictures won funding from the IC tomorrow Digital Innovation Contest in March 2011 to support user studies of their system on a large scale. Furthermore, Adventure Pictures have extended their investment to bring new functionalities to the web interface (including social networking and messaging) and thus widened the potential market from solely academic audiences towards film enthusiasts and the general public.

COMMUNICATIONS AND SIGNAL PROCESSING
DEMONSTRATING WHAT WE CAN DO...

Some of our ideas are so strong that we turn them into Demonstrator projects to show exactly what they can do.

These are larger ventures that may involve many organisations and form part of a multi-million pound enterprise. This approach produces a tangible system or product that demonstrates the value - and potential - of our EPSRC-funded research.

Cities that sense traffic conditions and automatically re-arrange one-way systems. Houses that switch on the heating because they know you're on the way home. Health monitoring systems that allow remote diagnosis. Waste bins that tell the collection lorry when they need emptying. Cars that automatically notify the emergency services after an accident. Video magazine programmes created and delivered to mobile devices on demand…

> "All the stuff of fantasy? No.

We are in the middle of a revolution in the application of communication technologies, demanding more-and-more from the networks (fixed, mobile and broadcast) and driving their development and convergence.

An eventual consequence of this will be the universal delivery of digital services via the next incarnation of the internet: the 'Future Internet'. An integral part of the Future Internet is the growth of digitally identified and connected devices known as the 'Internet of Things' (IoT) - a global network infrastructure linking physical and virtual objects through the exploitation of data capture and communication capabilities.

The University of Surrey's Centre for Communication Systems Research (CCSR) is building a test-bed to enable businesses and academics to develop, test and monitor applications that seemed like science fiction just a few years ago.

CCSR has been deeply engaged with research into the forms and functions of the Future Internet and the Internet of Things for many years. The focus has been on how interconnected devices and services will interact with applications, content and delivery methods, and how they could be used in various environments such as in government, health, transport, energy, environment, entertainment, education, etc.

In the UK, there is growing commercial and public interest in how businesses can benefit from the Future Internet and the Internet of Things, and what impact they will have on our everyday lives. So through the KTA we looked for a way that CCSR could engage with interested parties, linking University research with innovative UK businesses, enabling the development of new products and services, generating competitive advantage and leading to economic, social and environmental benefits.

ENABLING THE FUTURE INTERNET

CCSR, supported by the KTA and other initiatives, has started equipping the University of Surrey campus with a variety of networked sensors - together with the communications structure to control and monitor them - thus creating a 'smart-campus'.

Eventually, over 3,000 sensors and actuators will measure and spontaneously control energy usage, room occupation levels, traffic, air quality, water use, waste and any other issues that may require their attention in the future.

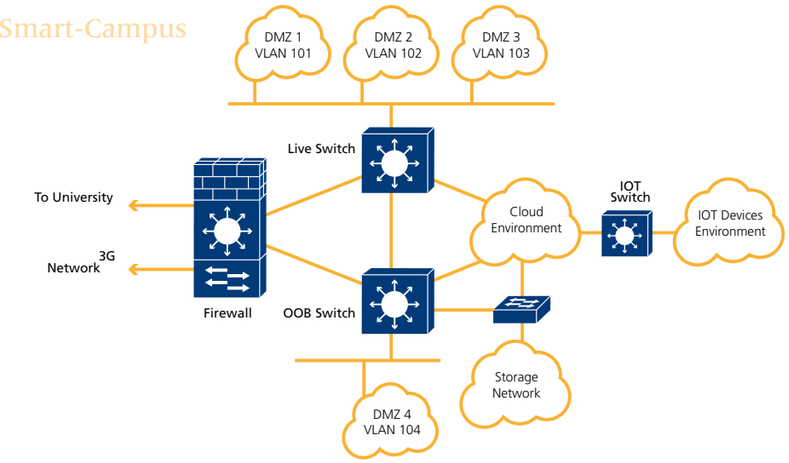
This platform is supported by high-performance cloud-computing and carrier-grade telecommunications equipment. This will give users physical and remote access via the internet, academic networks and public test-bed platforms, as well as providing standardised interfaces to connect with future technologies as they become available.

With hundreds of sensors already in place, we are well on the way to creating the Smart-Campus infrastructure upon which we can mount both research demonstrations and host industrial participation. Once we have placed all the thousands of sensors and actuators across the University they will be connected back into a cloud-computing environment and high-speed core network, enabling an 'IoT playground' on which businesses can experiment with application scenarios and develop meaningful and profitable solutions.

And we're not stopping at the campus level. We are involved in a multi-national, EU FP7 project called "SmartSantander" that will cover the city of Santander in Spain with 20,000 sensors by 2013, enabling researchers to understand what opportunities a city-wide IoT system can generate.

The facility will:

- Serve as an experimental research and development facility for the Internet of Things
- Enable students and staff at the University to benefit directly from the developments and outcomes of innovative research in this area
- Improve the student experience, the quality of University services and the working lives of staff whilst contributing to a more sustainable organisation
- Provide an eco-system for innovation and the organic growth of research and development demonstrators, providing a foundation of continuous knowledge transfer of research result to commercialisation



NANOTECHNOLOGY AND PHOTONICS
DEMONSTRATING WHAT WE CAN DO...

A revolutionary new way to harness the power of the sun to extract clean and almost unlimited energy supplies from water is underway within the Advanced Technology Institute (ATI) under the supervision of Professor Ravi Silva. This advanced demonstrator project is funded via the University of Surrey KTA to investigate the micro-generation and storage of electricity.

