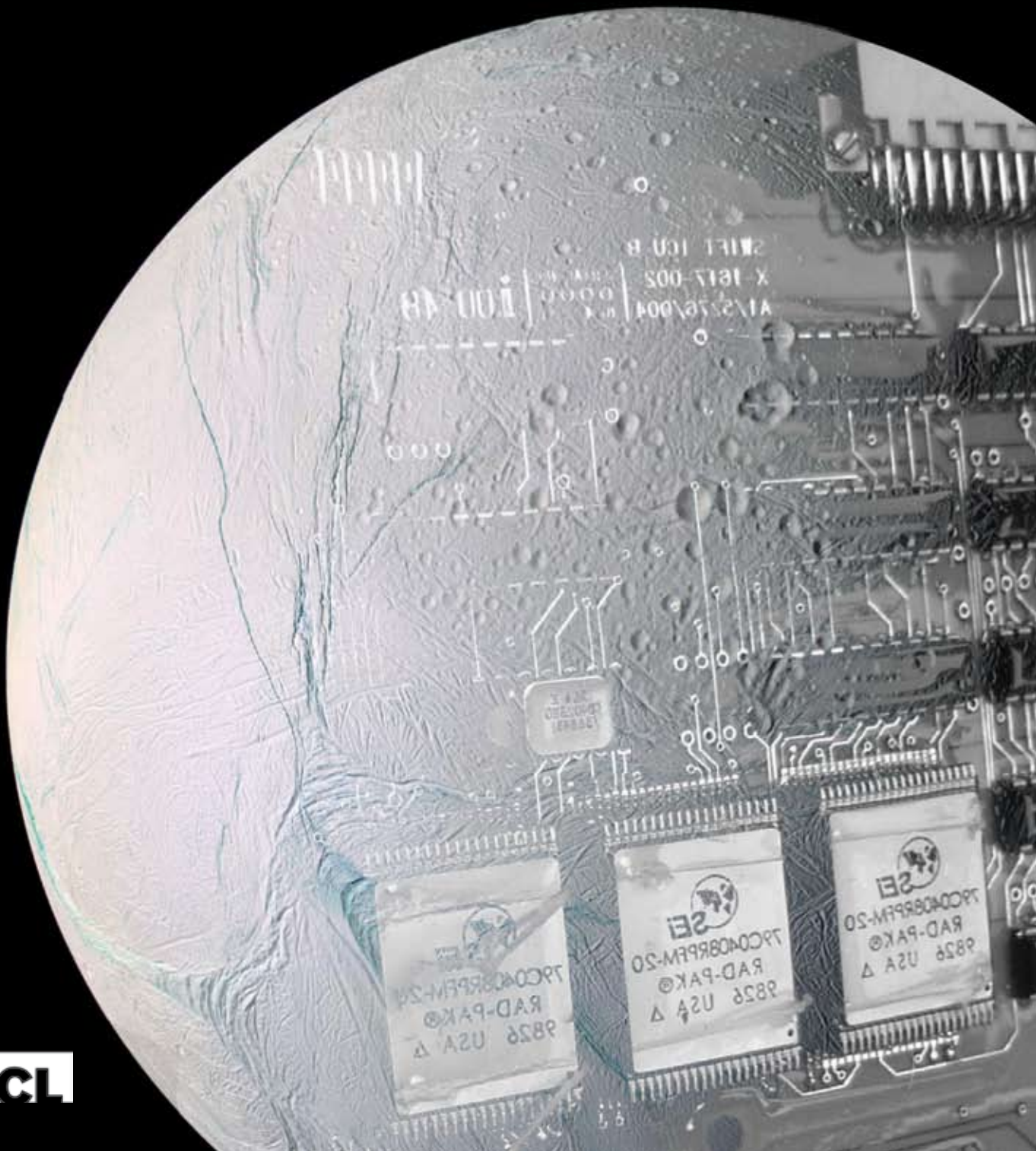


M S S L

Technology Management





We Know About Technology

MSSL—The Mullard Space Science Laboratory—is the home of the largest university-based space science group in the UK. Founded in 1956 at University College London's Gower Street campus, the group has participated in more than 200 sounding rockets and 35 satellites and space probes. From 1967 the space group, now the Department of Space and Climate Physics and one of University College London's 72 departments, has operated from its own site in Surrey and hardware built and/or tested there is currently in use on 16 spacecraft as far afield as Venus, Mars and Saturn as well as in Earth orbit and between the Earth and the Sun. MSSL has provided instrumentation to all of the major space agencies including ESA, NASA, and those of China, Japan and Russia.

