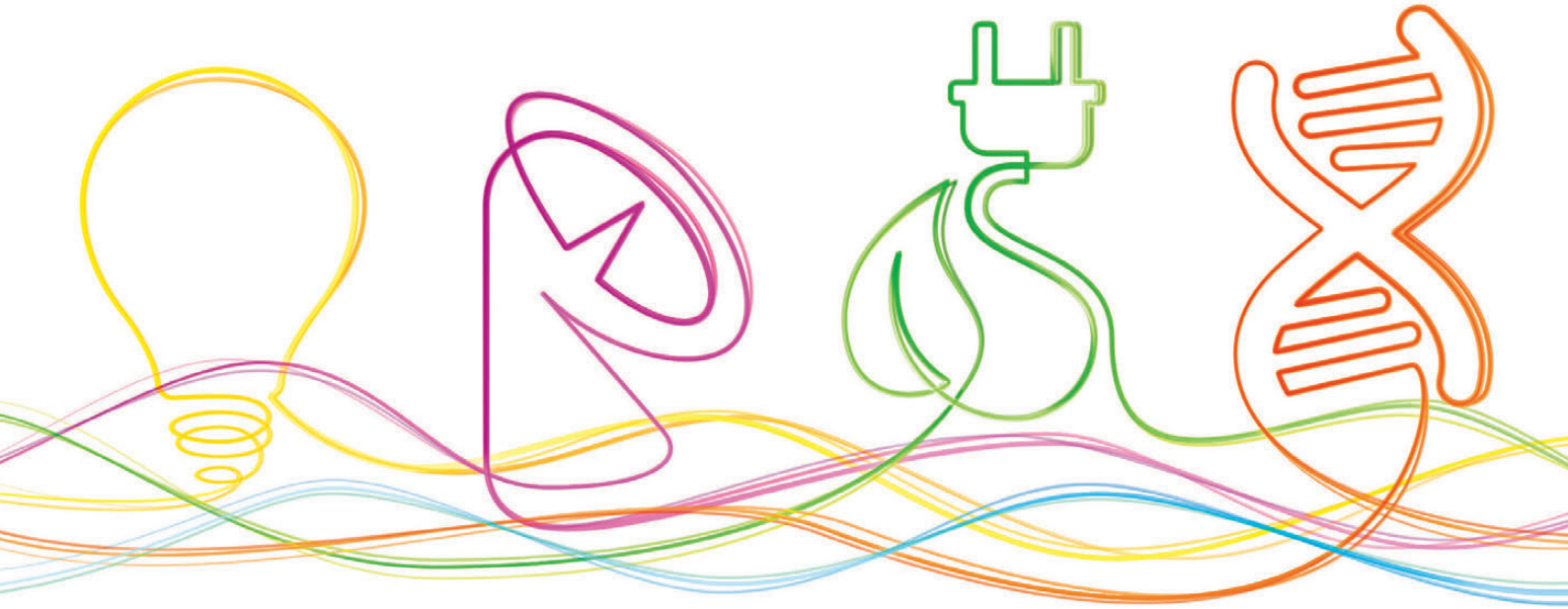
IOP BUSINESS INNOVATION AWARDS 2017

Innovative physics. Winning solutions.



IOP Institute of Physics

The Institute of Physics is a leading scientific membership society working to advance physics for the benefit of all.

We have a worldwide membership, from enthusiastic amateurs to those at the top of their fields in academia, business, education and government.

Our purpose is to gather, inspire, guide, represent and celebrate all who share a passion for physics. And, in our role as a charity, we're here to ensure that physics delivers on its exceptional potential to benefit society.

Alongside professional support for our members, we engage with policymakers and the public to increase awareness and understanding of the value that physics holds for all of us.

Our subsidiary company, IOP Publishing, is a world leader in scientific communications, publishing journals, ebooks, magazines and websites globally.

You can help us transform the future of our discipline.
Invest in physics today at **iop.org/fundraising**

Find out about our strategy for success at **iop.org/strategy**

WELCOME TO THE AWARDS

Physics is at the heart of innovations all around us. It's in your home, in your car and in your pocket. It helps you get more work done and enjoy more time off, gets you where you're going and keeps us all safe. It underpins the growth that will secure our economic future.

The Institute's Business Innovation Awards are the only awards recognising companies in the UK and Ireland that have built success on the innovative application of physics – companies that have generated profit, secured jobs and improved efficiency across a range of sectors, from oil and gas to renewable energy, medical technologies to high-tech manufacturing.

This year also sees the launch of the Institute's Business Innovation and Growth Group. This will support entrepreneurs, small-to-medium-sized enterprises and larger companies taking physics-based ideas, products and services to market. It will enable our members to build supportive networks, share knowledge and explore collaborations, as well as access business support, finance and affordable workspace – empowering them to continue to produce the physics-based innovations that can make our economy thrive.

Introduction

Professor Dame Julia Higgins
DBE FRS FREng CPhys
Hon.FInstP
President, Institute of Physics

Physics-based innovation is at the heart of the UK's successes.