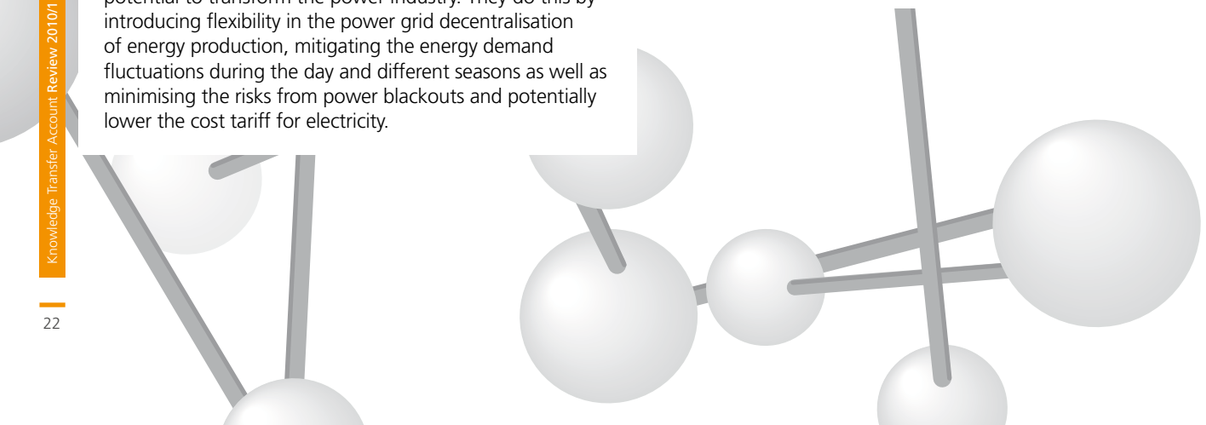
Energy Storage is one of the "Holy Grails" of the power industry to make the power grid more flexible and to integrate renewable energy onto the grid. However, clean energy sources are historically plagued with intermittency issues, creating nationwide challenges for implementing these new technologies into the UK power grid. The most common forms of renewable energy such as solar, wind, wave and biofuel are characterised by their intermittent nature. At present, each of these energy sources can provide brief spurts of energy when a constant stream is required. Existing studies upon the feasibility to meet the renewable energy production and utilisation by 2020 indicate that it cannot be met unless the energy from these renewables is harnessed, stored and used more effectively by UK households and industry. For the grid to reach its full potential, new storage technologies are required to seamlessly deliver clean power, especially during peak operating times.

The project team is working to produce an integrated device that can generate hydrogen from water using solar energy, and then store that hydrogen for local consumption when electricity is required. There is increasing evidence that the efficient adoption of solar PV requires an integrated solution that addresses energy storage rather than simply feeding electricity to the grid.

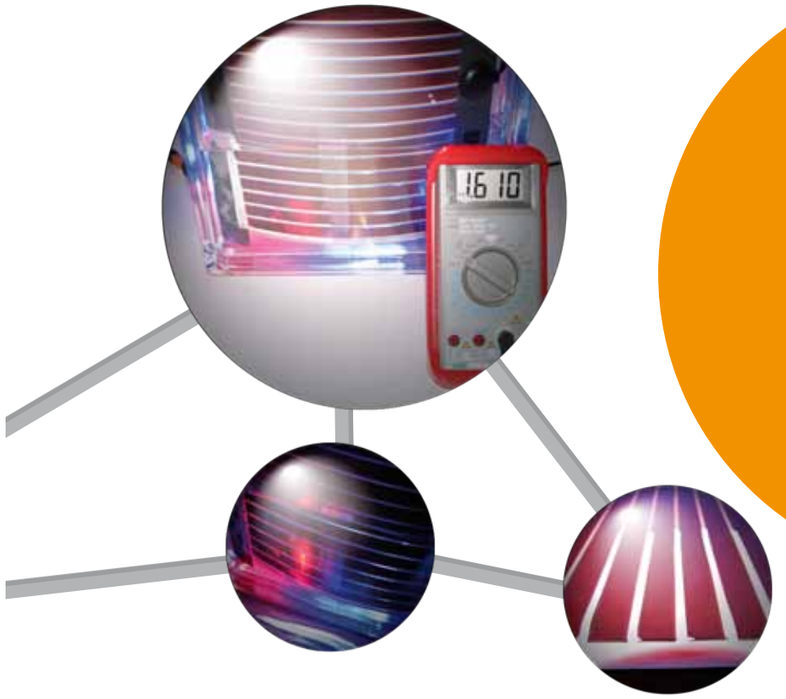
Multifunction structures which combine energy generation, storage and back feeding upon demand have the potential to transform the power industry. They do this by introducing flexibility in the power grid decentralisation of energy production, mitigating the energy demand fluctuations during the day and different seasons as well as minimising the risks from power blackouts and potentially lower the cost tariff for electricity.

The team is experimenting with combinations of a photovoltaic cell, photocatalyst, water electrolyser and fuel cell. In addition to its technical goals, this project aims to connect the UK photovoltaic industry to the University through the shared development of early R&D projects in next-generation technologies. Currently the UK Photovoltaic industry seeks to create high value energy generation solutions that fit the needs of the UK market. Although the PV supply chain in the UK is small, the support industry of component manufacturing is extensive and world class. As the market and Government regulations change, this support industry is projected to grow. The University of Surrey Nanotechnology team at the ATI seeks to become better connected with the UK photovoltaic industry with a view to becoming the preferred supplier of R&D. The ultimate target is to link academia with industry, bringing revolutionary ideas to reality through commercial products.

The project was granted targeted funding to produce a bench-top demonstrator and a route to commercialisation. A solar-hydrogen demonstrator has already been assembled using off-the-shelf technologies; this is a small scale proof-of-concept. In the next stage of the project we are integrating our technologies to make a more representative demonstration of the overall concept, paying close attention to the integration of the photocatalyst and the photovoltaic device, as this is believed to be the key to an efficient and cost effective deployment.



WORLD CITIZENSHIP, TAKING RESPONSIBILITY



"Aluminised PET is coated with a photo-catalyst. In this case, the PET film is cut to inter-digitate with the structure on part of a commercial organic photo-voltaic panel to create a model of a hybrid cell.

The ATI has extensive expertise in the low-temperature growth of carbon nanotubes (CNTs) and in integrating these in organic semiconductors to enhance charge transport. Low temperature growth enables the use of temperature-sensitive substrates and may also offer opportunities to engineer novel nanoparticle catalytic materials with improved activity. In addition, specialised alkaline membranes with tuneable water uptakes for electrochemical energy technologies have been developed by the University's Department of Chemistry. These revolutionary new membranes offer a cost effective alternative to those currently used.

This is an opportunity for the UK to exploit its strengths by developing networks in a growing and innovative world-class industry that is seeking to exploit early science and technology R&D, as well as the financing of low-carbon technologies. This Demonstrator project seeks to play an important co-ordinating role in bringing together key players of the UK PV supply chain as pioneers in energy-storage technology.

NEXT GENERATION MATERIALS AND CHARACTERISATION

DEMONSTRATING WHAT WE CAN DO...

As consumers and non-specialists, we may not pay much attention to polymer coatings. But they are everywhere, and the industry is worth an estimated $100bn per year. That's a lot of objects with a coating on them.