We underpin our scientific research with a holistic technology programme. We seek to excel in all that we do and we teach every facet of the programme. No effective technology programme can be imagined without strong interplay with industry and our industrial links are a pillar of our programme.

In this brochure you will find out how we translate our work at the cutting edge of high-reliability engineering into solutions for industry via consultancy and collaboration. You will also discover how we bring our systems engineering expertise to project management and technology planning, and how we can empower your staff by training them.

mssl.ucl.ac.uk/technology

We Work with Industry

MSSL has always worked closely with industry, both when developing specialist hardware for unusual and demanding applications outside of space, and as an expert customer for space projects: but we do much more than this.

The Technology Management group at MSSL includes the UCL Centres for Systems Engineering and Advanced Instrumentation Systems and through these we provide a gateway into the diverse capabilities within UCL, as well as consultancy to industry in areas such as technology planning and rapid capability assessment. To enhance the effectiveness of these approaches, we have developed unique tools and methodologies; we deploy these for our customers and even train their staff to use them themselves.

We have also turned our expertise at crossing the gap between the research base and industry into significant 'knowledge transfer' activities for the public sector, such as our delivery of the Photonics Knowledge Transfer Network. www.PhotonicsKTN.org

We Grow Knowledge for You

The Technology Management Group has a broad range of interests in the areas of technology, systems engineering and risk management and we actively explore these through research and consultancy projects.

Consultancy focuses directly on the needs of the customer, and can last from a day up to several months. Research projects tend to be longer, typically 1-3 years in duration, and may include an element of 'academic' interest. Specific areas of interest are:

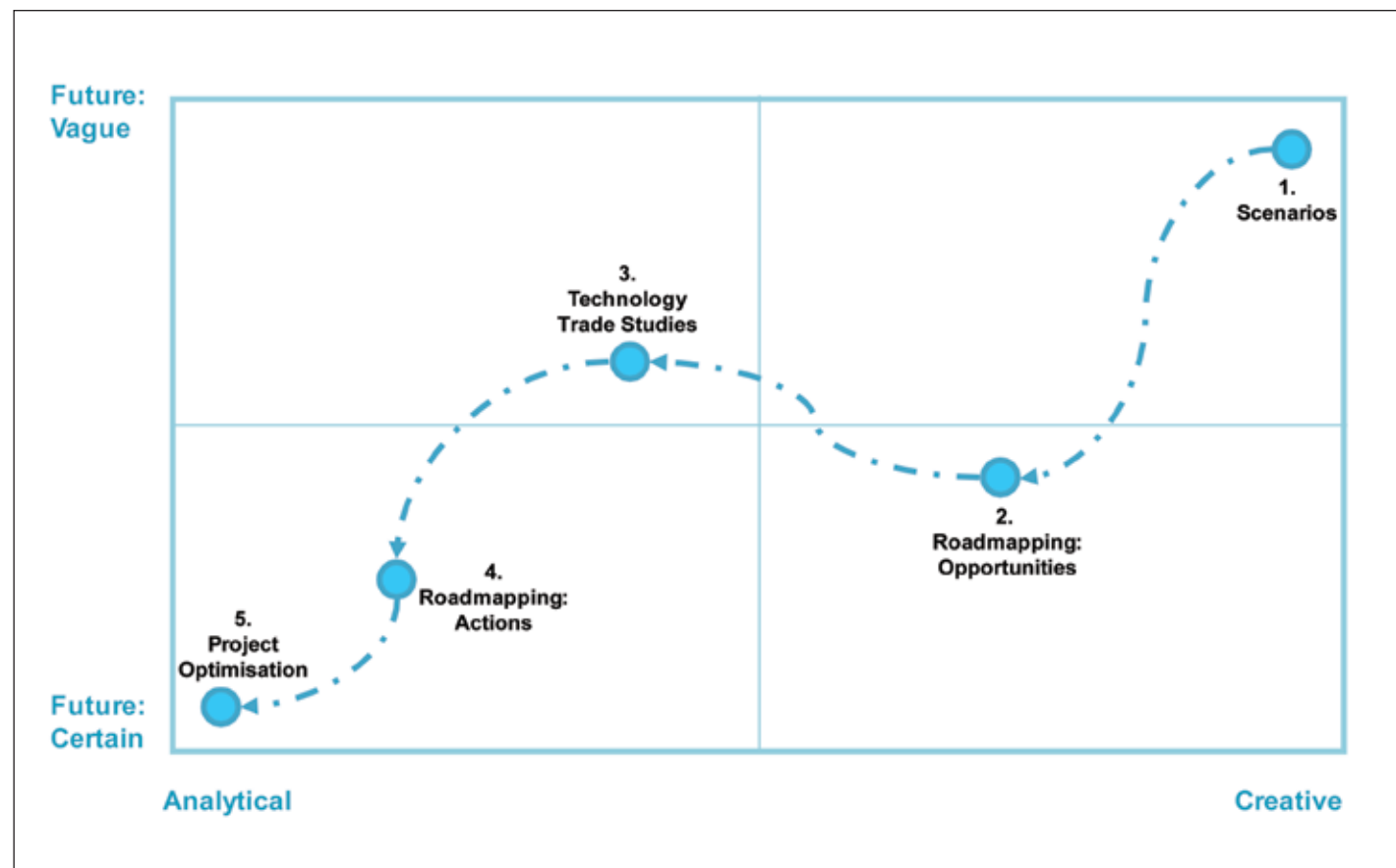
Technology Planning

We have developed our own approach for planning the introduction of new technologies. We conceived this during a three-year research project sponsored by EPSRC, the DTI, GlaxoSmithKline, and Syngenta, and we refined it in consultancy projects with GlaxoSmithKline and the Photonics Knowledge Transfer Network. The research on this was awarded the prize for the most novel use of systems engineering in the 2006 European Systems Engineering Conference.

Systems Modelling

We are experts in systems modelling, and with BAE Systems and Alexander Dennis Buses have recently been awarded a £4m grant over three years to develop hybrid electric/diesel technology for passenger transit vehicles. Our role is to develop a model to optimise the energy storage and power management throughout the vehicle, and to predict the challenges of integrating the technology into the existing system.

In addition to the interests of our research staff, we are supervising over 20 research projects that are being conducted by our MSc students.



We Teach What We Know

We can identify your skills gaps and deliver courses to fill those gaps in all areas of technology management. It is our philosophy that the realisation of large, complex projects is a combination of good systems engineering practice, strategic planning, project management and systems thinking. In our courses we instill this multi-level, long term view of systems developments so that the organisation undertaking such developments can be pro-active in dealing with the dynamics of the modern business environment.

We offer focused short courses that can be consolidated into an MSc, and also provide bespoke training courses to meet your organisation's needs. You may need one or two day introductory courses—or a week for more in-depth training. We host courses at UCL's central London campus, or elsewhere (such as at customers' sites), and provide web-based training that can be integrated with taught material or used alone.

We also offer flexibility in the types of courses taught and can combine the courses with assessments, consultancy or interventions on specific areas within your organisation.

<http://www.mssl.ucl.ac.uk/syseng/pages/courses.html>



The UCL MSc in Systems Engineering Management

Industrially relevant Masters programme, focused on the management of systems development projects.

Develop an in-depth understanding of a broad range of current systems engineering and project management practices.

UCL's expertise in systems engineering stems from its leadership in a variety of research fields, including: space, communications, computing, defence and instrumentation. Over 10 years' experience in collaborating with prominent systems companies, providing their staff with high-level training and education.