Physics is pivotal to the innovative technologies that drive economic growth, boost productivity and spur advances in better healthcare, more effective security, cleaner and more efficient power generation, and so much more besides.

At the Institute of Physics we think that the companies leading the way in those innovations should be recognised and celebrated. That's what our Business Innovation Awards are for.

These are the only awards in the UK and Ireland recognising companies that have built success on the innovative application of physics. Now in their sixth year, we're delighted to have celebrated 34 high-growth businesses that are succeeding through physics-based innovation.

This year's winners, detailed in this booklet, serve as tremendous examples of the many different ways in which physics can improve, save or protect lives and how it forms an invaluable part of the UK economy.

Their successes have been made possible by investing in physics and in physicists. To continue to build on those successes, it is essential that public- and private-sector investors continue to invest in physics education, research and innovation.

I would like to offer my warmest congratulations to all of this year's winners. Companies such as these are the backbone of a high-tech economy and society, and I wish them ever greater successes in the future.

“It is a great honour to receive this award, which is recognition of the outstanding team at ICEoxford, who continue to produce world-class innovative products for the global cryogenic markets.”

Chris Busby, managing director, ICEoxford

“This award is a great recognition of our ambition to innovate and collaborate with the wider physics network and to bring the discoveries out of the lab and into the real world.”

Graeme Malcolm OBE, CEO and founder, M Squared

“We’re delighted to receive this prestigious award and for the recognition by IOP of ANT’s highly innovative medical technology.”

Ian Quirk, CEO, Active Needle Technology

“It’s an honour to receive this award; a testament to our team’s dedication and the loyal support of our customers.”

James Kingsley, founder and managing director, Ossila

Business Innovation Award winners 2017

Innovation Award

Awarded to businesses for bringing new physics-based products, processes or services to market, which have had a transformative effect resulting in increased turnover, profitability and jobs.

Winners

- ICEoxford
- M Squared
- MR Solutions
- Ossila
- Thornton Tomasetti Defence

INNOVATION AWARD 2017

IOP Institute of Physics

Commended Innovation

Awarded to businesses for an outstanding innovative application of physics that pushes technological boundaries or leads to the development of bespoke solutions to market challenges, opening up new opportunities for discovery or market creation.

Winners

- Active Needle Technology
- Oxford Space Systems
- pureLiFi
- Rolls-Royce

COMMENDED INNOVATION 2017

IOP Institute of Physics

“This award represents a fantastic stamp of recognition from the Institute on the record-breaking achievements of the OSS team.”

Mike Lawton, chief executive, Oxford Space Systems

“We’re honoured by this recognition of our technical advancement as we strive to be a global driver of change and innovation in our industry.”

Tom Scarangello, chairman and CEO, Thornton Tomasetti Inc.

“After years of research, recognition by the IOP of the science in developing cryogen-free, superconducting MRI scanners is greatly appreciated.”

David Taylor, CEO, MR Solutions

“We’re extremely proud and delighted to receive the IOP Business Innovation Award, which recognises our advances in electrical systems integration.”

Paul Stein, CTO, Rolls-Royce

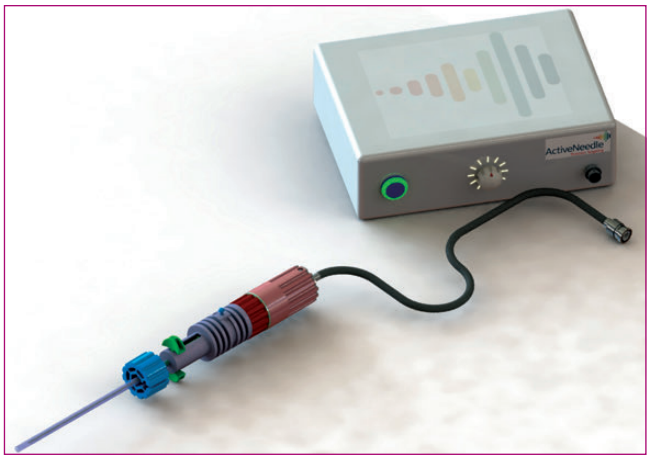
ACTIVE NEEDLE TECHNOLOGY

For the development of high-visibility needles that improve image-guided medical procedures.

Accurate needle placement is essential for interventional medical procedures: failure to do so can result in harm to patients, repeat procedures, delays in patient treatments and increased costs. Currently, approximately 30% of core needle biopsies have to be repeated. One of the key reasons for this is inaccurate needle placement: meaning that biopsy specimens are not taken from the intended region (due to lack of visibility and needle bending during insertion).

Active Needle Technology applied a simple principle of physics to innovatively improve the visibility of the needles used in biopsies – and reduce the level of skill required to conduct the procedure. A high-frequency oscillation is applied to the needles, resulting in them vibrating backwards and forwards by microscopic distances. The oscillations show up brightly when imaged in Doppler ultrasound mode (a mode that exists on ultrasound imaging systems and which detects movement). The coloured Doppler image very clearly shows the position of the inserted needle. Optimisation of the way in which the oscillation is applied, reduces needle bending. Consequently, this simple innovation addresses the principal causes of needles missing tumours in patients.

