Institute
for Life Sciences

UNIVERSITY OF
Southampton

Institute for Life Sciences
Annual Report

In this report

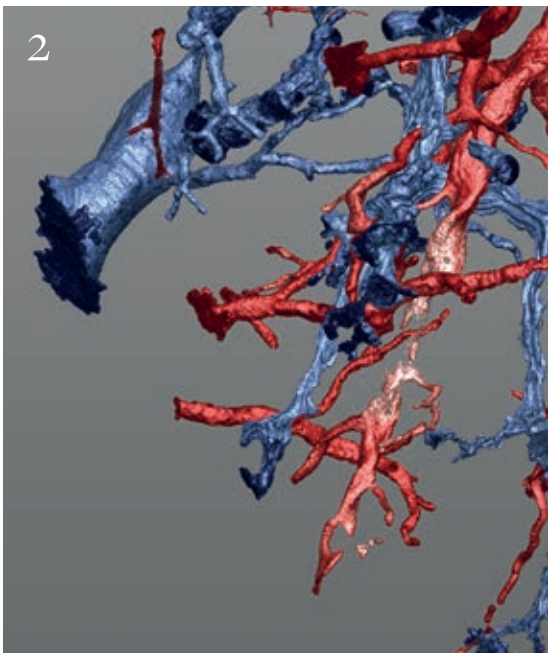
Celebrating its fourth anniversary, the Institute and its members have demonstrably shown the power of interdisciplinarity in the life sciences. Their impact and interests are clearly reflected by the new plans for the IfLS where our research is restructured around four grand challenges and where we are developing postgraduate and teaching engagement. A true community has been formed across the University, a community poised to make additional contributions around research, enterprise and education, feeding into regional and national aspirations embodied in the UK life sciences strategy.

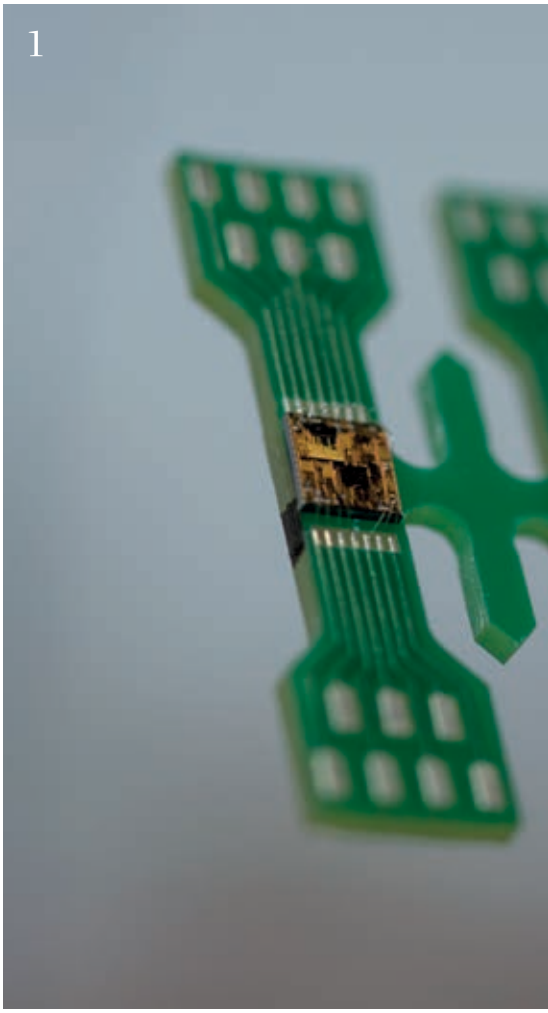
The university landscape has changed dramatically over the past few years, with economic challenges in education and rising international competition, but Southampton's forward thinking on interdisciplinarity, and its four flagship Institutes, makes us well placed to meet them. This year's annual report captures that spirit of impact and engagement.

Professor Peter J S Smith
Director, Institute for Life Sciences

The Institute has gone from strength to strength this year, with tangible and important developments in research and enterprise both across the University and with key industry and health partners, not least in the region. There is significant scope for further activities that respond to life sciences challenges and government priorities. The Institute is exceptionally well placed to deliver.

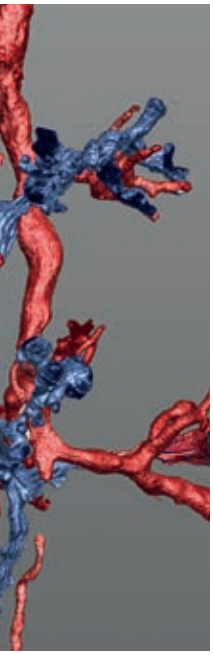
Professor Judith Petts
Pro Vice-Chancellor (Research and Enterprise)

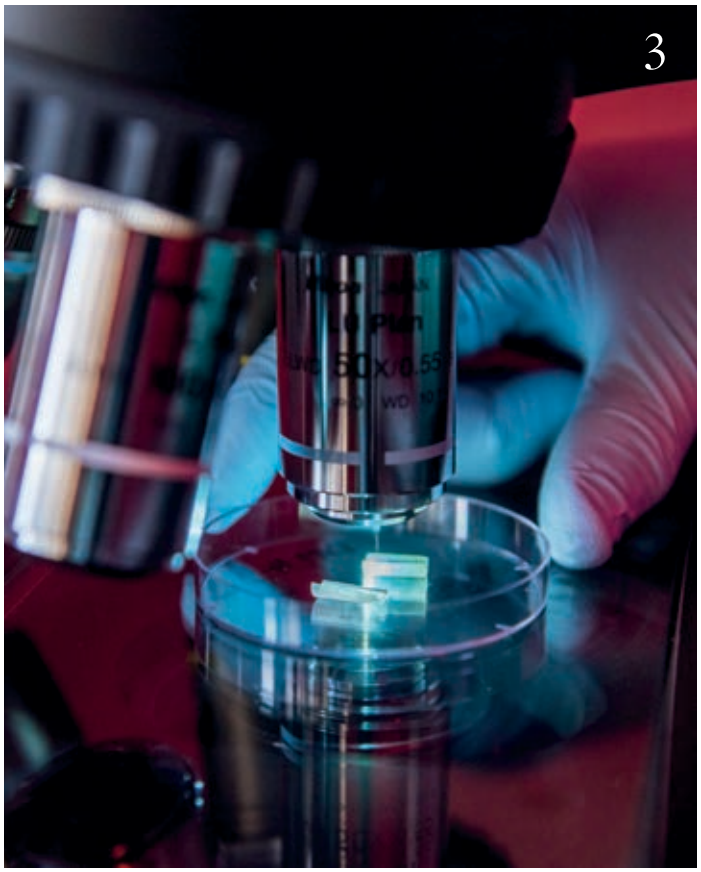


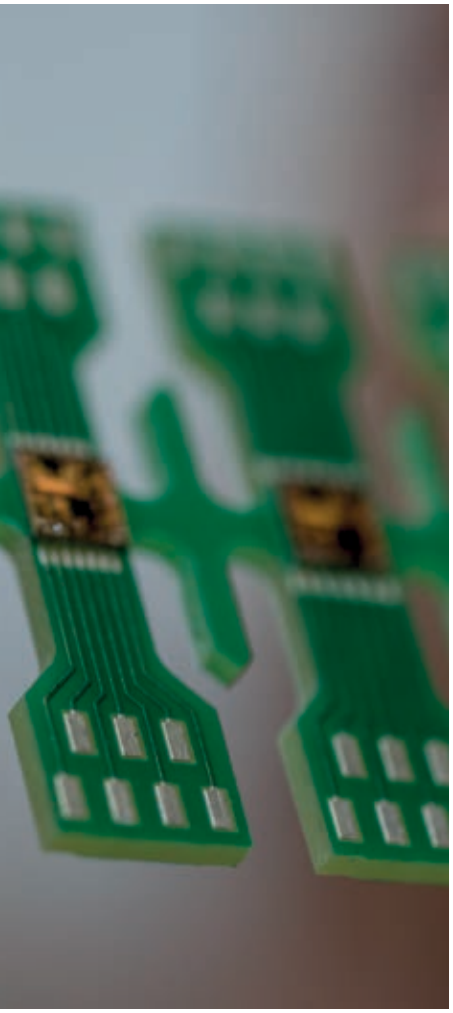


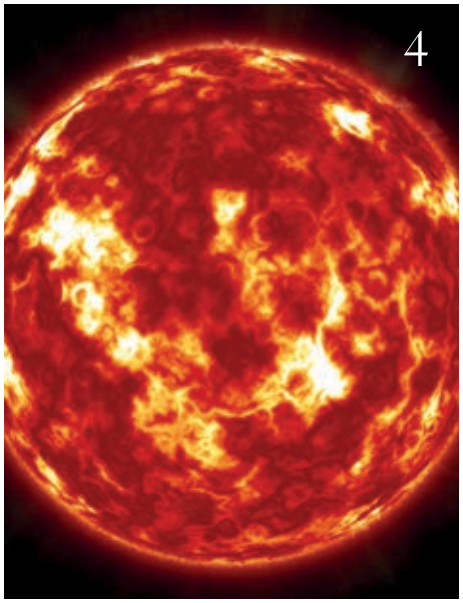
Cover photo: A wafer of small sensors that are used in an implantable fertility sensor. They are manufactured in the Southampton Clean Rooms and measure pH and dissolved oxygen.