UCL is a consistently highly-ranked institution, both in the UK and internationally MSc teaching and research supervision is undertaken by staff from top-rated departments (5 or 5).*

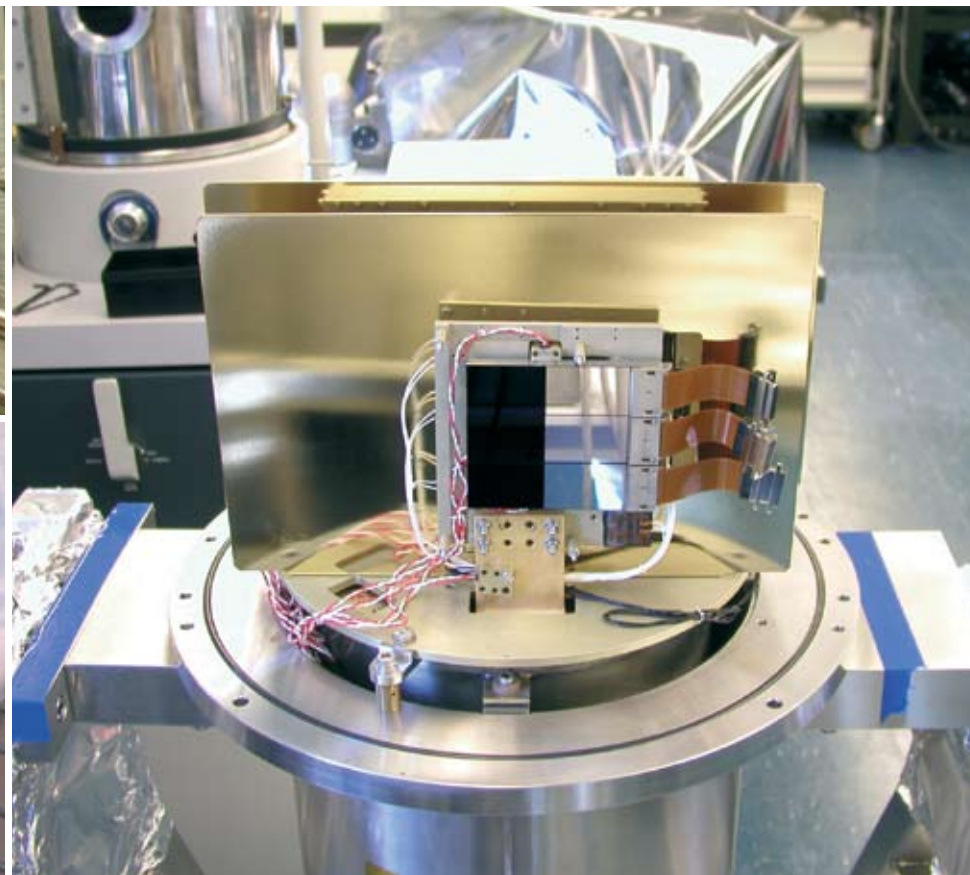
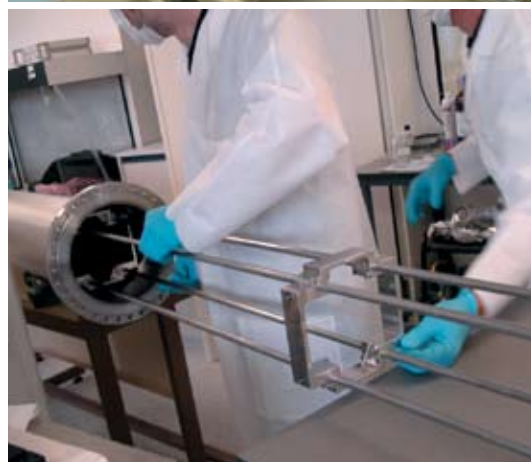
Benefits from participating in the programme

- The student gains a recognised Masters qualification from an internationally-known institution.
- Course contents are aligned to INCOSE core competencies and other institutions' standards.
- An established engineer or beginning systems engineer can expand their role, helping their organisation deliver more capable, more reliable, higher quality products, in a well-managed project framework.
- Supervised research dissertation is industrially focused, contributing to the capability of the sponsoring organisation : the business moves forward.