By improving the visibility of the needles and reducing their deflection, there are measurable improvements to clinical results: reduced procedure time and cost, a reduced number of repeat procedures – thereby freeing valuable resources



– reduced delays to patient treatment and, finally, reduced patient anxiety and improved well-being.

The company

Active Needle Technology is a pre-revenue medical device company aiming to commercialise its award-winning "needle actuating device" technology into a well-segmented $4+ billion special-purpose needle market. The initial focus is to exploit the ~$1 billion biopsy market to enable precise ultrasound-guided needle targeting of suspected tumours.

Halving the repeat biopsy rate would result in more than

£25 m

in savings for the NHS

Images: Active Needle Technology/Shutterstock

The winners

ICEoxford

For the development of the Kelvin High Cooling Power Cryogenic System, which will enable research in photonic quantum computing.

The research application of the integration of quantum photonic circuits with single-photon detectors in cryogenic environments will enable quantum photonic computers that will revolutionise computing over the coming decades.

Quantum computing is based on quantum bits or qubits. Unlike traditional computers, in which bits must have a value of either zero or one, a qubit can represent a zero, a one, or both values simultaneously. Representing information in qubits allows the information to be processed in ways that have no equivalent in classical computing, taking advantage of phenomena such as quantum tunneling and quantum entanglement. As such, quantum computers may theoretically be able to solve certain problems in a few days that would take millions of years on a classical computer.

A requirement of this research is the dissipation of large amounts of power while keeping the processor at an ultra-low temperature. Such conditions can be achieved in the patented cryostats developed by ICEoxford. This is a unique solution and has outperformed all other products currently in the market. Therefore, it has contributed significantly to the development of quantum photonic instruments.

The company

ICEoxford was established in 2004 and has become a leading manufacturer of top performance, state-of-the-art cryogenic systems for scientific research and industry around the world. The company employs 20 people and operates from its factory in Witney, Oxfordshire.

Innovation is expected to

double

turnover within two years

Images: ICEoxford

M SQUARED

For the development of the Aurora microscope, enabling 3D imaging of live cells, improving the understanding of diseases and providing a better chance of curing them.

M Squared developed Aurora for scientists to perform 3D volumetric imaging of live cells and fixed tissue so they can understand more about the biological processes of diseases such as cancer and dementia, with the hope of finding cures.

To meet the varying and high demands in neuroscience, developmental biology, regenerative medicine and cancer research, M Squared used Airy beam propagation light-sheet technology because understanding functional biology requires simultaneous sub-cellular and tissue imaging to be performed in seconds and minutes rather than hours.

Compact, modular and affordable, Aurora is a step change in light-sheet imaging technology that is capable of high spatial resolution, a large field of view, low photo-bleaching and deeper penetration, while rapidly acquiring and processing scanned data. It can also be configured to suit a researcher's specific requirements and budget.

Aurora is also facilitating new and exciting collaborations with researchers at leading universities and institutes that are pushing the system's capabilities, for example, large-area pancreatic function studies in Zebrafish, brain organoids and connectomes in neuroscience, where large-volume and sub-cellular resolution is required.