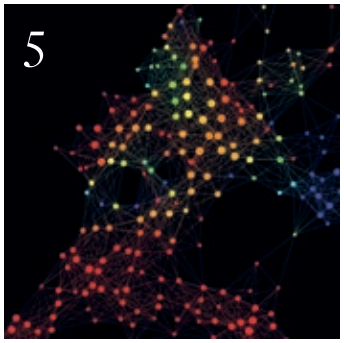
Photo credit: Jon Banfield











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Life Sciences in the Solent region

The Institute for Life Sciences (IfLS) is a global leader in life sciences, with a history of facilitating ground-breaking research and a pioneering approach to taking ideas from the laboratory to the workplace.

Now the Institute is part of a regional partnership aiming to position the Solent area at the forefront of innovation in life sciences, to develop a hub of expertise and resources that could see their ideas being translated into life-changing applications that will benefit society as a whole.

Vision for the future

Professor Peter J S Smith, Director of the IfLS, explains the Institute's vision for the future: "We commissioned a recent survey that revealed there were nearly 100 life sciences companies in the local region with a research and development component.

"All of these companies have resources and expertise that we would like to access and we also have resources and an intellectual value that they would like to access. This new initiative is looking at ways that we can work with other organisations such as the local councils and Local Enterprise Partnerships (LEPs), to make better use of these resources for mutual gain.

"The IfLS was set up to encourage cross-campus collaboration, to break down internal barriers and facilitate true interdisciplinary research. Now we are hoping to replicate this across the region, creating a hub of expertise that will boost the local economy, generate high quality jobs and become a 'go-to' resource for life sciences.

"This is a tremendous opportunity to take advantage of our unique capabilities and build innovation, particularly in the smart specialisation areas of orthopaedics, ophthalmology, sensors and devices, and information technology for health where the University has expertise."

A regional perspective

Southampton City Council is an integral part of the development of the new life sciences regional hub.

Chief Executive Dawn Baxendale said: "Southampton is undoubtedly the leading city on the south coast in terms of economic growth. We are already recognised as a key maritime and marine region and we want to build on our other strengths, such as life sciences, to raise our profile and become recognised as a centre for life science expertise.

"As a region we would benefit from this on so many levels in terms of economic growth, employment and reputation.

"As a local council we can help promulgate this vision out into the wider community; raise the aspirations of the next generation who as future residents and employees of this city could benefit from the creation of highly-skilled jobs; and work with the LEP and planners on the development of the hub."

Translating research into industry

Enabling innovative ideas to be translated into successful commercial applications is at the heart of the ethos of the University of Southampton Science Park.

Launched in 1983 the Park has created a safe environment where businesses at all stages, from multinationals to start-ups, can really support one another.

CEO Peter Birkett believes the Science Park has a key role to play in the development of a regional life sciences hub.

He said: "I see the Science Park as an intrinsic part in the overall vision and feel we could bring a number of valuable components to the development of a life sciences hub. Our Catalyst Centre offers mentoring and business support as part of a competitive process for small start-up companies; we have mature life science companies on the Park that can offer their expertise and experience; and we have the Science Centre with general purpose labs.

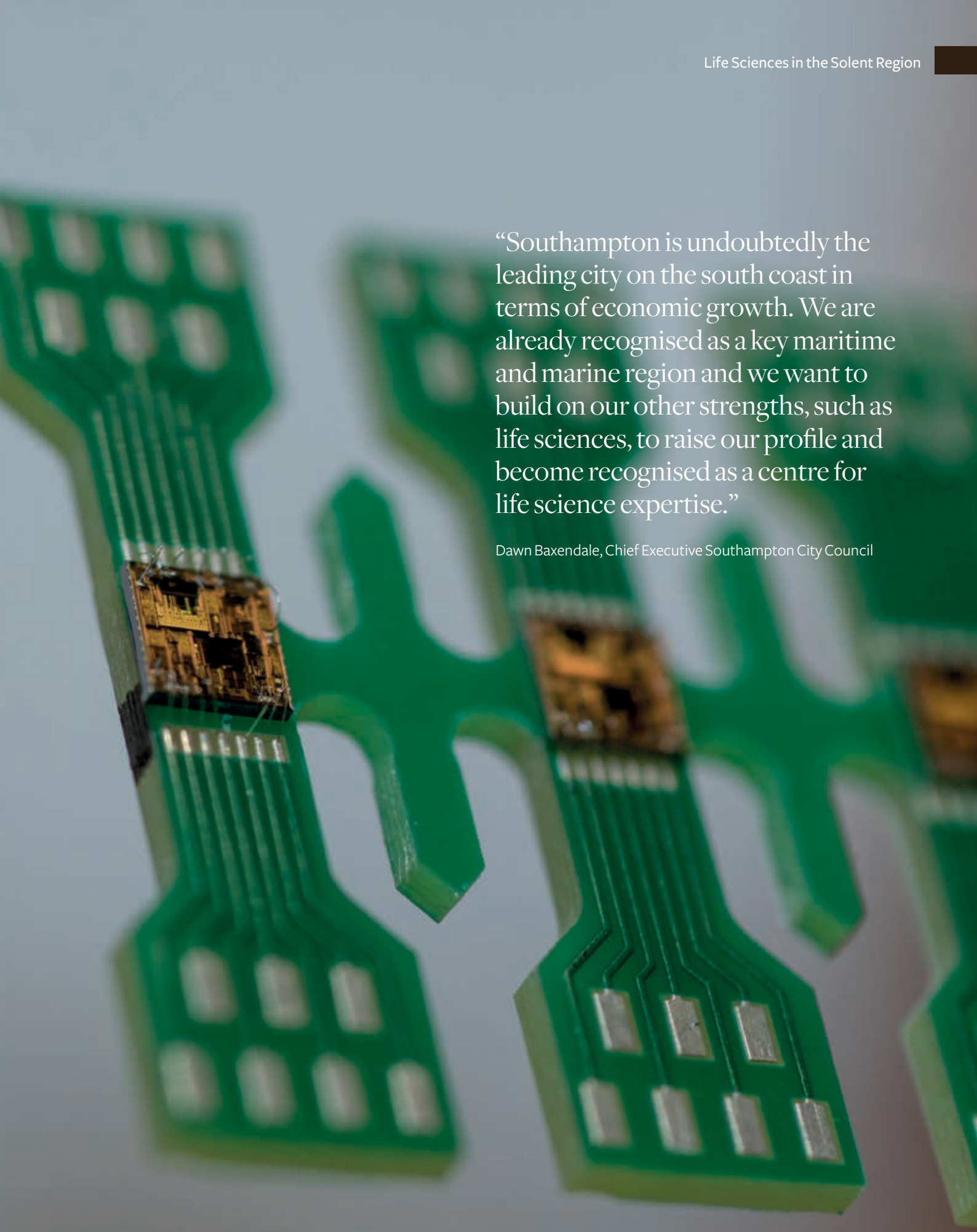
"There is a genuine concentration of high quality life science companies in this region and we have to try and raise the profile of this. Small businesses often find it difficult to engage or interact with large corporations unless they bind together. This proposed life sciences cluster will enable them to achieve things that individually they would never be able to do.

"We have got a lot of work to do but we have the potential to play a much more significant role. Only by getting companies and academia to work together are we actually going to be able to achieve this vision."