Organisations we have worked with include:

QinetiQ, BAESYSTEMS, General Dynamics, Atkins Rail, TWI, CIP, AILU, BERR, Technology Strategy Board, Photonics Cluster, EPSRC, STFC, BP, GlaxoSmithKline, Syngenta, Defra, Astrium and GE Aviation





How Our Technology Research and Development helps You

MSSL has remained at the forefront of space research by continuing to innovate and excel in its demanding market. To help us to achieve this we have developed tools, techniques and methodologies as a Centre of Excellence for research, education and training in systems engineering, technical project management, technology transfer and strategic technology management.

Capability Enhancement through Systems Thinking

We have developed a commercial product to enable organisations to improve effectiveness by applying systems engineering principles at the organisational level. This 'Capability Enhancement through Systems Thinking' product consists of four broad stages:

1) Assessment

Activities performed in the assessment phase include a rapid capability audit and roadmap, an opportunity audit including SWOT analysis, competitor analysis and benchmarking, and project diagnoses

2) Analysis

The analysis phase overlaps with the assessment phase, and consists of strategic road-mapping and scenario planning, technology impact analysis (including technology acquisition analysis), risk analysis, market and supply chain

analysis, and enterprise roadmapping (including training needs assessment and metric identification)

3) Change

Following the assessment and analysis phases, the change phase will recommend a course of action or set of strategies designed to improve organisational capabilities or effectiveness

4) Follow-through

The follow-through phase will ensure that the changes are effectively managed and incorporated. Mentoring and training will be provided where required. The success of the changes made will be assessed against metrics

Technology Planning Workshops

Applying the knowledge we have developed from research and consultancy projects, we also perform workshops to help organisations navigate the difficult process of introducing new technologies.

Starting with a strategic appraisal of the future state of the world the technology is expected to operate in through scenario planning, we next create a roadmap of the opportunities available. The potential technology options are compared through trade studies, before revisiting the roadmap with a view to implementing the technologies preferred in the trade studies. The final stage is to optimise the project that delivers the technology by considering the most appropriate resource profile given the risk of the project and other factors.

We build Spacecraft Systems

From blue sky technology research, through concept, design, implementation and operations of complex systems, MSSL has the engineering expertise to deliver.

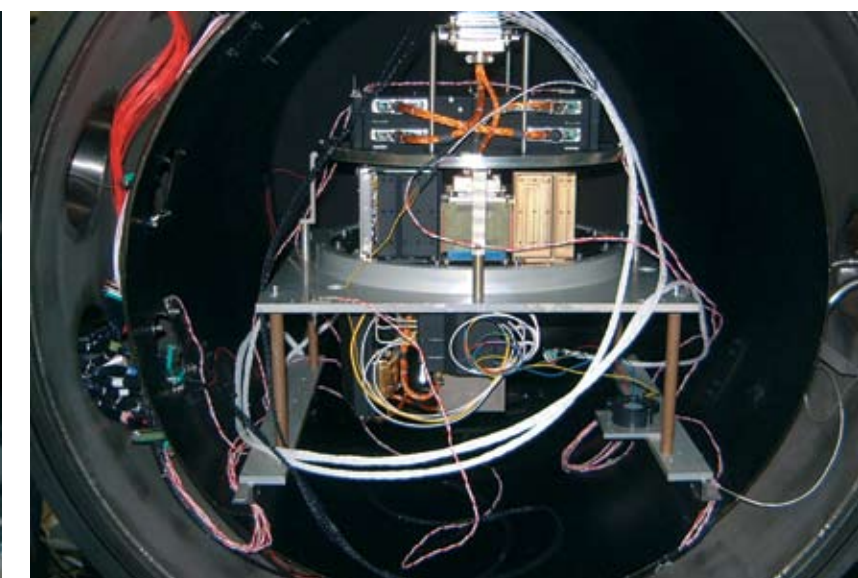
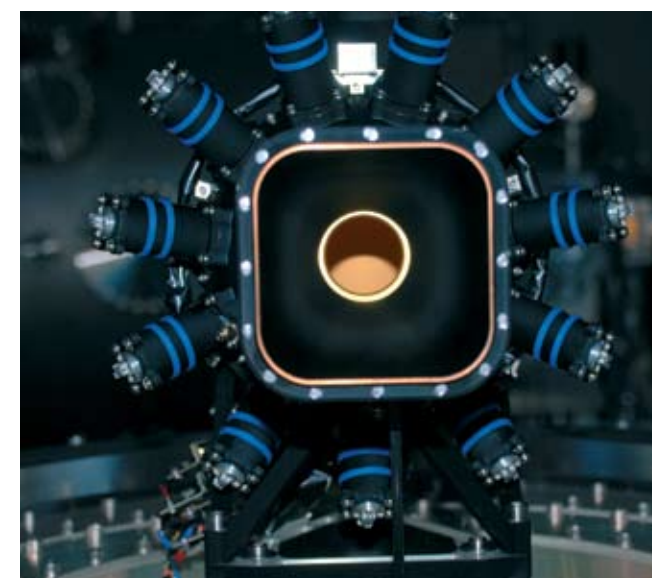
With significant on-site capability for electronics, mechanical thermal and software engineering, we are very much used to working to extreme tolerances and delivering complex hardware and software in systems that are very constrained. A number of our high reliability requirements map very well into safety critical systems; this enables us to deliver external consultancy for a wide range of non-space companies.