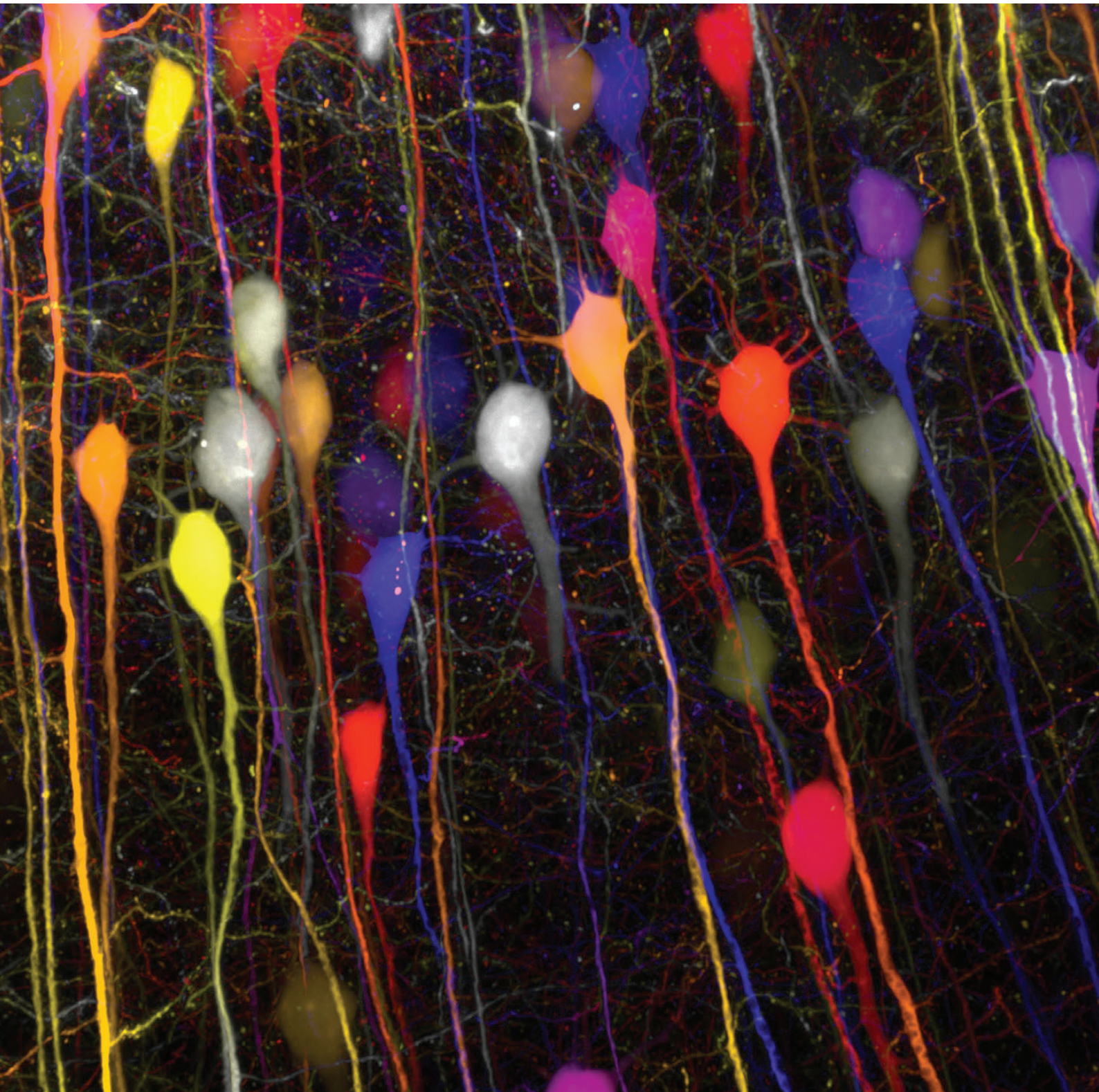
The company

M Squared is a leading developer of photonic and quantum technologies, harnessing the power of light to drive society-changing innovation. The tools it designs and manufactures are used in collaboration with Nobel Prize-winning scientists, the world's top universities and innovative manufacturers.

First-year sales of

£650K

Images: M Squared/Dr Anthony Vernon and Robert Chesters



The winners

MR SOLUTIONS

For the development of the first commercially available preclinical, helium-free high-field MRI imaging systems.

Previously, high-field MRI scanners (those with a strength of more than 3T) required huge magnets bathed in liquid helium, an emergency venting system and their own room: meaning they were both expensive and required a lot of space to install.

MR Solutions' research has developed a range of preclinical multi-modality MRI scanners that no longer require liquid helium to cool the magnets enough to achieve superconductivity. The company has developed a novel magnet design that only needs a readily available cryocooler unit to achieve the very low temperature required.

This technology has many benefits: it has halved the price, improved the imaging quality, reduced the stray magnetic field from metres to a few centimetres and almost halved the footprint for the lab. Combined multi-modality imaging technologies, such as MRI with PET or SPECT, can be incorporated either for simultaneous imaging or sequentially for more accurate comparative results. The scanner can also be wheeled in without the need to strengthen the floors or install emergency venting systems. MR Solutions' range of 3T to 9.4T MRI compact scanners are now being offered to research laboratories across the world.

The company

MR Solutions is an independent world leader in MRI technology and a developer and manufacturer of the world's first range of commercial, superconducting, cryogen-free (dry magnet), preclinical compact MRI systems. PET and SPECT modules can be added for sequential/simultaneous multi-modality imaging.

£8 m
revenue in 2016

Images: MR Solutions

OSSILA

For the development of a solar-cell prototyping platform.

Before this innovation, and despite the established worldwide community working on next-generation solar cells, there were no supply chains or prototyping platforms available to provide the specific components required for this work. This meant that instead of being able to focus solely on making scientific advances, the solar-cell research community was spending substantial amounts of time and money on designing and sourcing the components that they needed.

Ossila's founders recognised this problem and built the company to address it. They developed the substrates, materials, masks and test boards to provide a solar-cell prototyping platform capable of producing world-class results.