Professor Peter J S Smith, Director, Institute for Life Sciences

Dawn Baxendale, Chief Executive, Southampton City Council

Peter Birkett, CEO, University of Southampton Science Park

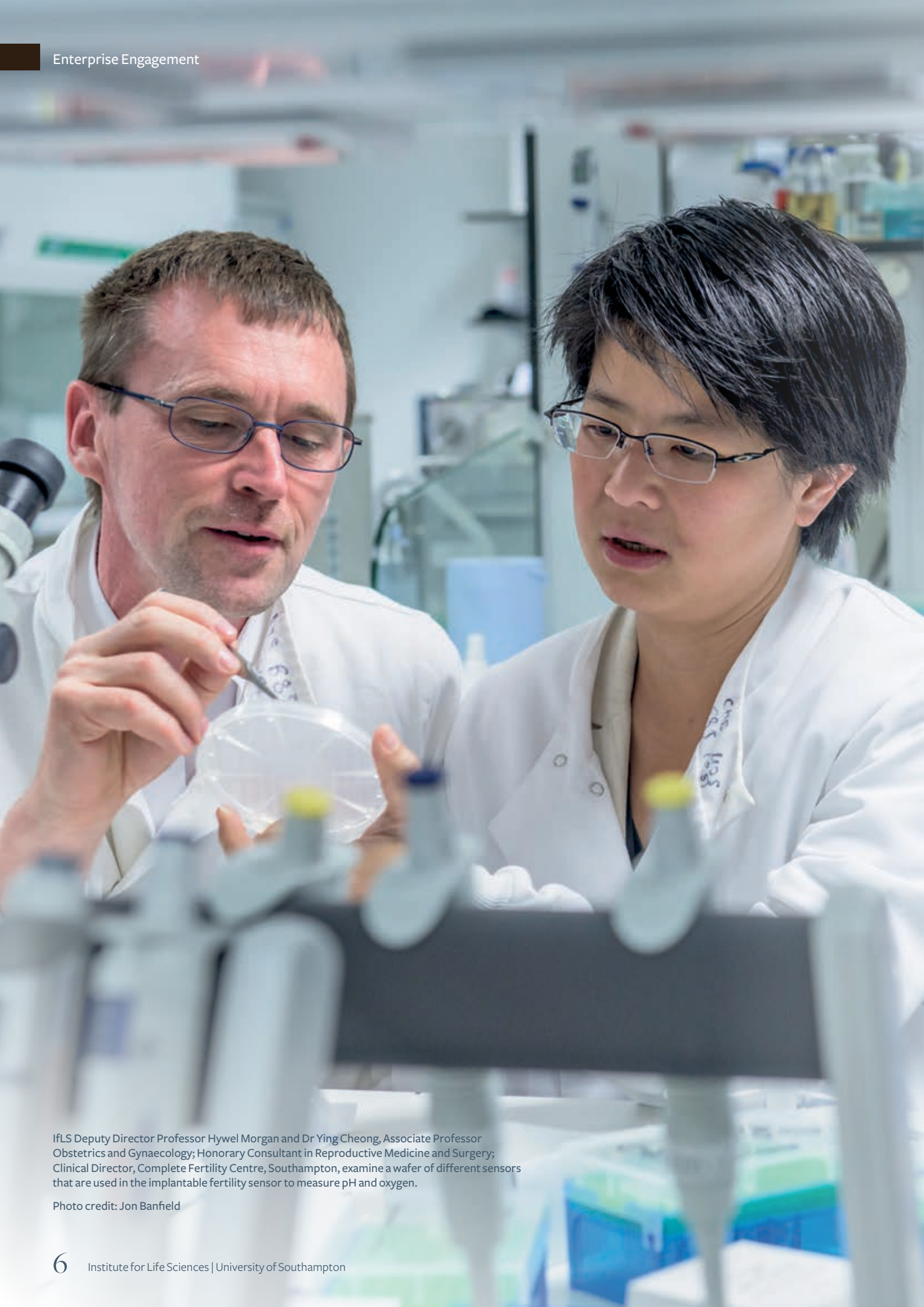


"Southampton is undoubtedly the leading city on the south coast in terms of economic growth. We are already recognised as a key maritime and marine region and we want to build on our other strengths, such as life sciences, to raise our profile and become recognised as a centre for life science expertise."

Dawn Baxendale, Chief Executive Southampton City Council

A microprocessor chip that is used in an implantable fertility sensing device.

Photo credit: Jon Banfield



IfLS Deputy Director Professor Hywel Morgan and Dr Ying Cheong, Associate Professor Obstetrics and Gynaecology; Honorary Consultant in Reproductive Medicine and Surgery; Clinical Director, Complete Fertility Centre, Southampton, examine a wafer of different sensors that are used in the implantable fertility sensor to measure pH and oxygen.

Photo credit: Jon Banfield

"The device measures temperature, oxygen and pH levels in the uterus. There is currently no other device available that can continuously monitor all these parameters. By knowing these parameters, it can help us tell whether the uterine environment is of the right biophysical nature to accept the fertilised embryo."

Professor Hywel Morgan,
Deputy Director Institute for Life Sciences and Professor of Bioelectronics

Successful collaboration

Members of the Institute's highly regarded research community within the University have already been working with colleagues in industry to develop successful commercial applications, particularly in the field of health care devices.

Professor Hywel Morgan, Deputy Director of the IfLS and a Professor of Bioelectronics at the University of Southampton, is working with a number of partners including Sharp, SAL Scientific and consultants at Southampton's Princess Anne Hospital developing medical technologies.

The latter collaboration with the Princess Anne Hospital has seen Hywel's team working with clinicians Dr Ying Cheong and Professor Nick Macklon to develop a small implantable smart sensor that can help understand and improve fertility.

"The device measures temperature, oxygen and pH levels in the uterus. There is currently no other device available that can continuously monitor all these parameters. By knowing these parameters, it can help us tell whether the uterine environment is of the right biophysical nature to accept the fertilised embryo," said Hywel.

The team has carried out a clinical trial on patients and has created a spin out company, Fidelity Technologies, to further develop the device with a view to taking it to the marketplace.

"The development of this technology could have a significant commercial opportunity for us and could lead to us working with fertility clinics. The partnership between our research team and the clinicians has seen us combining both of our strengths to develop a device for this area of healthcare where there is currently a lack of diagnostic tools," added Hywel.

To find out more visit
www.southampton.ac.uk/ifls/enterprise

Imaging innovations lead developments in medical diagnosis and food security

Pioneering imaging techniques are being used by teams of Institute for Life Sciences (IfLS) researchers to drive forward innovative developments in medical diagnosis and environmental food security.

X-ray computed tomography (CT) in Southampton's µ-VIS Imaging Centre is a way of non-destructively seeing inside solid objects, allowing scientists to preserve precious samples while gaining an extremely detailed picture of whole systems.

Improving the diagnosis of lung disease

Every year respiratory disease costs the UK economy more than £6bn and accounts for 30 per cent of UK deaths.

Researchers from the IfLS community are exploring the use of new imaging technology to address the issues of long-term debilitating lung diseases.

Building on pioneering work by the University of Southampton and University Hospital Southampton NHS Foundation Trust, they are developing the use of microfocus CT technology to provide improved examination of lung samples.

"Traditionally, very thin sections of lung are cut and examined under a microscope, looking for changes in the organisation of the lung caused by disease. However, these sections provide only a single snapshot of how far disease has degraded the vitally important 3D-structure of the lung," said Dr Peter Lackie, a Lecturer in Medicine.

"By developing this advanced micro CT technology we image the lung microstructure in 3D, overcoming these limitations and producing a new and exciting diagnostic capability. This delivers 3D scans showing features also seen under the microscope and hundreds of times more detailed than conventional CT," he added.

Professor Ian Sinclair, Director of the µ-VIS Imaging Centre, explained: "Digital images are easy to deliver to medical staff and we have shown that scanning can be carried out on samples that are entirely consistent with normal medical methods – therefore integration with hospital workflow is quite straightforward.

"We hope that this technique will enable the NHS to deliver earlier, more efficient and more accurate diagnosis, improve patient outcomes and make more targeted therapeutic decisions for patients suffering not only from lung diseases but a range of other medical conditions."

Protecting food security

Southampton researchers are using innovative imaging techniques to tackle the challenge of meeting potential global food shortages.

With the world's population continually growing and climate change set to reduce future crop yield, global food supplies are at risk.

Tiina Roose, Southampton Professor of Biological and Environmental Modelling, is leading an interdisciplinary team at the forefront of developments in soil science to determine how crops can be grown more efficiently.

The team of engineers, mathematicians, biologists and computer scientists is using high-resolution CT imaging to see what happens as roots grow in soil.

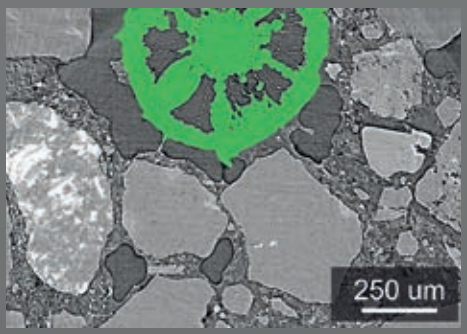
Traditionally used in medicine and aerospace engineering, the CT imaging at Southampton and at Swiss Light Source, in Switzerland, has carried out the first-ever imaging of live wheat root hairs in soil.

Postdoctoral researcher Dr Sam Keyes explains: "Most plant roots are very hairy and these minute hair cells infiltrate small spaces in the soil and play a vital role in absorbing the nutrients plants need. Using our CT imaging we are now able to see what happens as roots grow in soil."