Unfortunately, it also means a lot of pollution.

Many existing coatings processes deposit polymers from organic solvents. As the coating dries, volatile organic compounds (VOCs) are released into the atmosphere, where they can damage the environment and the health of workers.

Professor Joe Keddie from the University of Surrey's Department of Physics is developing a process that will change that.

While carrying out research during an EPSRC-funded project, he developed an advanced understanding of the factors that determine the flow of water and polymers within the thin plane of a coating.

This basic research inspired an idea to control the lateral flow of water to move the polymer to desired positions on a coating surface. The newly-invented process, for which a patent application has been submitted, is called Infra-Red-Assisted Evaporative Lithography (IREL).

It's a simple method that will be able to create patterned, textured coatings from "hard" polymers, with a glass transition temperature above room temperature. Using flat glass substrates in his laboratory, Prof. Keddie has been able to create textured coatings with peak-to-valley heights ranging from the microscopic up to 1mm.

The IREL process offers the following advantages over existing coating methods:

- no emission of volatile organic compounds (VOCs)
- low energy use
- fast processing
- bespoke surface structures and textures on hard, crack-free, transparent coatings

Discussions are currently underway with manufacturers of domestic products, and the IREL process is being developed with input from key members of the supply chain to ensure that it can be applied to existing industrial processes. It is envisaged that IREL could add novelty to their products - and thus increase their sales volume - through the creation of a distinctive coating.

But the new process has the potential to go beyond novelty. With the new technology, UK polymer and coatings manufacturers will gain a competitive advantage and be able to launch entirely new types of product, since textured coatings have additional functionality compared to standard protective coatings.

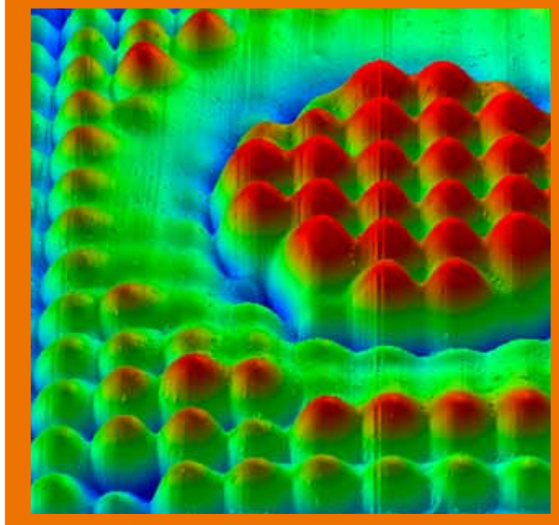
IREL coatings could potentially be used for drag reduction on boats and ships, leading to lower fuel consumption and a smaller carbon footprint. IREL can create arrays of microlenses that can be 'painted' in any desired pattern on any surface. Square microlens arrays are already commercially available for applications in welding, drilling, laser ablation and fibre coupling. Furthermore, micro-lens surface structures improve the efficiency of optical displays and photovoltaics and improve the plasmonic interaction in anti-reflection coatings and waveguides.

Textured coatings can be used to create desired visual effects on textiles, leather, and home appliances or fittings. A logo could also be introduced into the coating to give the product a distinctive look. The automotive industry has interest in coatings with specialist visual effects, such as from periodically-arranged pigment, which can potentially be created by IREL. Yet another application is as a light diffuser for the coating of windows, which add privacy while allowing light transmission.

Textured coatings might also reduce slipperiness when applied to grips on handles or on floor tiles. Texture (such as raised bumps) on the surface of gloves increases the tactile sensitivity to the user. Textured gloves might be particularly useful for surgeons who need a good grip on surgical instruments.
In robotics, there is also a need to increase the grip on the "hands" of the robot, therefore soft textured latex films could be used on the robot hands.

CLEANER, QUICKER, TEXTURED COATINGS

"UK polymer and coatings manufacturers will gain a competitive advantage and be able to launch entirely new types of product, since textured coatings have additional functionality compared to standard protective coatings



Environmental benefits

IREL will transform the coatings industry by introducing a novel, patented technology that is environmentally-benign. Coatings manufacturers will be able to meet the strict environmental regulations set out in EU directives and UK law.

IREL will enable the elimination of VOCs from coatings formulations, while offering enhanced properties resulting from the surface texture. The process is up-scalable using industrial infra-red heaters currently used in the crosslinking of polymer coatings.

Energy Reduction

IREL will transform current practice in waterborne coatings by offering an alternative with lower energy consumption.

Current production methods use convection ovens to dry waterborne coatings and to induce film formation. Such ovens are inefficient in their use of energy - research has found that removing water with an infra-red lamp / convection oven combination requires 245% less energy than ovens alone.

Furthermore, drying is faster with infra-red technology. Drying times of aqueous solutions of polyvinyl alcohol were reduced from 120 minutes for convective drying to only 15 minutes for combined convective and IR radiation.

KTA CASE STUDY

Project title: Helping businesses to improve their: Carbon Credentials
Academic: Professor Matthew Leach

One of the great problems facing business and industry is how to minimise energy usage and carbon emissions in a way that improves financial performance. All too often, these issues have been regarded as a nuisance rather than an opportunity, a cost rather than a potential saving. The University of Surrey has entered into a KTA partnership with Carbon Credentials Ltd to help companies build energy optimisation into their building and construction processes.

The partnership is receiving financial and technical support from the University's Centre for Environmental Strategy to develop an energy-optimisation software tool for the building sector. In reaction to new energy legislation, we are also jointly developing a way of assessing the environmental impacts of building projects and the use of energy in existing buildings.

"Energy efficiency activity is gaining ground amongst large public and private sector organisations," says Cian Duggan, Technical Director at Carbon Credentials. "There is a finite, yet increasingly available collection of capital expenditure funds for energy efficiency projects in the UK and worldwide. Therefore it is increasingly important to identify the most optimal energy efficiency projects that will have maximum financial and carbon-reduction impact on a building portfolio.

"We are delighted to be working with the University of Surrey to develop a tool which will help these finite financial resources be matched with the best performing energy efficiency projects."

The project will lead to development of a software tool which will enable companies with complex building portfolios to fully understand resource usage. The tool will also embed the process of continuous improvement within the cultures of organisations.

"The UK Government has recognised the importance of energy saving as part of the overall effort to tackle climate change," says Professor Matthew Leach, Director of the Centre for Environmental Strategy and project-leader for the University. "Policy and regulations are increasingly targeting business users of energy, and alongside other international drivers this means there is enormous upwards pressure on the costs of using energy.