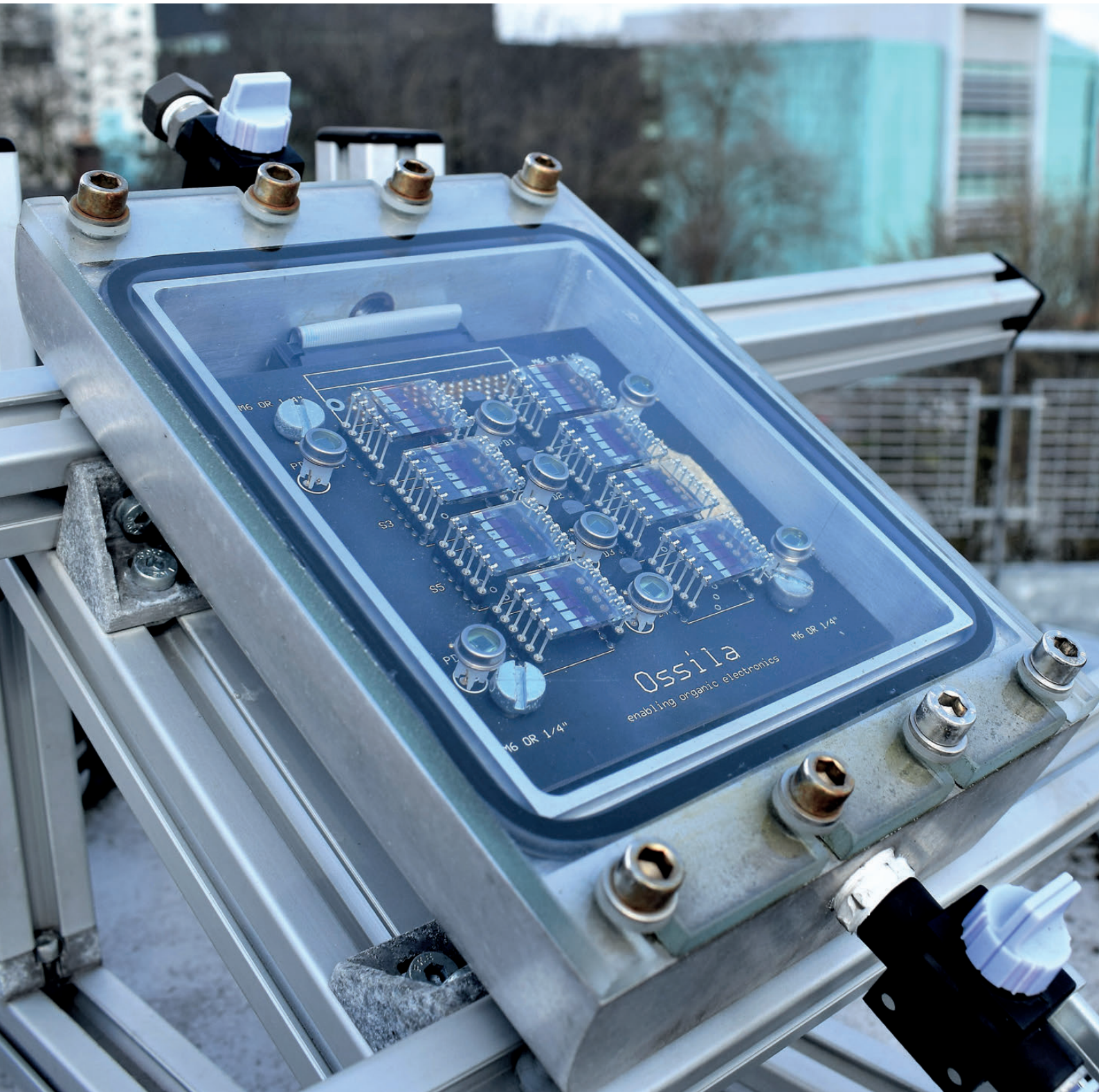
By handling the design and procurement processes, Ossila has enabled research to be significantly sped up and simplified, which lowers the barrier-to-entry for students new to the field. Funding for solar-cell research goes further with our cost-effective platform. Moreover, our standardised photovoltaic reference architectures and procedures result in reliable, reproducible data to use as a confident baseline of performance. Through Ossila's system of coherent, complementary materials and test equipment, researchers can be assured that their fabrication process has been optimised for the best results.

The company

Founded in 2009 by organic electronics research scientists, Ossila aims to provide the equipment and materials to enable smarter research and a faster pace of scientific discovery. Eight years on, we supply more than 1,000 institutions in 67 countries worldwide.

24
jobs created

Images: Ossila


M6 OR 1/4"
Ossila
enabling organic electronics

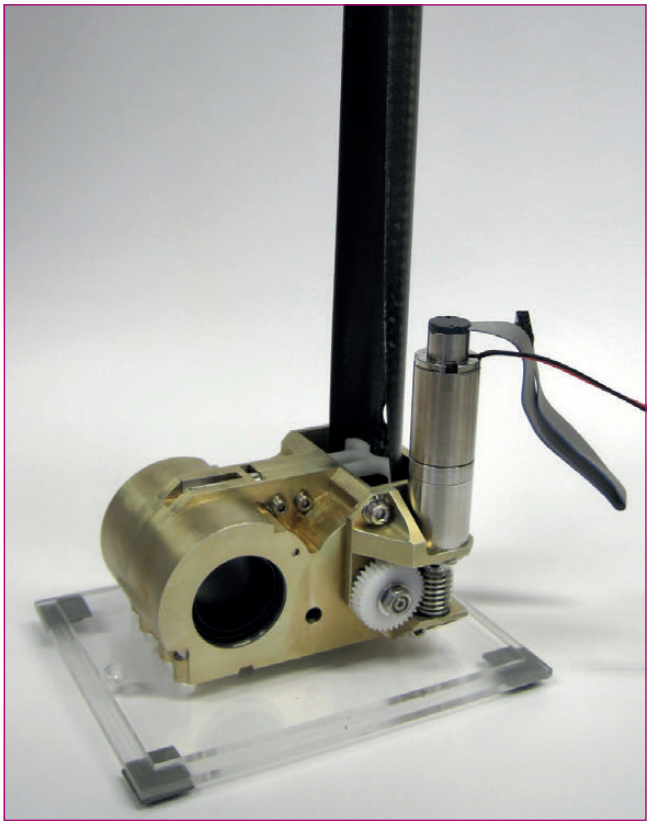
OXFORD SPACE SYSTEMS

For the development of the AstroTube Space Boom.