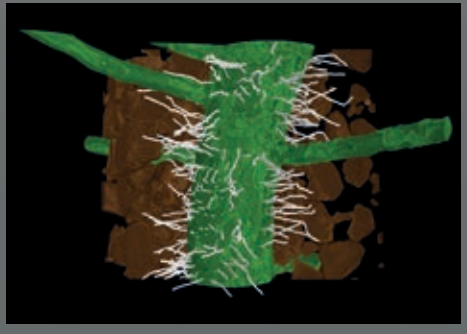
Tiina added: "By determining the root traits that lead to the most efficient uptake of water or fertiliser, it will be possible to breed and test plants with those characteristics.

"Climate change is set to reduce crop yields by more than 25 per cent from 2050, and it is estimated that we need to double food production by 2050 to feed a global population of nine billion, so it is crucial that we gain a greater understanding of the interaction between plants and soil in order to feed the world."

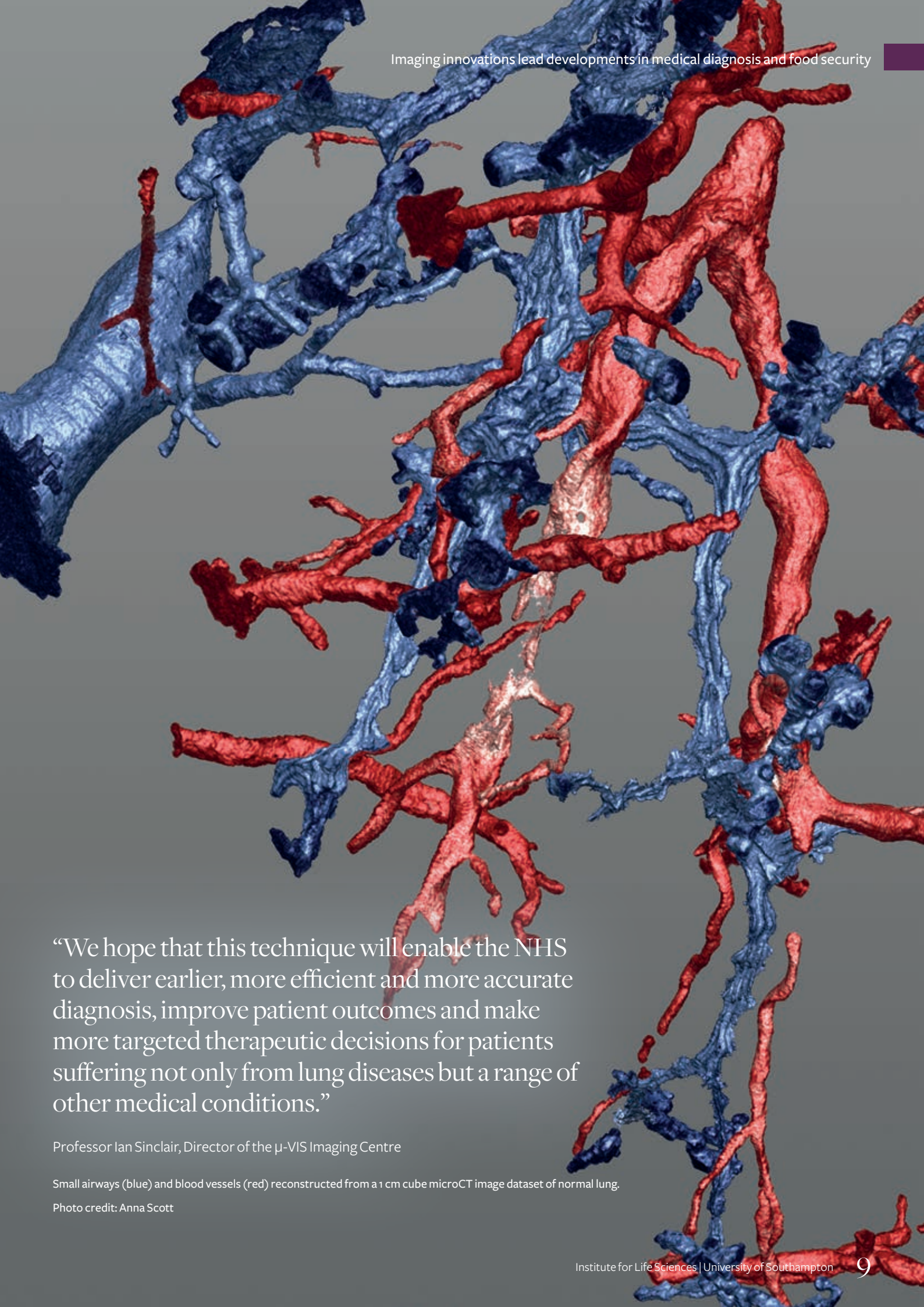
To find out more visit:
www.southampton.ac.uk/ifls/lifetechnologies



Synchrotron CT cross-section image showing rice root (green) surrounded by soil particles, fluid and gas-filled pores.



3D synchrotron CT image of rice root (green) showing root hairs (white) and soil particles (brown).



"We hope that this technique will enable the NHS to deliver earlier, more efficient and more accurate diagnosis, improve patient outcomes and make more targeted therapeutic decisions for patients suffering not only from lung diseases but a range of other medical conditions."

Professor Ian Sinclair, Director of the μ-VIS Imaging Centre

Small airways (blue) and blood vessels (red) reconstructed from a 1 cm cube microCT image dataset of normal lung.

Photo credit: Anna Scott

"This Fellowship has allowed me to apply the study of biofilms to the major clinical issue of finding effective solutions to infections and blockages caused by urinary catheter use. Working with Health Sciences has given me the opportunity to develop my work from the laboratory bench to the patient."

Dr Sandra Wilks, Senior Research Fellow, Centre for Biological Sciences

Main image: Biofilms on urinary catheters lead to infection and blockage. By using EDIC microscopy, biofilms can be examined directly, increasing our understanding of how they develop and persist.

Inset image (right): Deciphering the complex communication network in the tumour microenvironment can be used to predict progression and response to immunotherapy.

Photo credit: Sonya James

Enabling new pathways to health

Life science activities across the University attract a significant amount of funding. As well as facilitating huge intellectual value, they also bring in a third of the University's new income in grants.

The Institute for Life Sciences (IfLS) focuses on co-ordinating these life science activities and acts as a catalyst to encourage collaboration and funding applications.

Under the umbrella of the IfLS, interdisciplinary teams are encouraged to apply for a range of grants – both internal and external – to fund their research into novel pilot projects.

Without access to this start-up funding, much of this innovative research may never get off the ground and would find it difficult to generate the data or feasibility study required to secure further funding.

By drawing together teams from across different specialisms the IfLS is enabling access to more funding streams.

Recent successful grant awards have seen cross campus collaborations pursuing innovative new pathways to health in the fields of health sciences and cancer research.

Expanding health sciences

When Health Sciences at the University had some grant funding to allocate, they wanted to encourage cross-faculty collaboration particularly with the field of engineering. They approached the IfLS to help them facilitate this.

IfLS Director Professor Peter J S Smith said: "Our unique network of researchers across the University allowed us to be the vehicle to enable Health Sciences to achieve this. We could encourage the creation of collaborative teams in the required areas to work together and further research."

The IfLS Health Sciences Knowledge Mobilisation Fellows were created and three two-year projects were successfully awarded.

The Fellowships have seen researchers in Health Sciences working with their colleagues in Engineering, the Optoelectronics Research Centre, and the Centre for Biological Sciences, to develop laser-printable sensors for low-cost medical diagnosis and disease monitoring; explore the healthcare issues of biofilm development on urinary catheters; and create mobile sensing and computing for assessing and promoting physical activity in health and disease.

Furthering research into cancer

The IfLS has also been instrumental in the allocation of Cancer Research UK (CRUK) funding to support interdisciplinary teams' research into furthering the global fight against cancer.

Southampton is one of only 15 CRUK Centres across the UK and is home to world-leading scientists and clinicians that drive the discovery, development and testing of new treatments to combat cancer, particularly in the area of immunotherapy.

The Centre was awarded CRUK development money to fund a number of pilot projects and asked the IfLS for its support in attracting high-quality interdisciplinary research applications.

Professor of Molecular Oncology Graham Packham said: "The IfLS' pre-existing network of researchers and their ability to reach the right people across different campuses of the University was crucial.

"This funding is enabling collaborations to be set up, is drawing the teams together and is generating the data that is required to access future external funding.