Systems for scientific spacecraft have to be built to tolerate the vibration of launch, the temperature variations seen in orbit and the radiation environment. There is also a need for high reliability, to survive missions often longer than 10 years with no opportunity for repair. Despite these constraints, high performance and low power operation also have to be achieved. Many instruments use large optical surfaces that are exposed to space and consequently run cold. Consequently, extreme cleanliness is required so that no volatile materials can condense on these cold surfaces.

Some of our unique capabilities include:

- Low noise and high speed analogue signal processing
- On-board data handling systems including processor systems as well as DSP and FPGA based systems
- Low voltage power conditioning systems
- High voltage generators
- Light weight aluminium and carbon fibre structures
- Advanced instrumentation
- Cryogenics including the first space qualified adiabatic demagnetisation refrigeration system

Software engineering at MSSL needs to meet the demands of real-time spacecraft instrument control and onboard data processing, where the ability to develop high quality, reliable, fault tolerant, efficient and flexible software to demanding schedules are essential qualities. Our software ranges from real-time embedded on-board code, to offline analysis and visualisation code, and the platforms range from bespoke specialist hardware to commodity platforms. Along with the technical expertise in programming languages, we also apply our scientific expertise to modelling and the development of novel algorithms, often driven by the need to operate on computationally 'impoverished' platforms.





What does Space Science do for You?

What about the weather? Amongst our interests is the monitoring, modelling and predicting of extreme weather events.