Launching satellites into space is very expensive – each kilogram costs around £50,000 to put into orbit. Booms are regularly used in satellites to deploy scientific instruments once the satellite is in orbit. Conventional booms are complex, heavy and expensive.

Oxford Space Systems' AstroTube boom addresses this problem using a combination of advanced materials and a new, proprietary physics-based software tool. The advanced proprietary materials developed include highly tuneable flexible composites: carbon-fibre-based materials that are thin enough to be rolled and stowed in a compact form, yet become fully rigid when deployed into their final configuration. Using these advanced materials, together with origami, allows for class-leading stowage efficiency and complexity reduction, meaning that deployable structures can be stowed more efficiently than ever before.

This translates into significant savings in terms of launch cost due to the reduced volume and mass of the satellite. The state-of-the art software developed by OSS, in collaboration with the University of Bristol, uses the latest research in applied mechanics to reliably predict the performance of flexible composites. An ability to predict on-orbit behaviour is critical in such a risk-averse industry and thus was key to achieving the first – and record-breaking – on-orbit demonstration in late 2016. This software was developed and validated using a comprehensive experimental programme and orbital operations data. OSS has been approached by two well-known US aerospace entities with requests to purchase the new proprietary software.



The company

Oxford Space Systems is a venture-capital-backed space technology business that is pioneering the development of deployable structures for the global satellite industry. Using novel proprietary materials, OSS products are lighter, simpler and more cost-effective than those in commercial demand.

£2 m
business generated

Images: Oxford Space Systems

pureLiFi

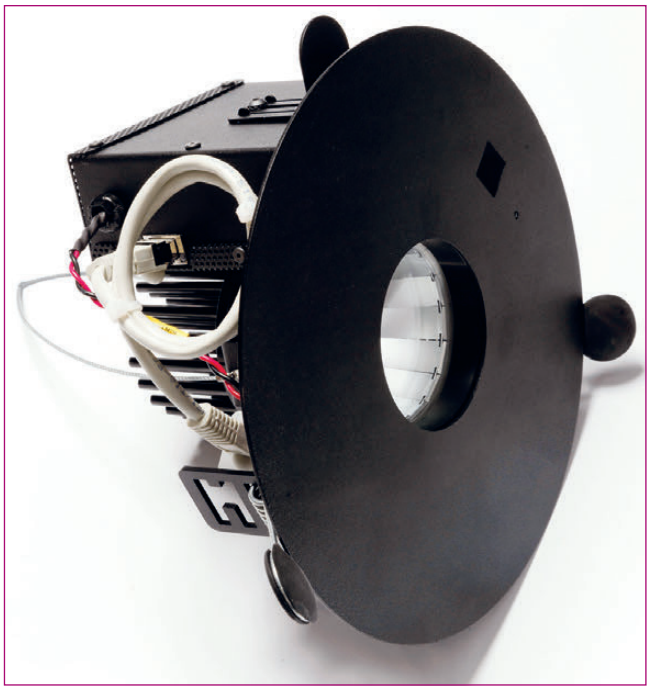
For the development of LiFi-X, providing wireless internet using the visible-light spectrum.

Imagine every LED light could connect you to the Internet. Lights in our homes, offices, buildings and streetlights connecting us to high-speed, secure and reliable internet. LiFi is high-speed bi-directional, fully networked and mobile communication of data using light.

Connectivity is evolving. The spectrum now has to accommodate more mobile users and a forecasted increase to 20 billion devices connected to the Internet of Things by the year 2020. It is time to future-proof our wireless networks to enable the connectivity demands of tomorrow. With LiFi we can utilise the spectrum more than 1000 times greater than the spectrum utilised for radio frequencies.

pureLiFi brought the first commercial LiFi product to the world and continue to lead the advancement of this ground-breaking technology. In 2016 they released the world's first LiFi-integrated luminaire and the world's fastest, smallest and most secure LiFi dongle.

The company was co-founded by Professor Harald Haas – known as the "Father of LiFI" – in 2011 after his famous TedGlobal talk, where he demonstrated light fidelity for the first time and coined the phrase LiFi. pureLiFi is pioneering the advancement of LiFi, which will revolutionise wireless communications and deliver unprecedented bandwidth and data to the world.