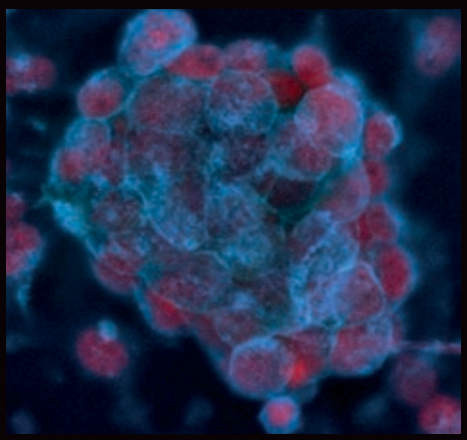
"Cancer Research UK has a very ambitious research strategy and a core part of that is to encourage interdisciplinary working. We want to put ourselves in the best position to benefit from any funding they put into developing that."

Three interdisciplinary projects were successful in winning CRUK development funding and are exploring the development of new tools – microdevices and data analysis – that will lead to better diagnosis, treatment and prognosis of cancers.

To find out more visit: **www.southampton.ac.uk/ifls/newpathwaystohealth**

"This funding allows us to explore the background genetic environment in which tumours exist to paint a more complete genome wide picture. This could not only help identify people at risk of cancers, but also give doctors and patients a more personalised insight into prognosis and treatment options."

Diana Eccles, Professor of Cancer Sciences, Medicine



Adapting to environmental change

Humans and animals have to continually adjust to environmental change to ensure they thrive and survive.

Teams of interdisciplinary scientists from the University of Southampton's Institute for Life Sciences (IfLS) are exploring the physiological processes that allow them to cope with an ever-changing habitat.

Bringing together scientists from many different disciplines, this IfLS-led research potentially opens up opportunities for future collaborations addressing environmental change.

Adapting to high altitudes

Exploring how the human body adapts to extreme changes in oxygen availability is helping scientists uncover valuable information that could benefit the treatment of critically ill patients in hospital.

Oxygen levels fall while ascending to high altitude because of a reduction in atmospheric pressure, and patients in critical care commonly suffer from hypoxaemia (a lack of oxygen in the arterial blood); therefore understanding the adaptive response to hypoxia in healthy humans may provide new therapeutic avenues for interventions that will improve patients' survival.

Research, led by Martin Feelisch, Professor of Experimental Medicine and Integrative Biology, and Mike Grocott, Professor of Anaesthesia and Critical Care Medicine, has revealed that the production of nitric oxide (NO) increases as people acclimatise to high altitude, suggesting that NO is an integral part of the human physiological response to a shortage in oxygen.

Martin said: "This research is offering valuable insights into how the regulatory mechanisms keep our bodily functions appropriately balanced; understanding the key players orchestrating this may one day help provide better treatment and care for critically ill patients who suffer from limited oxygen supply or usage due to heart, lung or vascular disease."

The benefits of sunlight

Exposure to sunlight could have a long-term beneficial effect on many of today's increasing healthcare issues, research by members of the IfLS has revealed.

Cardiovascular disease accounts for 30 per cent of deaths globally each year; hypertension is a major risk factor for strokes; and obesity (that can lead to diabetes, breast and colon cancer, dementia and depression) is on the increase.

Research carried out by Martin and colleagues at the universities of Edinburgh and Western Australia has shown that human skin contains large stores of NO which is mobilised by exposure to UVA suppressing the development of obesity and lowering blood pressure which is essential to human health.

Martin said: "Current public health advice advocates avoiding direct exposure to sunlight for fear of skin cancer, but not being exposed to it at all may be a risk factor for disease. Our results could have significant implications for public health advice and may lead to a change in risk-benefit evaluation and future guidance for sun exposure."

Ensuring the sustainability of marine life

Climate change does not just affect the lives of humans and animals on land, creatures that live underwater also face significant challenges.

Hidden beneath the waves, marine organisms form an irreplaceable natural heritage and provide valuable ecosystem services. As the climate of our atmosphere changes, so does the temperature and water chemistry of our oceans, impacting the marine organisms on which we depend.

The Marine Invertebrate Physiology and Immunology Lab, led by Dr Chris Hauton from Ocean and Earth Science at Southampton, is collaborating with Bangor University to explore the long-term, interactive effects of reduced salinity and ocean acidification on two important crab species – the shore crab and the edible crab.

The physiological responses of more than 1,000 crabs are being monitored over a year to see how much energy they consume in coping with reduced salinity and pH levels, and what this means for their ability to grow, reproduce and fight disease in the future ocean.

Chris said: "This is one of the first long-term studies of climate change impacts on marine organisms. Crabs and other crustaceans survive short-term variations in conditions quite well. We need to find out whether they can cope in the long-term and when faced with modifications to more than one variable at a time, since these are the types of changes they will experience in the wild."

The project research fellow Dr Ben Ciotti added: "Studying responses of marine animals to more realistic climate scenarios allows us to forecast future impacts on marine ecosystems, and design measures to minimise or mitigate damage to biodiversity and living natural resources."

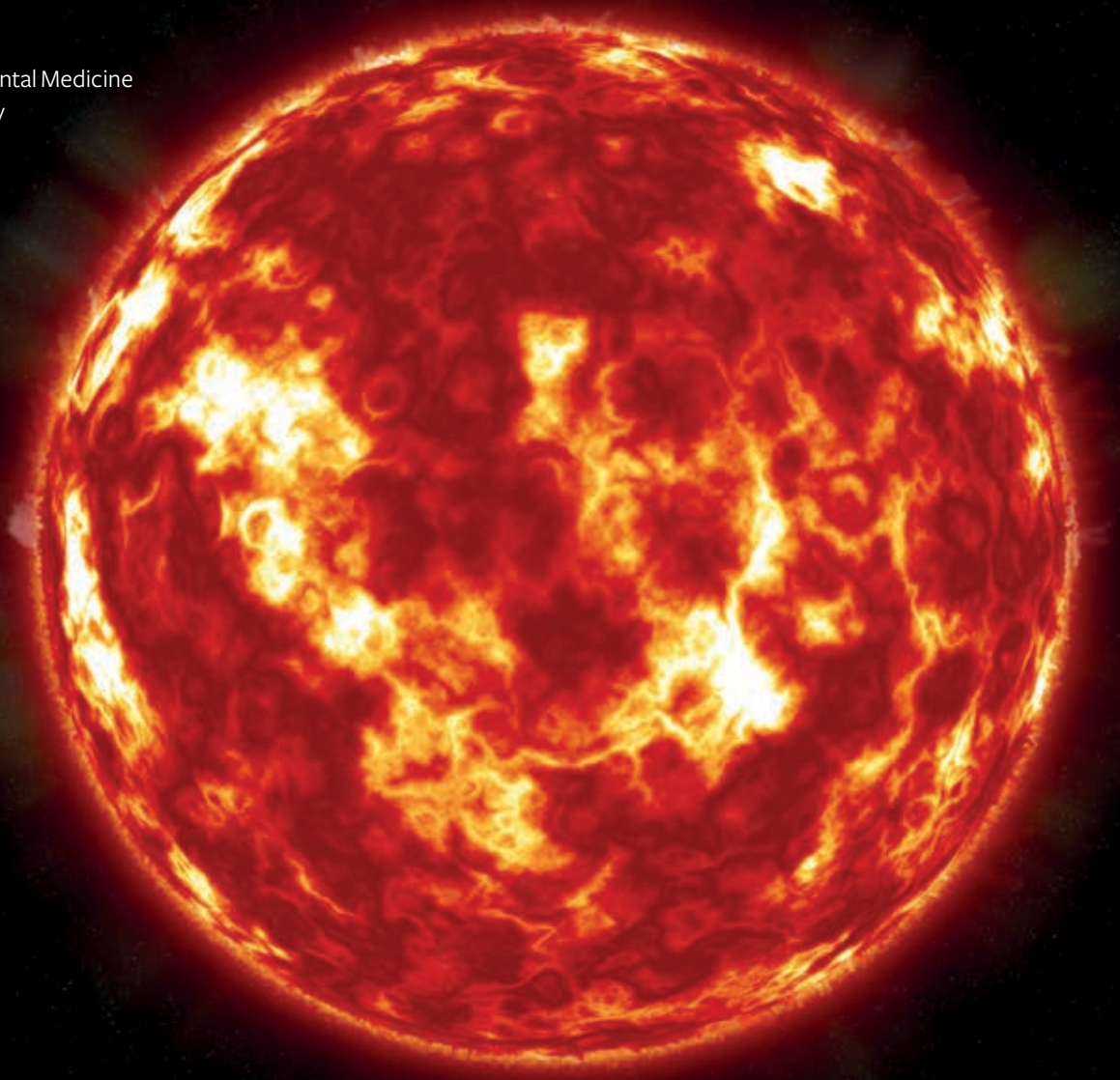
To find out more visit **www.southampton.ac.uk/ifls/globalchange**

Shore crab

Photo credit: Ben Ciotti

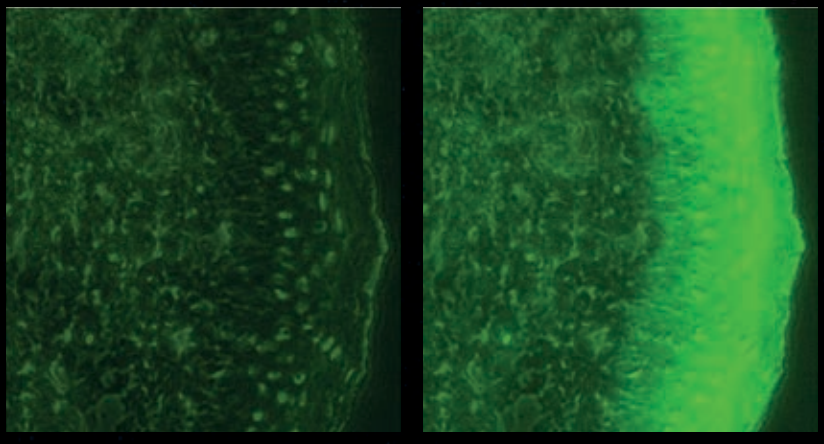
"Current public health advice advocates avoiding direct exposure to sunlight for fear of skin cancer, but not being exposed to it at all may be a risk factor for disease."