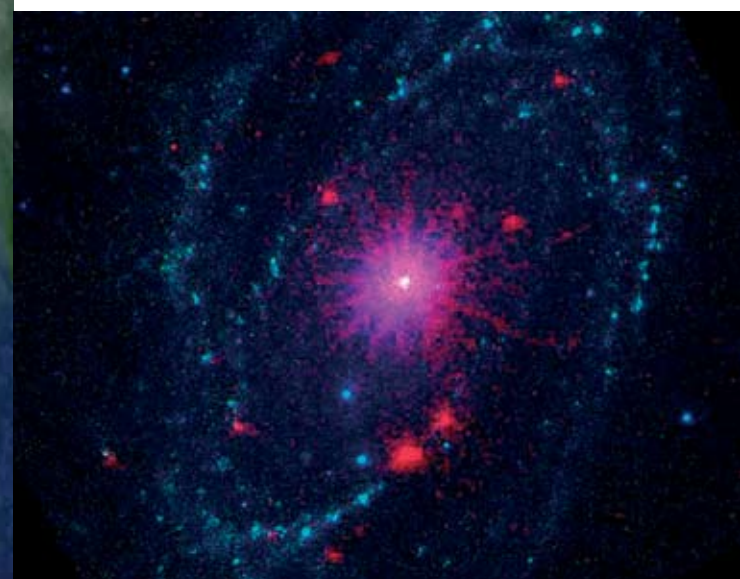
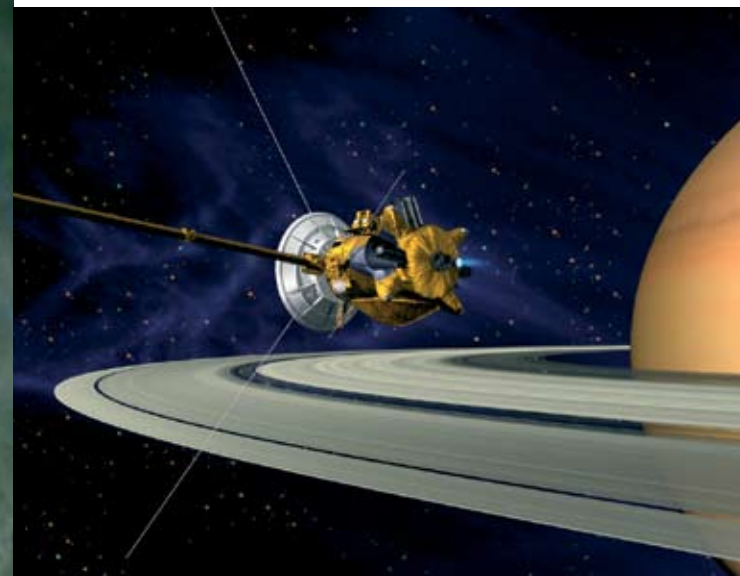
Even forecasts with modest accuracy rates could lead to huge financial savings for industry. For example, for the period 1990-1999, the damage bills for US land-falling hurricanes and for severe winter gales in Europe are US \$5.5 billion and \$3.0 billion per year respectively. For temperature, the weather-related volatility of energy and power usage in the US and UK are \$7.0 billion (non-industrial only) and \$1.5 billion per year respectively.

We provide regular long-range forecasts and real-time monitoring of extreme weather events (see <http://climate.mssl.ucl.ac.uk>), and our work is sponsored by international insurance, reinsurance, and risk management companies.