"We are delighted to be working with Carbon Credentials in helping companies understand the opportunities to save energy and reduce emissions. The KTA project gives the academic team a valuable connection with the business community and a way to increase the impact of our research."

A main feature of this project is the employment of a skilled PhD researcher with experience in mathematical models, probability-based software, code writing, analysis of optimisation techniques and financial probabilistic techniques. The researcher also has knowledge of the energy-efficiency and built-environment sectors that can be supported by the knowledge and experience of the KTA partners.

Richard Green, Carbon Credentials Commercial Director, said: "In the current economic climate, company directors are looking for guarantees of savings (rather than ROI indicators) prior to sanctioning capital investment in energy savings projects.

"Energy managers will highly value the instruments provided by this KTA. Investment proposals will be underpinned by empirical, independently validated reference data and algorithms to reduce investment risk and enhance post-implementation reporting.

"Carbon Credentials and the University of Surrey share a remarkable opportunity to develop these important instruments to improve energy investment and the impact on the environment. The revenue streams will contribute to ongoing research and development in this vital field".

> "Energy managers will highly value the instruments provided by this KTA. Investment proposals will be underpinned by empirical, independently validated reference data and algorithms to reduce investment risk and enhance post-implementation reporting"

CarbonCredentials
Energy Savings | Energy Compliance

Project title: Low carbon, high ambitions
Academic: Dr Seyed Ali Hosseini & Dr Franjo Cecelja

Pro Enviro Ltd is a consultancy that specialises in low-carbon technologies, low-carbon skills and resource efficiency. It assesses the policies, strategies and skills that companies need to progress towards efficiency through low-carbon operation.

In partnership with the University of Surrey, Pro Enviro received financial and technical support to examine and fine tune a technique for knowledge-based experimental design, using mathematical models and experimental processes as a means to analyse data.

This project works with a number of large energy users in different sectors and focuses on optimising energy usage whilst maintaining product quality. The results are expected to lead to an extended and generalised technique which would enable companies in energy-intensive industries to fully understand resource usage and embed a process of continuous improvement across the whole organisation.

The main feature of the project is the employment of a process-engineering graduate, Atiyeh Abedpour, who has specific knowledge of information systems and a grounding in industrial processes and complex mathematical models. "The KTA gave me a great opportunity to work in a professional environment at Pro Enviro," says Atiyeh, "and to improve my knowledge of energy and water-monitoring systems and the diagnostic tools available to help energy-intensive companies reach their optimum usage whilst reducing their cost and energy loss.

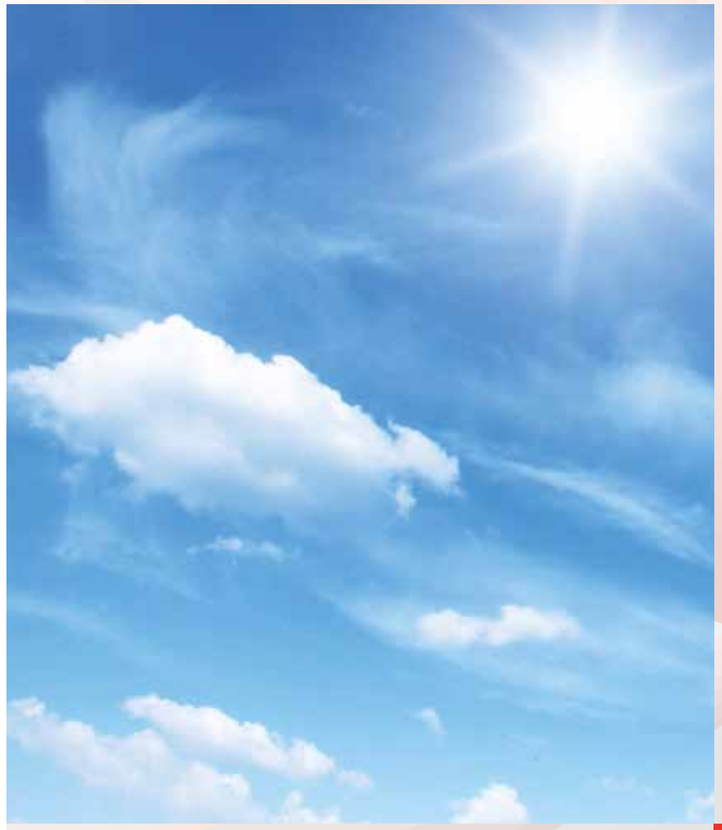
"I also get the opportunity to examine chemical-engineering applications in real operational settings. This is great for energy optimisation and a step towards sustainable-energy management."

This programme will deliver a fully tested and developed system that helps optimise organisational performance through data capture and analysis followed by modifications to the process, combined with working practices that are embedded within the organisation through increased awareness and workforce competencies.

"We expect the collaboration with the University of Surrey KTA to have a significant impact on the way we develop our business," said Pro Enviro's Steve Stones.

Dr Ali Hosseini of the University of Surrey commented: "Working with Pro Enviro has enabled us to examine a new technique for knowledge-based experimental design developed in the Centre for Process and Information Systems Engineering (PRISE). This technique uses detailed mathematical models of the experimental process as a means for analysing available data to design the minimum number of new experiments required.

"Upon implementation, this tool could have the potential to revolutionise existing business processes and even create new business paradigms, as well as offering new modes of interaction for government."



> "We expect the collaboration with the University of Surrey KTA to have a significant impact on the way we develop our business"
>
> Pro Enviro's Steve Stones

KTA CASE STUDY

Project title: Lighten up
Academic: Professor Yaochu Jin & Professor Andrew Crocombe

It has been estimated that a mere 1kg reduction in the mass of an aircraft panel can lead to a €1.5m-€2m saving on fuel, based on today's prices. But how can weight reductions be achieved when the aerospace industry is already using advanced composite materials, and what are the safety implications of making aircraft from even lighter materials?

Aero Optimal specialises in solving unique and challenging technical problems in the aerospace and space industries. Established in 2006, they have extensive experience in the supply of technical consultancy services in the design and analysis of aerospace structures, with particular focus on the use of composites.