The company

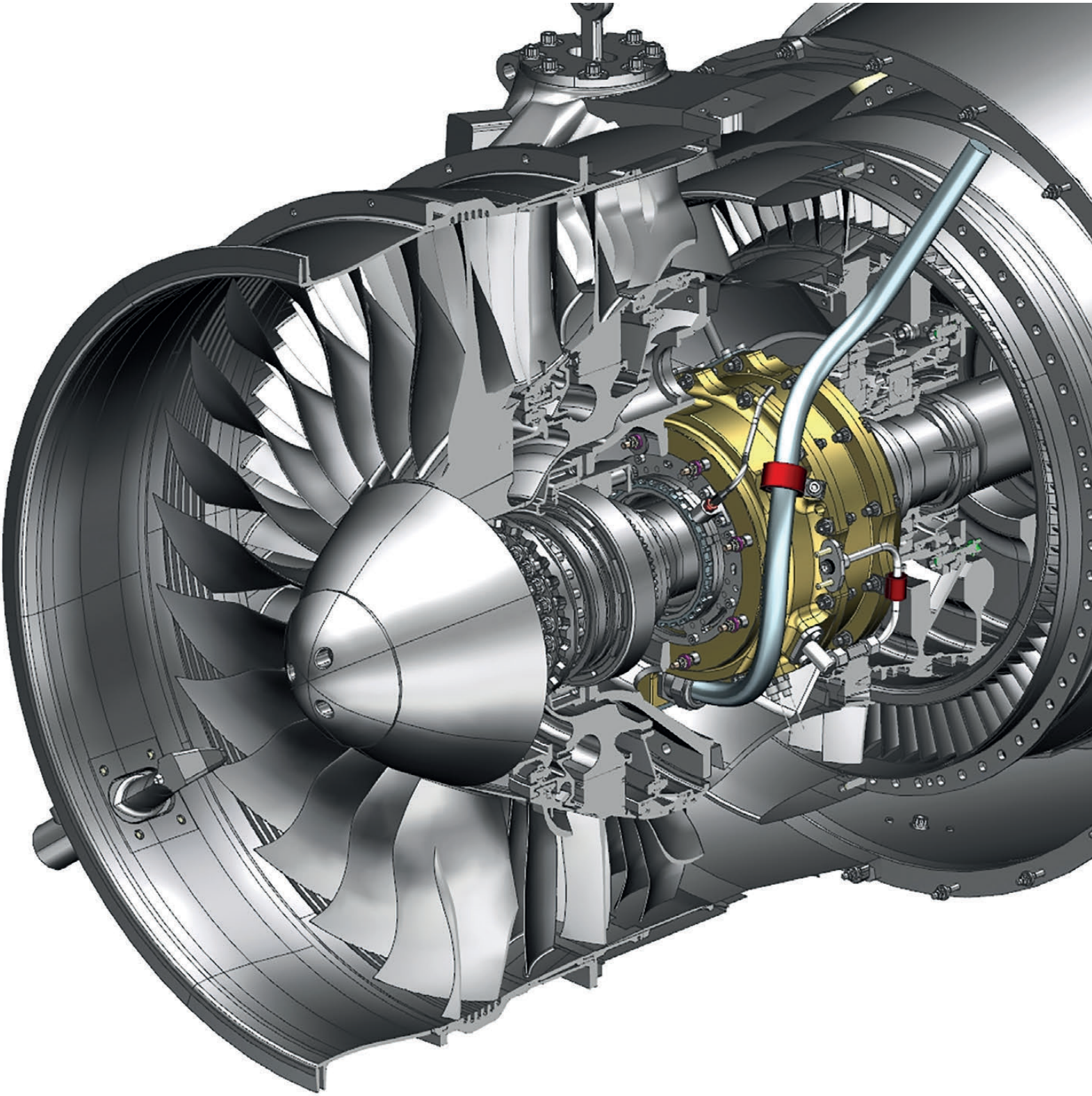
Imagine that every LED light could connect you to the Internet – pureLiFi is the world leader in the development and adoption of light fidelity (LiFi) technology. LiFi is the high-speed bidirectional networked and mobile communication of data using light.

Year-on-year revenue increased by more than

300%

Images: pureLiFi

The winners



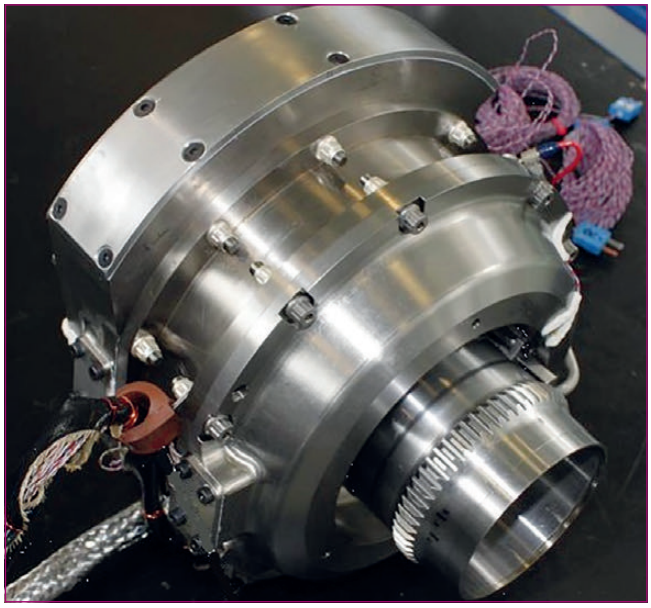
ROLLS-ROYCE

For the development of the Embedded Electrical Starter Generator (E2SG).