Martin Feelisch,
Professor of Experimental Medicine
and Integrative Biology



Images of a cross-section of human skin

A cross-section of human skin stained with a fluorescent dye sensitive to nitric oxide showing how and where ultraviolet light releases this substance in the tissue.



Before

After

Photo credit: M Minnion, DA Johnston, PM Lackie and M Feelisch

Analysing the complexity of data

Data is at the centre of every major scientific discovery that has shaped today's world from predicting the weather to unlocking the human genome.

As data is becoming more and more complex, there is a pressing need to develop new analytic and visualisation strategies that will allow scientists to interpret these large datasets.

Members of the Institute for Life Sciences (IfLS) community are at the forefront of new techniques to effectively analyse these data so that it can help inform medical research of the future.

The complexity of data

Creating data in a form that aids discovery is a delicate art and is a major challenge facing experimental scientists around the globe. However, recent rapid advances in experimental techniques and supporting technologies have opened up access to new areas of discovery.

These new techniques are enabling scientists to read the human genome, trace the structure and behaviour of key proteins, and investigate how transcription errors in DNA can contribute to cancer.

But with a typical sample of DNA containing a string of hundreds of thousands of symbols, a complete readout of the human genome would require many millions of dimensions, and it is this high dimensionality that is one of the main challenges in analysing these types of data.

Southampton Professor of Mathematical Sciences Jacek Brodzki is leading a number of interdisciplinary projects that are exploring the application of topology – the study of the shape of complex spaces – to data analysis. Their main areas of exploration are genomic studies, the phenotyping of asthma, and the precise characterisation of pre-eclampsia.

Jacek explains: "Topology provides numerical methods to classify spaces by comparing them to known shapes. We are developing a systematic fusion of statistical, machine learning and topological methods that can be applied to a range of datasets emerging in medical research.

"This is where difficult theoretical challenges abound and where new results can have immediate and significant impact."

Focusing on pre-eclampsia

Preliminary studies of pre-eclampsia data may lead to the discovery of predictors that would allow doctors to screen pregnant women for a predisposition to this potentially life-threatening condition.

Working with data supplied by colleagues in Medicine, the team has used topological analysis to detect various sub-types of pre-eclampsia, some of which are already known to clinicians but some of which may be new and will require further study.

Jacek said: "The flexibility of topology allows us to create models of data that can lead to new directions of clinical research, and this avenue of research is very promising."

Focusing on breast cancer

Jacek and his team, in collaboration with colleagues in Cancer Genetics, are also studying early onset breast cancer. Their research has discovered that the likelihood of the occurrence of cancer depends on a large number of mutations that occur in various parts of the genome.

"A true topological understanding of this result is very difficult to achieve and provides a robust test for topological methods," said Jacek.

They are exploring genomic data from the environment within which the cancer tumours exist to see if there are novel patterns that could lead to better understanding of an individual patient's risk of developing cancer and their anticipated prognosis.

Focusing on asthma

Promising new asthma phenotypes have been identified thanks to the collaboration between the IfLS and the U-BIOPRED consortium (the largest asthma research programme in the world, redefining severe asthma based on various types of high-dimensional clinical and biomarker data).

These findings are potentially very important for future asthma diagnostic strategies and saw the team studying inference and verification methods to ensure the robustness of topological models.

To find out more visit:
www.southampton.ac.uk/ifls/humannexus

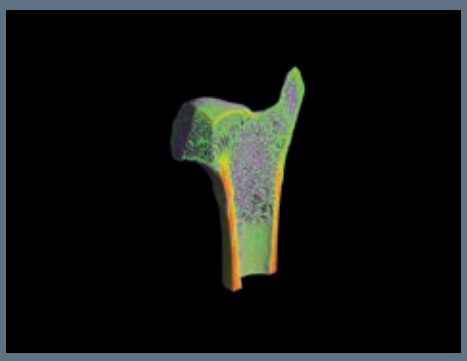
A topological representation of data created in a study of pre-eclampsia indicating the existence of significant clusters coloured by distinguishing clinical features.

Photo credit: Brodzki, Smyth, Spakulova using Ayasdi Core software.

"Topology provides numerical methods to classify spaces by comparing them to known shapes. We are developing a systematic fusion of statistical, machine learning and topological methods that can be applied to a range of datasets emerging in medical research."

Jacek Brodzki
Professor of Mathematical Sciences

In brief



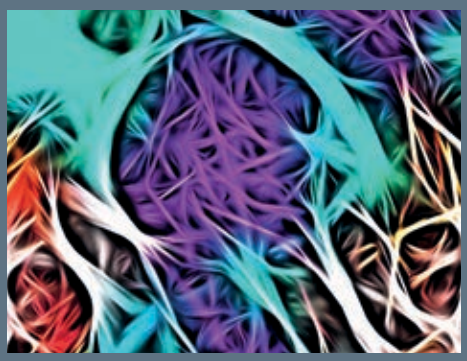
Creating a hub of bone expertise – FortisNet

The IfLS is leading the way in facilitating a hub of expertise in the field of bone and soft tissue research and development.

The University of Southampton has an enormous concentration of expertise in research centred around bone and soft tissue – from stem cell technology, to designing better implants and prosthetic limbs, to assisting the rehabilitation of patients.

FortisNet will see the Institute drawing together this expertise from across the University, and encouraging and enabling collaboration with counterparts from industry, health services and other organisations around the Solent region.

IfLS Director Professor Peter J S Smith said: "Our aim is to become an innovation hub for bone and soft tissue research and development, to create high quality jobs for our graduates and to enhance the employment opportunities within these specialisms in the Solent area."



Focusing in on Nucleic Acids (FioNA)

Since the IfLS launched its Focusing in on Nucleic Acids (FioNA) programme in last year's Annual Report, the network has gone from strength to strength and is already starting to make an impact on policy, enterprise and outreach.

FioNA has supported a number of different activities promoting nucleic acids research within these three areas – including the Next Generation Sequencing (NGS) Symposium, collaborating with the new South Wiltshire University Technical College, and organising the IfLS Conference: Epigenetics and Evolution.

Support for the NGS Symposium has seen the identification of the next big challenge for FioNA that links directly with one of the Institute's grand challenges – the Human Nexus. The network will focus on tackling one of the major issues facing scientists today – how to interpret, analyse, and maximise the use of the large datasets generated through nucleic acids research.

To find out more visit **www.southampton.ac.uk/ifls/fiona**

Award recognises research excellence

IfLS member Dr Roxana Carare has recently been recognised for the quality of her research in the Dementia Research Leaders awards.

The awards were set up by the Alzheimer's Society to mark the contribution that early-career researchers make to dementia research and those affected by dementia.

Roxana, an Associate Professor in Clinical Neurosciences, in Medicine at Southampton, was awarded runner-up in the Academic Achievement award for her achievements and the challenges she has had to overcome in her research to help prevent and treat neurodegenerative diseases.

As we age our brains gradually lose the ability to clear away the protein amyloid-beta, a condition which is exacerbated by Alzheimer's disease. Roxana has demonstrated a major pathway by which amyloid is removed from the brain.