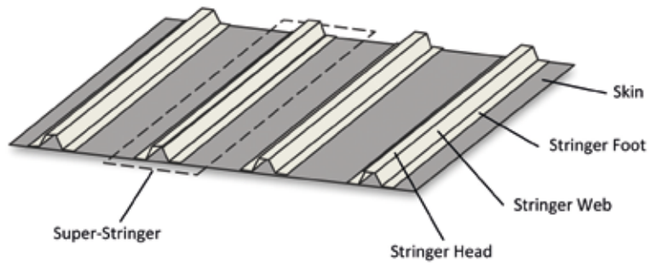
In partnership with the University of Surrey, they received financial and technical support from the KTA to develop and optimise carbon-fibre-reinforced plastic stiffened panels for aircraft. The aim is to develop a powerful, user-friendly optimisation tool specifically for carbon-fibre-reinforced plastic panel design, but with wider applications for improved efficiency in terms of weight and load-carrying capabilities.

This project takes a detailed look at the design and use of materials in the aerospace industry, and will deliver a fully designed structure for use in aircraft design. It joins up a number of key themes in weight reduction, including a reduction of fuel consumption and the knock-on environmental effects.

"Successful conclusion of this project will greatly facilitate the implementation and application of optimisation strategies," said Aero Optimal's Dr G Roshan, "leading to a minimisation of fuselage weight with commensurate reductions in fuel and carbon footprint."

The University of Surrey has provided two top academics to work with Aero Optimal: Professor Yaochu Jin and Professor Andy Crocombe. Professor Jin has many years' experience in evolutionary multi-disciplinary and multi-objective aerodynamic design, including turbine blades, racing cars, and micro heat exchangers. He is one of the leading experts in the area of evolutionary design optimisation. "The University will benefit by demonstrable application of expertise in a high-impact study," said Professor Jin, "and through the exposure of staff to the latest aerospace design procedures."

A typical omega-type stiffened CFRP panel used in Aircraft design



> "I am very proud to be involved in a project that incorporates state-of-the-art optimisation techniques and applies them to real-world problems at the forefront of aerospace engineering"
>
> Dr Colin Bell

Professor Crocombe has expertise in structural mechanics and is a leading expert in structural adhesive bonding. He has published nearly 300 journal and international-conference papers in this and related fields.

The principal cost of this project is associated with the employment of a skilled researcher, Dr Colin Bell, who has hands-on experience in evolutionary optimisation as well as computer programming. Dr Bell has knowledge in engineering design combined with excellent programming skills. These are essential, as the tool is intended to be used in 2012 by Aero Optimal for its ongoing and future projects.

"The project's unique and varied challenges make it extremely interesting to a researcher," said Dr Bell. "I am very proud to be involved in a project that incorporates state-of-the-art optimisation techniques and applies them to real-world problems at the forefront of aerospace engineering."

KTA CASE STUDY

Project title: Reflected glory
Academic: Professor Stephen Sweeney & Dr Vlad Stolojan

Digital technology has created a quiet revolution in cinemas. While we stare at the actors and munch our popcorn much as we have always done, the changes behind the scenes have been quite giddying.

"The digital revolution has delivered major changes to cinema projection," says David Harrison, Technical Director at Harkness Screens (UK) Ltd. "Digital content - including 3D - controlled by servers and delivered by digital projectors is a paradigm shift in cinemas comparable to the Swiss watch industry coping with digital timepieces."

One piece of equipment that hasn't attracted quite so much attention is, paradoxically, the very object we go to the cinema to look at: the screen itself. There is a need for improved surface technology to reflect all the glorious colours and detail that digital film and projection create, otherwise the effort and investment of going digital and 3D has been wasted.

Working in partnership with the University of Surrey via the KTA, Harkness Screens has received financial and technical support to examine novel optical techniques with complementary surface studies using facilities and expertise from the University's Advanced Technology Institute (ATI). The project will develop and apply a methodology for characterising the optical response of a screen and ascertain the influence of microscopic screen properties on macroscopic parameters.

Harkness Screens is the world's largest manufacturer of projection screen surfaces, specialising in the design and production of custom screens of virtually any size and shape. They have been working in cinemas for more than 80 years, and recently moved into the event-screen and custom-screen market.

"There is a need for improved surface technology to reflect all the glorious colours and detail that digital film and projection create, otherwise the effort and investment of going digital and 3D has been wasted"

A major feature of the project is the employment of Sayid Ally Sayid, a researcher with a PhD in physics and experience working with thin-film optical materials and structural and optical characterisation techniques.
"The opportunity to work on this exciting project has opened doors for me to increase my knowledge and realise my full potential in using the knowledge gained for real-world application," says Sayid. "As a huge fan of 3D movies, working on this project gives me huge satisfaction and motivation."

Dr Vlad Stolojan, one of the Surrey academics working with Harkness Screens, said: "We are excited about bringing science and engineering expertise to the real-world technological development of cinema screens.

Together with Harkness Screens, we are developing novel ideas and methodologies that will result in improved technical performance and enhanced user experience.

"The resulting long-term competitive advantages will provide a significant basis for further research and collaboration. The University and Harkness Screens have proved ideal partners, able to share the necessary know-how and provide access to resources."

THE KTA TEAM

Each of the KTA's three Platforms is supported by a Lead Academic. These experts in their fields of research drive the development and strategic direction of the Platform, whilst also engaging fellow researchers.

Communications and Signal Processing

Professor Barry Evans

Nanotechnology and Photonics

Professor Ravi Silva

Next Generation Materials and Characterisation

Professor Karen Kirkby

over 100 industry partners have engaged in the KTA programme

via project collaborations and Board & Advisory Group membership

Each Lead Academic is supported by a Knowledge Exchange (KE) Director. These are experienced knowledge-exchange professionals with specialist experience in exploiting the specific technologies being developed by each Platform. They work closely with the academic community to build and maintain industrial partnerships and produce funding applications:

Communications and Signal Processing

Peter Lancaster

Nanotechnology and Photonics
Next Generation Materials and Characterisation

Rob Yates

The Academic Leads and KE Directors are supported by an experienced project management team in the Research and Enterprise Support (RES) department. They ensure the KTA programme runs smoothly, and raise awareness of its activities via marketing publications:

Sophie Woodward

Octavia Beer

LOOKING AHEAD

The Surrey KTA has been very successful to date, with an impressively high level of engagement and enthusiasm from Surrey's academics and their industrial partners. Surrey has always had a strong collaborative focus, and the KTA has been a great support in strengthening those efforts.

But we can't rest on our laurels - and we don't intend to.