A Rolls-Royce team has designed, integrated and tested a power-dense electrical motor generator embedded within the inhospitable confines of an aerospace gas turbine engine. The project showed that the technology can reliably start the engine and deliver electrical power for the aircraft, while housed in a high-vibration, high-temperature environment and running over a wide range of speeds. Innovative applications of physics in both electromagnetism and heat transfer has resulted in a successful demonstration programme that leads the way in bringing electrical hybrid concepts to an aerospace business with an ever more electric future.

Aerospace customers are asking how to improve integration between the propulsion and electrical power systems to supply the inexorably increasing electrical demands and capitalise on benefits to system-level technical performance and operational efficiency. Research into embedding the electrical machine presents opportunities to streamline the engine profile, minimising space constraints within the airframe, and to replace traditional mechanical units such as the fuel and oil accessories for electrical counterparts, which can provide novel flexible operations.

This project starts the journey with a crucial enabling capability which, when expanded, can bring increased engine efficiencies, responsiveness and disruptive innovations relating to the fundamentals of operating a gas turbine.



The company

Rolls-Royce is a pre-eminent engineering group focused on designing, manufacturing and servicing world-class power and propulsion systems. Its vision is to be the market leader in high-performance power systems, where the company's engineering expertise, global reach and deep industry knowledge deliver outstanding customer relationships and sustainable solutions.

Increased

engine efficiencies

Images: Rolls-Royce

THORNTON TOMASETTI DEFENCE

For the development of seismic airgun arrays that have revolutionised the shock testing of warships.

To demonstrate that naval ship designs are robust and capable of withstanding the rigours of underwater explosions during combat, warships are regularly shock tested by detonating explosives close to the vessel. Thornton Tomasetti's patented development of seismic airgun arrays has revolutionised the way in which these tests are conducted. By replacing explosives with an array of seismic airguns similar to those used in oil exploration, surrogate shock waves of the required intensity can be applied to the ship. This provides a more controllable method of shock testing, which is safer, repeatable, less expensive and more environmentally benign.

The airgun technique allows testing to be carried out with a low environmental impact and at a much-reduced cost. The technique reduces fish kill to zero and greatly reduces the acoustic pollution spread into the marine environment by using low-level focussed sources, meaning that testing can be performed in the controlled environment of a dockyard away from marine mammals. The airgun testing method also eliminates the safety precautions required when handling live explosives.

The testing of warship designs and the proving of naval equipment on specially designed shock-test barges using

the airgun system is now routine, ensuring that our ships have enhanced survivability and resilience before they go into harm's way.

The company

Thornton Tomasetti Defence Limited is a part of the Thornton Tomasetti Group, a global multidisciplinary firm of consulting engineers and scientists. We analyse and develop solutions to extreme engineering problems in the fields of blast, underwater shock, impact and vibration effects on military and civilian systems, facilities and structures.

Reduced costs of tests by

70%

Images: Thornton Tomasetti Defence

PAST WINNERS

“It gave the ZephIR team a big boost to win an IOP Innovation Award in 2013, recognising our pioneering work in the development of lidar for the wind industry. We continue even now to enjoy the benefit to our reputation with customers.”

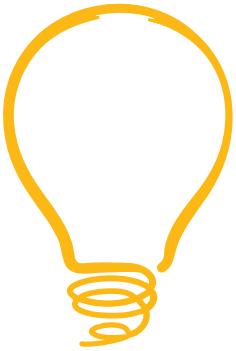
Michael Harris, chief scientist, ZephIR, 2013 winner

“The IOP Business Innovation Award is the most credible award that Coherent Scotland has won, it is the one we are most proud of.”

Chris Dorman, vice president, Coherent Scotland, 2013 winner

SIX YEARS OF BUSINESS INNOVATION AWARD WINNERS

Active Needle Technology
Airbus Defence and Space
Aqua Cooling Solutions
Aurox
Coherent Scotland
Displaydata
e2v
Elekta
Endomag
Gas Sensing Solutions
Gooch & Housego
Hallmarq Veterinary Imaging
ICEoxford
Ikon Science
Jaguar Land Rover
Kromek
M Squared
Magnox
MBDA UK
Metrasens
MR Solution
Naneum
Ossila
Oxford Space Solutions
pureLiFi
Rolls-Royce
Silixa
Simpleware
Tesla Engineering
The Technology Partnership
Thornton Tomasetti Defence
Tracerco
Ultra Electronics
Zephir



For further information contact:

Anne Crean
Institute of Physics
76 Portland Place, London W1B 1NT
Tel +44 (0)20 7470 4800
Email **innovation.awards@iop.org**

www.iop.org/innovation