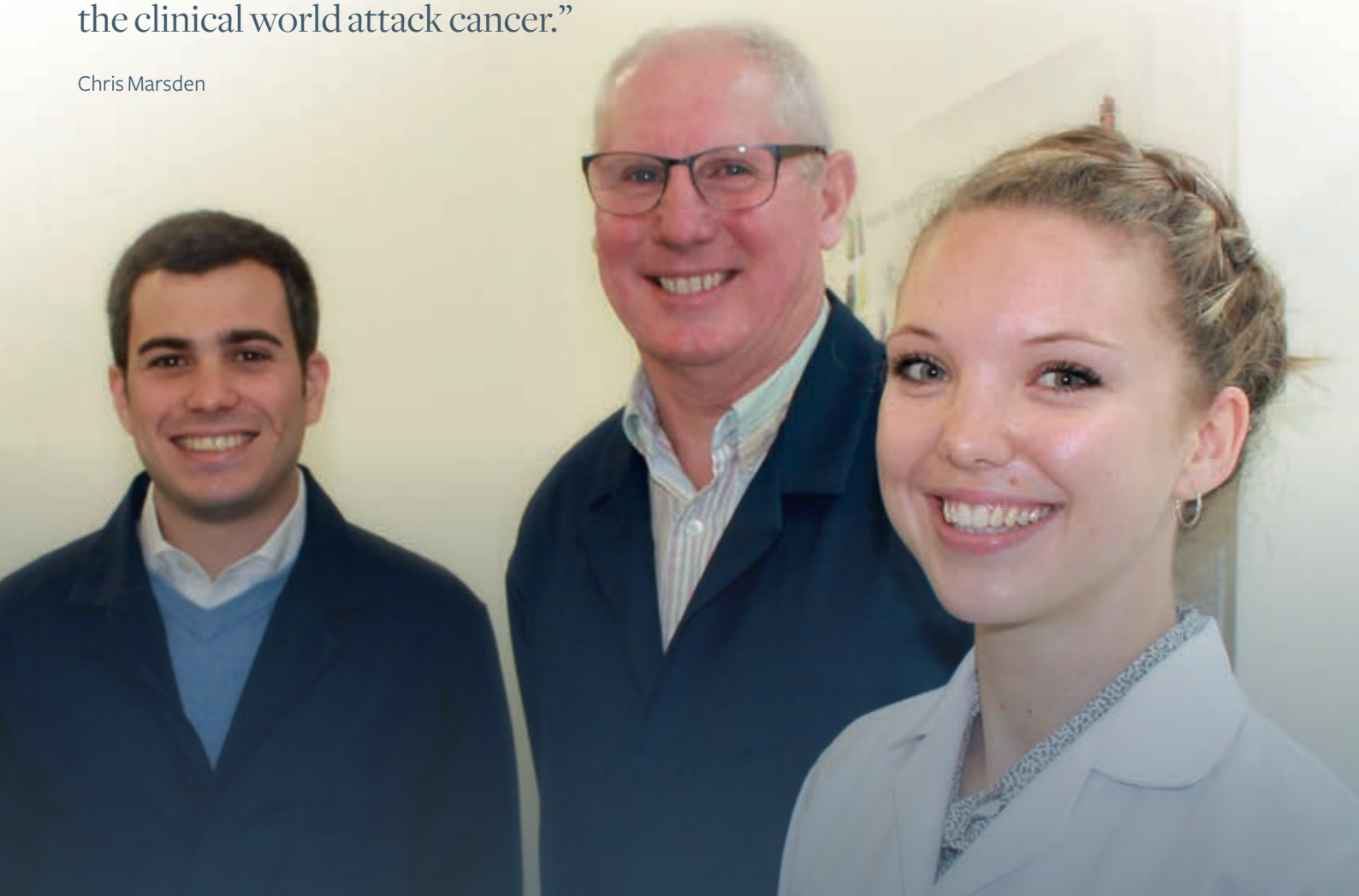
She is now focusing on manipulating these pathways in order to improve amyloid clearance from an ageing brain.

Roxana received £500 for personal and professional development from Dr James Pickett, Head of Research at the Alzheimer's Society.

Photo credit: Professor Richard Oreffo, Bone and Joint Research Group

"The funding we provide to the IfLS is a legacy. We are doing our little bit in the hope that they will find answers to questions that will help the clinical world attack cancer."

Chris Marsden



Helping in the global fight against cancer and childhood disease

Two new interdisciplinary PhD research posts have been created thanks to significant philanthropic funding from long-term Institute for Life Sciences (IfLS) supporter Chris Marsden.

Chris has donated nearly £70,000 as a legacy to his late wife Hilary who died from cancer in 2004. The money will part fund PhD students Emma Sutton and Enrico Mossotto's research that could help in the battle to beat cancer and childhood diseases.

Chris said: "You don't understand diseases like cancer first hand until they knock on your door, it is only then you realise how devastating they have been to thousands of people. It puts it in a completely different light and you realise you should be doing more about it.

"When my wife died of cancer, that's when my family and I realised we could do a little bit more. The funding we provide to the IfLS is a legacy for her. We are doing our little bit in the hope that they will find answers to questions that will help the clinical world attack cancer."

Emma will be exploring the molecular mechanisms involved in developing effective cancer immunotherapy, while Enrico will be developing a mathematical model that can efficiently analyse large genomic datasets to provide better, quicker, more targeted treatment for children with bowel disease.

To find out more visit **www.southampton.ac.uk/ifls/about/our_students.page**

IfLS supporter Chris Marsden meets PhD students Enrico Mossotto and Emma Sutton.

"It is exciting and challenging to be approaching a medical problem using the tools of the engineer and mathematician. The interdisciplinary approach has the potential to produce novel insights in cell biology."

Patricia Goggin,
IfLS Postgraduate Research Student

Patricia Goggin is a IfLS PhD student studying three dimensional bone structure in health and disease. The osteocyte is a crucial cell for mechanosensation and transmission of signals within bone. The processes link blood vessels, bone marrow and other bone cells to regulate homeostasis. Understanding osteocyte structure may help in developing treatments for bone conditions such as osteoporosis. This image has been produced using serial block face scanning electron microscopy and Amira software.

Photo credit: Patricia Goggin, IfLS Postgraduate Research Student

A sample of publications from our members: 2014–2015

The Institute is a catalyst for interdisciplinary research and training. Working across the University campuses and the regional community, we aim to develop our collaborative models and address key societal issues and enterprise opportunities. The sample of publications are a selection from many hundreds produced by our members and illustrate the type of research being carried out under our grand challenges.

New Pathways to Health

Bryant JA et al (2015)
Higher oily fish consumption in late pregnancy is associated with reduced aortic stiffness in the child at age 9 years.
Circulation Research 116:1202-1205.

Bull KS et al (2014)
Improved health-related quality of life outcomes associated with SHH subgroup medulloblastoma in SIOP-UKCCSG PNET3 trial survivors.
Acta Neuropathol. 128:151-153. (doi:10.1007/s00401-014-1300-4)

Clifford V, Tebruegge M and Curtis N (2015)
Limitations of current tuberculosis screening tests in immunosuppressed patients.
British Medical Journal 350:h2226.

Dillon J et al (2015)
Metabotropic Glutamate Receptors: Modulators of context-dependent feeding behaviour in C. elegans.
J. Biol. Chem. 290(24):15052-65. (doi:10.1074/jbc.M114.606608)

Hawkes CA, Carare RO and Weller RO (2014)
Amyloid and tau in the brain in sporadic Alzheimer's disease: defining the chicken and the egg.
Acta Neuropathologica 127(4):617-618. (doi:10.1007/s00401-014-1243-9)

Head MG et al (2014)
Investment in pneumonia and pneumococcal research.
Lancet Infect. Dis. 14(11):1037-8. (doi:10.1016/S1473-3099(14)70949-1)

Kermack AJ et al (2014)
A randomised controlled trial of a preconceptional dietary intervention in women undergoing IVF treatment (PREPARE trial).
BMC Women's Health 14:130. (doi:10.1186/1472-6874-14-130)

Lillycrop KA et al (2015)
Association between perinatal methylation of the neuronal differentiation regulator HES1 and later childhood neurocognitive function and behaviour.
In.t J. Epidemiol. (Epub), doi:10.1093/ije/dyv052

Loxham M et al (2015)
The effects on bronchial epithelial mucociliary cultures of coarse, fine, and ultrafine particulate matter from an underground railway station.
Toxicological Sciences 145(1):98-107. (doi:10.1093/toxsci/kfv034)

McElroy KE et al (2014)
Strain-specific parallel evolution drives short-term diversification during Pseudomonas aeruginosa biofilm formation.
Proc. Natl. Acad. Sci. USA 111(14):E1419-27. (doi:10.1073/pnas.1314340111.)

Meyers DA, Bleecker ER, Holloway JW and Holgate ST (2014)
Asthma genetics and personalised medicine.
The Lancet Respiratory Medicine 2(5):405-415. (doi:10.1016/S2213-2600(14)70012-8)

Murphy C, Prieto J and Fader M (2015)
"It's easier to stick a tube in": a qualitative study to understand clinicians' individual decisions to place urinary catheters in acute medical care.
BMJ Quality & Safety 24 (7):444-450. (doi:10.1136/bmjqs-2015-004114)

White AL et al (2014)
Conformation of the Human Immunoglobulin G2 Hinge Imparts Superagonistic Properties to Immunostimulatory Anticancer Antibodies.
Cancer Cell 27(1):138-148. (doi: 10.1016/j.ccell.2014.11.001)

Life Technologies

Agyapong-Badu S et al (2014)
Anterior thigh composition measured using ultrasound imaging to quantify relative thickness of muscle and non-contractile tissue: a potential biomarker for musculoskeletal health.
Physiological Measurement 35: 2165–2176.