In contrast to the last two years, where we concentrated on getting the KTA up and running, we're now looking forward to the future and planning how to continue the excellent work that has been started.

Indeed, the KTA has been so productive that we are working on a variety of strategies to continue knowledge-transfer activities well beyond the end of EPSRC funding in September 2012. Ideas are developing all the time, so please get in touch if you want to keep up with our progress.

In 2009/2010 Surrey's knowledge transfer income reached

£22.9m

Project title: Biologically Inspired Information Fusion
Academic: Dr Matthew Casey & Dr Athanasios Pavlou

Could understanding the evolution of our senses be the key to producing CCTV systems that can automatically distinguish between harmless movements and potential threats? The University of Surrey's Department of Computing is using its EPSRC-funded research to help Waterfall Solutions Ltd find out.

Despite the number of CCTV systems that have been developed throughout the world, producing useable information from real-time processing of live images is still a big challenge. For example, while it is relatively easy to spot a person or a car moving within a series of CCTV images, how do we distinguish between normal and potentially threatening behaviour?

The answer might lie in the way human senses have evolved to protect us.

Imagine for example that you are being stalked by a camouflaged predator that is moving quietly towards you. The predator is difficult to spot, but there may be some movement you can see out of the corner of your eyes. The predator is also quiet, but may still make some slight noise.

Our senses have evolved so that these slight sights and sounds cause us to look automatically towards any such disturbance. However, the really clever part of our response to such a situation is not the simple turning of our eyes. What has really helped us to survive is that by the time we have recognised the predator from the shapes and sounds we have seen and heard, our body is already prepared to run away.

This superfast subconscious recognition of potential threats is an important survival mechanism. And though we are less likely to be stalked by predators today, the mechanism still works for modern-day dangers. Instead of a lion, think of a fast car suddenly coming round the corner as you cross a road.

What does this have to do with CCTV systems?

Well, it is these fast, low-level senses that have been studied at the University of Surrey by Dr Matthew Casey and Dr Athanasios Pavlou from the Department of Computing. They have developed models of the 'brain circuits' involved in moving our eyes automatically towards slight sights and sounds, and in detecting threats.

With the help of funding from the University's EPSRC-funded KTA, models of these threat-detection circuits have been applied to real-time detection in CCTV-image systems developed by Waterfall Solutions Ltd, a company specialising in the development of fast and effective sensor systems.

> "By using KTA funding, Surrey were able to demonstrate how models of human senses could be applied to CCTV images to detect small-scale threats in real time.

One of Waterfall's products is a system that stitches together a wide-angle CCTV image from several normal and thermal-imaging cameras, in real-time. For example, the system can be used to provide anything from a 100-degree wide image through to an all-round 360-degree image. It can then go on to detect large-scale motion of objects within the image, such as cars and people. Impressive as it is, the system couldn't detect small-scale, potentially threatening targets.

It is easy to spot small-scale motion - think of leaves moving in the wind - but potentially threatening small-scale motion has always been the big stumbling block.

This is where the people from the University of Surrey come in. The novelty of their model is that it can be trained to filter certain types of sights (or even sounds). For example, the system could be tuned to detect walking people. While this is not remarkable in itself, the power of the technique is its ability to filter even on a small-scale. Think of distinguishing between moving leaves versus a person lurking behind a tree.

As an example, look at the following wide-area image from Waterfall. The top image shows a typical office car park, with cars and people easy to spot as they move through the seen. There is also a lot of other, noisy movement, such as the leaves moving on the trees and clouds moving in the background. However, if you look at the area highlighted with a red box you may just be able to make out a small lighter patch, which is a person's head that has just poked out from behind the wall. This is behaviour that would be of interest to a CCTV-operator, but it is very small and difficult to see. Surrey's technique is able to distinguish this small-scale change versus other noise, as seen in the bottom image where the threat has been highlighted automatically.

By using KTA funding, Surrey were able to demonstrate how models of human senses could be applied to CCTV images to detect small-scale threats in real time. Further work has already started to combine this with sounds, and a follow-up project is being proposed to develop the idea further via the Centre for Defence Enterprise, with the potential to apply the technique to a range of applications to detect both urban and military threats.

Project title: Large Area Deposition of AZO Thin Films
Academic: Dr Mark Baker

Think of all the products available today that use optoelectronic devices (ie, devices that convert electric into light, or vice versa). Flat-screen displays, LEDs, solar cells and other such devices are made of many different materials with important properties, including transparent conducting oxides (TCOs).

TCOs are thin film materials that play an increasingly vital role as they offer both high optical transparency and high electrical conductivity.

The most widely used TCO is tin-doped indium oxide (ITO). However, indium is a relatively rare and expensive commodity. Prices have increased tenfold in recent years due to increased demand, and supplies are likely to become limited in the near future, so there is a need to find substitutes. Aluminium-doped zinc oxide (AZO) is currently the best alternative, but the production processes required to use it have not yet been fully developed. That's where the University of Surrey's involvement began, via a KTA with Plasma Quest Ltd.

Plasma Quest is an SME (small-to-medium-sized enterprise) specialising in the deposition of high-quality thin films, mostly for optoelectronic applications. Their patented high-target utilisation sputtering (HiTUS) deposition technique is particularly suited to the deposition of metal oxide thin films.

Working with researchers from the University in a recent EngD project, Plasma Quest were able to develop a large-area deposition instrument capable of depositing uniform ITO thin films onto A4 substrates at fast deposition rates and low temperatures (which is important for flexible electronics). The aim of this KTA project was to take that process and develop a similar, large-area deposition process for AZO.

The project was a success, and Plasma Quest and the University of Surrey are now pursuing exploitation of large-area deposited AZO thin films through a joint project with The Welding Institute (TWI) in Cambridge and Ecole Polytechnique Federal de Lausanne (EPFL), Switzerland. This joint project is working to deposit AZO films onto a Grätzel-cell photovoltaic device, which would herald a major breakthrough in cost-effective solar energy.

Speaking about the benefits of working through collaborative programmes such as the KTA, Mike Thwaites, CEO and founder of Plasma Quest, commented: "Working with the University of Surrey has helped us improve our products and promote ourselves better technically. The information acquired has already been used to guide and accelerate new product and process development and to assist in 'tailoring' coatings to specific – sometimes previously unachievable - customer requirements."

The KTA working with the EPSRC Doctoral Prize

In 2009 the EPSRC initiated a Doctoral Prize. This two-year pilot programme provided a new £10m funding stream within Doctoral Training Grants (DTG) to help universities retain and recruit the best EPSRC-supported PhD students, increase the impact of their PhD students' work, and improve the number of top PhD students going into research careers.

Surrey was one of the trial universities for the Doctoral Prize. We received enough funding in 2009/10 to help two students launch successful careers in research at the end of their PhDs. The KTA subsequently made a contribution to the scheme, allowing a third student to take advantage of the programme.

This proved to be a very successful merger of EPSRC funding streams. The third student funded, Dr Radu Sporea, used the extra time to explore deeper aspects of his research into a new type of electronic transistor invented here at Surrey. The source-gated transistor (SGT) is cheaper than traditional transistors, more flexible, uses less energy and can be manufactured both with traditional and non-traditional transistor-production methods. Thanks to the EPSRC Doctoral Prize he is now looking at the potential engineering challenges associated with taking his research closer to commercialisation.

Dr Sporea says: "I have been able to use the money provided by EPSRC to perform small but essential upgrades to the fabrication and measuring tools I use, as well as acquire the consumables needed in my day-to-day research. I have also been able to travel to prestigious conferences to discuss future collaborations, both with international academic groups and with interested companies."

Dr Sporea has since gone on to win a prestigious Royal Academy of Engineering Research Fellowship, a tremendous accolade for his efforts and very well deserved achievement.

Dr Sporea believes the extra resources he received via the KTA and the EPSRC Doctoral Prize helped his application for the Fellowship by building up his CV and portfolio. "I am very grateful for the support of EPSRC during my time at Surrey," he says, "both during my PhD and for the Doctoral Prize.

"It has offered me an outstanding combination of technical facilities, administrative infrastructure and mentoring, and has made my development a successful and enjoyable undertaking."

"Dr Sporea has since gone on to win a prestigious Royal Academy of Engineering Research Fellowship, a tremendous accolade for his efforts and very well deserved achievement.

Project title: Gunshot Residue Analysis
Academic: Dr Melanie Bailey

How can we help to show that a person suspected of gun crime is associated with the use of firearms?

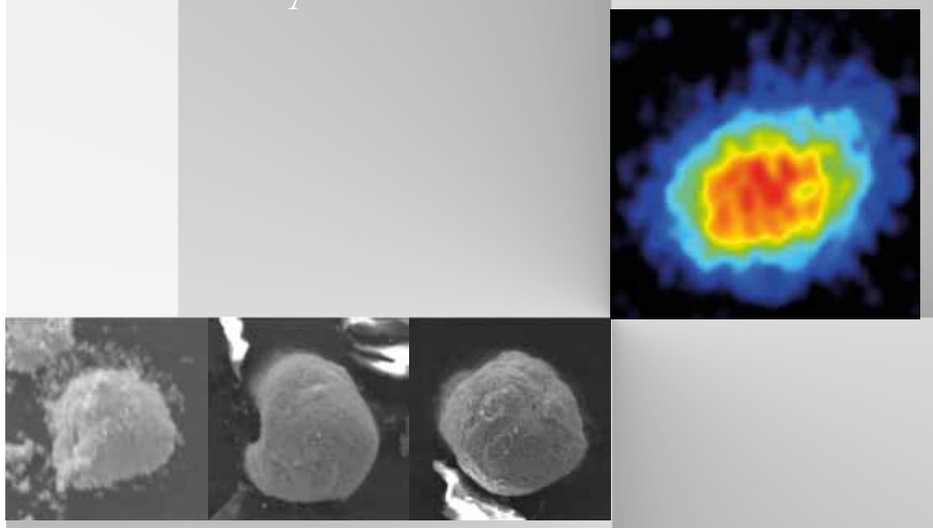
Swabbing the hands of a suspect collects particles of gunshot residue (GSR) that may be present and can be analysed in the laboratory. These particles are typically a few micrometers in diameter and contain lead, barium and antimony, as well as other less abundant elemental components. If a suspect has been involved in a shooting incident, GSR particles will typically be found on the hands, but additionally on the face, hair and clothing.

The challenge for forensic examiners comes in determining the difference between GSR from a specific shooting incident and genuine GSR from other sources (such as an arresting officer carrying a firearm).

LGC Forensics currently supply many UK police forces with analysis. They use a technique called Scanning Electron Microscopy Energy-Dispersive X-ray analysis (SEM-EDX) to characterise GSR in accordance with its elemental composition. Using this method, LGC Forensics can categorise GSR into several different types. Unfortunately, when employing SEM-EDX, GSR produced by police ammunition may be insufficiently distinct from GSR generated from 'illegal' firearms use. This can make it difficult in some cases to tell whether GSR recovered from a suspect is really from a shooting incident or has been transferred during arrest by armed police.

Melanie Bailey and Matthew Christopher at the University of Surrey have previously found that a technique called Ion-Beam Analysis (IBA) is very sensitive to the elemental composition of GSR particles. With IBA, which uses a small particle accelerator, it is possible to detect trace elements within gunshot residue particles that cannot be detected by SEM-EDX.

Images showing gunshot residue particles and a particle imaged using ion beam analysis



With KTA funding, Melanie and Matthew have been able to develop the technology's use from basic research into a feasibility study. The first step of the project was to investigate whether the enhanced sensitivity of IBA could actually be used to provide reproducible and discriminatory differences between GSR from different sources, which would otherwise be insufficiently distinct using SEM-EDX.

GSR samples from a large number of different sources provided by LGC Forensics have now been analysed at Surrey using IBA. We have shown that the results are reproducible, with the residues from the same type of ammunition being indistinguishable under defined criteria when analysed on different days or collected under different conditions. We have also demonstrated that a distinction (or match) can be made using as few as ten particles for a valid analysis. These are fundamental considerations required by LGC Forensics and the Forensic Regulator to validate the analysis.

Our proof of principle results suggest that different types of ammunition, which are indistinguishable by SEM-EDX, look reproducibly different under ion-beam analysis. This is an important step, as reproducibility of a validated technology is critical in a court of law.

Building on this basic framework established under the KTA, we have been able to construct a preliminary database of GSR trace-element composition using IBA for use in future police case work. We are continuing to expand the database, which will increase the evidential value of ion-beam analysis of gunshot residue.

Further work has already been proposed to enhance the speed and performance of ion-beam GSR analysis, enhancing the attractiveness of the technique to the forensics community.