Alidousti H, Taylor M and Bressloff NW (2014)
Periprosthetic wear particle migration and distribution modelling and the implication for osteolysis in cementless total hip replacement.
J. Mech. Behav. Biomed. Mat. 32:225-244.

Casanova M, Little D, Müller R and Schneider P (2014)
Quantitative phenotyping of bone fracture repair: a review.
BoneKEy Reports 3:550. (doi:10.1038/bonekey.2014.45)

Daly KR and Roose T (2015)
Homogenization of two fluid flow in porous media.
Proceedings of the Royal Society A: Mathematical Physical and Engineering Sciences 471:20140564. (doi:10.1098/rspa.2014.0564)

Dario C et al (2014)
A thin-reflector microfluidic resonator for continuous-flow concentration of microorganisms: a new approach to water quality analysis using acoustofluidics.
Lab on a Chip (19): 3830-3842. (doi:10.1039/C4LC00577E)

Dickinson AS, Browne M, Roques AC and Taylor AC (2014)
A fatigue assessment technique for modular and pre-stressed orthopaedic implants.
Medical Engineering & Physics 36(1):72-80. (doi:10.1016/j.medengphy.2013.09.009)

Dumez JN et al (2015)
Theory of long-lived nuclear spin states in methyl groups and quantum-rotor induced polarisation.
J. Chem. Phys.142(4):044506. (doi:10.1063/1.4906273)

Hassan S, Morgan H, Zhang X and Niu X (2015)
Droplet interfaced parallel and quantitative microfluidic-based separations.
Analytical Chemistry 87(7):3895-3901. (doi:10.1021/ac504695w)

Kongsuphol P et al (2014)
EIS-based biosensor for ultra-sensitive detection of TNF-alpha from non-diluted human serum.
Biosensors and Bioelectronics 61:274-279. (doi:10.1016/j.bios.2014.05.017)

Laurent C et al (2014)
Nanomechanical properties of bird feather rachises: exploring naturally occurring fibre reinforced laminar composites.
Journal of the Royal Society Interface 11(101):20140961. (doi:10.1098/rsif.2014.0961)

Leung YM, Holdbrook DA, Piggot TJ and Khalid S (2014)
The NorM MATE transporter from N. gonorrhoeae: insights into drug and ion binding from atomistic molecular dynamics simulations.
Biophysical Journal 107(2):460-468. (doi:10.1016/j.bpj.2014.06.005)

Nobakhti S, Limbert G and Thurner P (2014)
Cement lines and interlamellar areas in compact bone as strain amplifiers – contributors to elasticity, fracture toughness and mechanotransduction.
Journal of the Mechanical Behavior of Biomedical Materials 29: 235-251. (doi:10.1016/j.jmbbm.2013.09.011)

Papadopoulou E et al (2015)
Strain discrimination of Yersinia pestis using a SERS-based electrochemically driven melting curve analysis of variable number tandem repeat sequences.
Chem. Sci. 6:1846 – 1852. (doi: 10.1039/c4sc03084b)

Prasad A, Huefner A, Mahajan S and Seshia AA (2015)
Investigating biomechanical noise in neuroblastoma cells using the quartz crystal microbalance.
Journal of the Royal Society Interface 12(106):20141389-20141389. (doi:10.1098/rsif.2014.1389)

Saha SC et al (2015)
Screening ion-channel ligand interactions with passive pumping in a microfluidic bilayer lipid membrane (BLM) chip.
Biomicrofluidics 9:014103. (doi:10.1063/1.4905313)

Sones CL et al (2014)
Laser-induced photo-polymerisation for creation of paper-based fluidic devices.
Lab on a Chip 14:4567-4574.

Tait A et al (2015)
Biocompatibility of poly(2-alkyl-2-oxazoline) brush surfaces for adherent lung cell lines.
Biomaterials 61: 26-32. (doi:10.1016/j.biomaterials.2015.04.059)

Tedesco Triccas L et al (2015)
Multiple sessions of transcranial direct current stimulation and upper extremity rehabilitation in stroke: A review and meta-analysis.
Clinical Neurophysiology (Epub) doi:10.1016/j.clinph.2015.04.067.

Trantidou T, Terracciano CM, Kontziampasis D, Humphrey EJ and Prodromakis T (2015)
Biorealistic cardiac cell culture platforms with integrated monitoring of extracellular action potentials.
Scientific Reports 5: 11067. (doi:10.1038/srep11067)

Global Change: Systems and Cycles

Birch J et al (2014)
What benefits do community forests provide, and to whom? A rapid assessment of ecosystem services from a Himalayan forest, Nepal.
Ecosystem Services 8:118-127. (doi:10.1016/j.ecoser.2014.03.005)

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A bioelectrochemical approach to characterize extracellular electron transfer by Synechocystis sp. PCC6803.
PLoS ONE 9(3):e91484. (doi:10.1371/journal.pone.0091484)

D'Angelo C et al (2015)
Local adaptation constrains the distribution potential of heat-tolerant Symbiodinium from the Persian/Arabian Gulf.
The ISME Journal, online doi:10.1038/ismej.2015.80.

Dearing JA et al (2015)
Social-ecological systems in the Anthropocene: the need for integrating social and biophysical records at regional scales.
The Anthropocene Review (Epub), doi:10.1177/2053019615579128.

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Vulnerability of ecosystems to climate change moderated by habitat intactness.
Global Change Biology 21(1):275-286. (doi:10.1111/gcb.12669)

Lucas CH et al (2014)
Gelatinous zooplankton biomass in the global oceans: geographic variation and environmental drivers.
Global Ecology and Biogeography 23(7):701-714. (doi:10.1111/geb.12169)

Morris JP et al (2015)
Characterising multi-level effects of an acute pressure exposure on a shallow-water invertebrate: insights into the kinetics and hierarchy of the stress response.
Journal of Experimental Biology, online doi:10.1242/jeb.125914.

Song B et al (2014)
Impact of volcanic ash on anammox communities in deep sea sediments.
Environmental Microbiology Reports 6(2):159-166.
(doi:10.1111/1758-2229.12137)

Spake R et al (2015)
A meta-analysis of functional group responses to forest recovery outside of the tropics.
Conservation Biology, online doi:10.1111/cobi.12548.

Whiteside JH et al (2015)
Extreme ecosystem instability suppressed tropical dinosaur dominance for 30 million years.
Proc. Natl. Acad. Sci. USA 112(26):7909-7913. (doi:10.1073/pnas.1505252112)

Human Nexus

Andreoletti G et al (2015)
Exome analysis of patients with concurrent pediatric inflammatory bowel disease (PIBD) and autoimmune disease.
Inflammatory Bowel Diseases 21(6):1229-1236.
(doi:10.1097/MIB.0000000000000381)

Boehning D, Mylona K and Kimber A (2015)
Meta-analysis of clinical trials with rare events.
Biometrical Journal 57:633-648.

Bønnelykke K et al (2014)
A genome-wide association study identifies CDHR3 as a susceptibility locus for early childhood asthma with severe exacerbations.
Nature Genetics 46(1):51-55.

Kaiping GA, Jacobs GS, Cox SJ and Sluckin TJ (2014)
Nonequivalence of updating rules in evolutionary games under high mutation rates.
Phys. Rev. E 90(4):042726. (doi: 10.1103/PhysRevE.90.042726)

Kassebaum NJ et al (2014)
Global, regional, and national levels and causes of maternal mortality during 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013.
Lancet 384:980-1004.

Kuijper B and Hoyle RB (2015)
When to rely on maternal effects and when on phenotypic plasticity?
Evolution 69(4):950-968. (doi:10.1111/evo.12635)

Murray A et al (2014)
Population-based estimates of the prevalence of FMR1 expansion mutations in women with early menopause and primary ovarian insufficiency.
Genetics in Medicine 16(1):19-24. (doi:10.1038/gim.2013.64)

Pengelly RJ et al (2014)
Resolving clinical diagnoses for syndromic cleft lip and/or palate phenotypes using whole-exome sequencing.
Clinical Genetics (Epub) doi:10.1111/cge.12547.

Smyth C et al (2015)
Quantifying the cumulative effect of low-penetrance genetic variants on breast cancer risk.
Molecular Genetics & Genomic Medicine 3(3):182-188.
(doi: 10.1002/mgg3.129)

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