OTHER OPPORTUNITIES TO SHARE OUR KNOWLEDGE

Industrial Doctorate Centres at Surrey

In 2009, the EPSRC awarded us a £12m grant to launch two prestigious Industrial Doctorate Centres (IDC). Only 19 such centres exist in the UK.

The IDCs provide a supportive and exciting environment for students, or 'Research Engineers' as they are known within the Centres. Each Research Engineer carries out challenging research projects in collaboration with industrial sponsor organisations during four-year research degrees (which are academically equivalent to a PhD).

MiNMaT Industrial Doctorate Centre

The Micro- and NanoMaterials and Technology (MiNMaT) Industrial Doctorate Centre is at the forefront of understanding in processing-microstructure-property relationships, which are the foundations of materials science and engineering. Through its provision of the four-year Engineering Doctorate in Micro- and NanoMaterials and Technologies, the MiNMaT IDC offers a hands-on approach to developing new solutions using world-class characterisation instrumentation.

SEES Industrial Doctorate Centre

The Sustainability for Engineering and Energy Systems (SEES) Industrial Doctorate Centre provides a four-year Engineering Doctorate with research in three key topic areas:

- Engineering for Sustainable Development analyses full product and process life cycles
- Systems Approaches considers supply chains for products and services
- Sustainable Energy and Low-Carbon Systems is a key growth area that considers how to incorporate low-cost and low-carbon power into existing energy supply chains.

www.surrey.ac.uk/idc

Knowledge Transfer Partnerships

Knowledge Transfer Partnerships (KTP) are a flagship Government-funded initiative which has been running nationally for over 30 years. Here at the University of Surrey we have an active and diverse portfolio of KTPs.

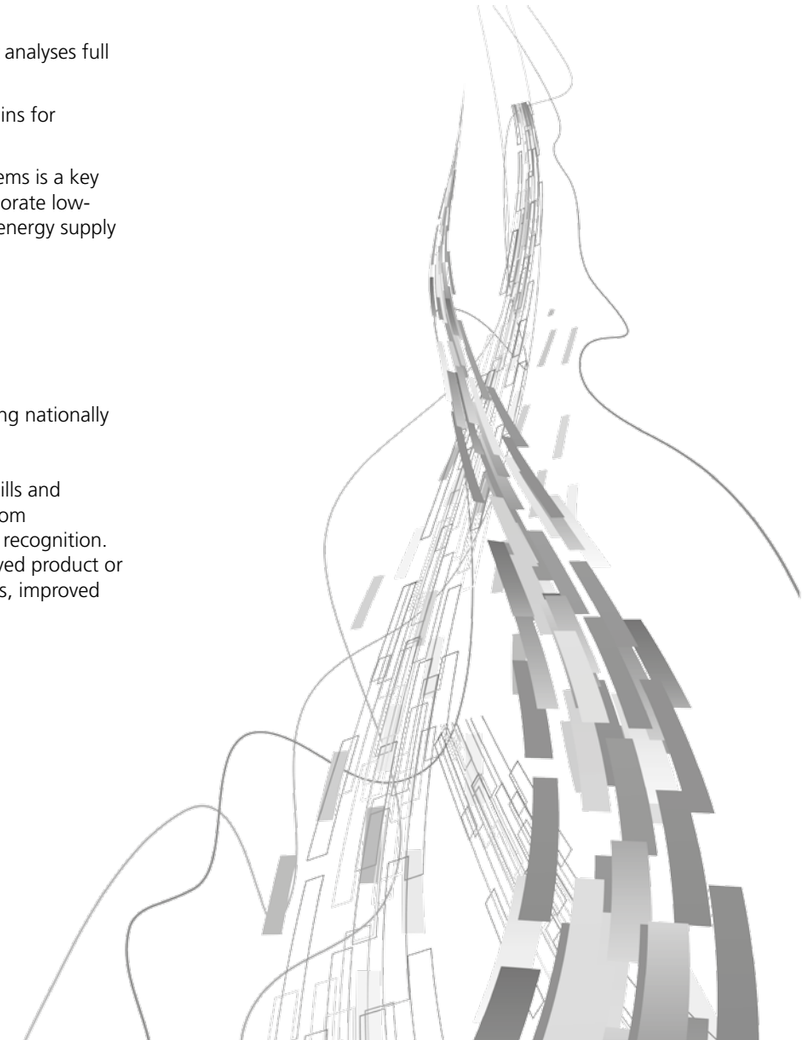
KTPs typically involve a partnership between a company and an academic institution for the transfer of skills and knowledge within a particular field. Businesses throughout the UK have achieved considerable benefits from involvement with our KTP project programmes in science and technology, which have gained widespread recognition. Surrey can shape KTP programmes for a wide range of business areas including new technologies, improved product or process design, enhanced manufacturing processes, reduced costs, access to new markets, increased sales, improved profitability, and enhanced efficiency and quality standards.

www.surrey.ac.uk/res

Over the period 2006 – 2011 a total of

£387m

external investment for spin out and start up companies was raised from Surrey's growing network of commercial investors



CONTACT US

We welcome the opportunity to engage in new collaborations and partnerships with all types of organisations.

If you have a challenging problem that needs an innovative solution, or you want to discuss ways of getting our skills, resources and technologies working for your benefit, please contact the Knowledge Exchange (KE) Director for the Platform area best suited to your needs:

Communications and Signal Processing

KE Director:

Peter Lancaster

T: +44 (0)7738 895464

E: peter.lancaster@npl.co.uk

Nanotechnology and Photonics

KE Director:

Rob Yates

T: +44 (0)7850 765521

E: rob.yates@npl.co.uk

Next Generation Materials and Characterisation

KE Director:

Rob Yates

T: +44 (0)7850 765521

E: rob.yates@npl.co.uk

www.surrey.ac.uk/kta

For more information on any of our KTA Platforms, please contact the relevant Knowledge Exchange (KE) Director.

Communications and Signal Processing
KE Director:
Peter Lancaster

T: +44 (0)7738 895464
E: peter.lancaster@npl.co.uk

Nanotechnology and Photonics
KE Director:
Rob Yates

T: +44 (0)7850 765521
E: rob.yates@npl.co.uk

Next Generation Materials and Characterisation
KE Director:
Rob Yates

T: +44 (0)7850 765521
E: rob.yates@npl.co.uk

www.surrey.ac.uk/kta

National Physical Laboratory

Engineering and Physical Sciences Research Council

4894-0312