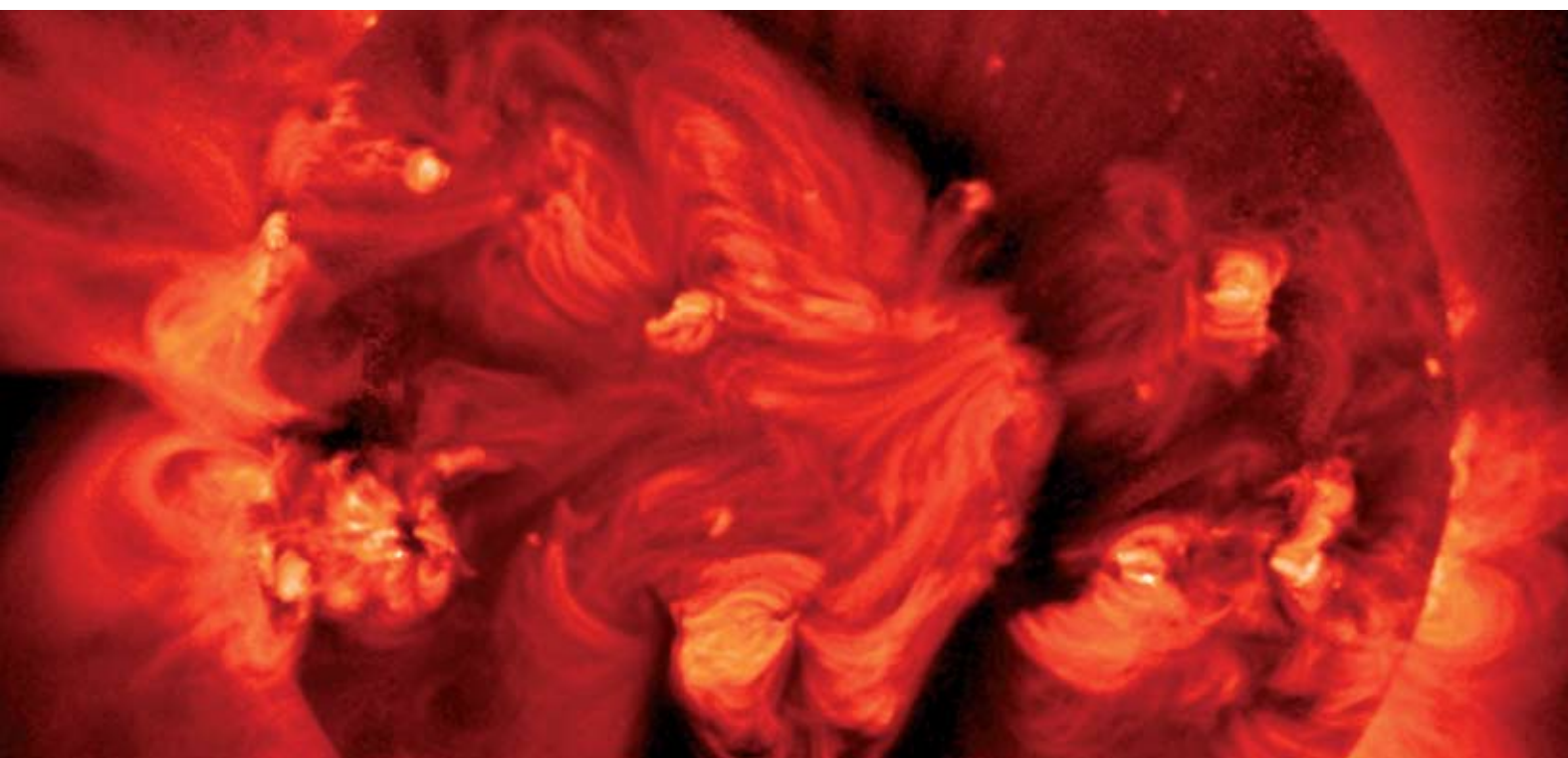
Our climate group recently won the British Insurance Awards for Risk Management (2006) and London Market Innovation of the Year (2004). Winning these prestigious awards - presented at the Royal Albert Hall - involved beating stiff competition from several international companies.

We are also very interested in exploring how the solar wind interacts with Earth and other planets and comets throughout the solar system. Instruments we have that are exploring the space environment are giving us an understanding of the nature and evolution of the solar system. This knowledge has lots of practical applications in understanding the influence of the Sun on our climate. We use space hardware to measure electrons and ions in space plasmas, and also to provide cameras for planetary landers.

A key recent mission for us is Cassini-Huygens which is carrying our electron instrument, the Cassini Plasma Spectrometer-Electron Spectrometer. We used this to take a 'snapshot' of the Earth's magnetosphere during a very fast flyby, while at Jupiter we gathered some exciting data on Jupiter's plasma environment and the causes of Jupiter's aurora. We measured the solar wind between Jupiter and Saturn, and since 1 July 2004 Cassini-Huygens has been in Saturn orbit. Already we have excellent data on Saturn's magnetosphere including plasma near the rings and interaction with Titan and with the icy satellites. Cassini is currently planned to orbit Saturn for four years until 2008 and an extended mission to at least 2010 is likely.



When it comes to Astronomy, putting any type of telescope outside the Earth's atmosphere is a great advantage. For some wavelengths, however, the atmosphere is not just distorting — it is completely opaque. For these wavelengths we have to put our instruments in orbit. MSSL has a lengthy association with space astronomy, working in particular in the infra-red, ultraviolet and X-ray parts of the spectrum.



MSSL has a peerless heritage and enormous experience in systems engineering and the management of new, high-reliability technologies. We could work with you in any of the following areas:

- Research – longer term projects helping you to break new ground and stand out from your competitors
- Consultancy – shorter projects aiming to address immediate business needs
- Engineering – integrating software, mechanical, electrical/electronic, and thermal factors to deliver instrumentation for the harshest environments
- Teaching – from one day bespoke training courses through to full MSc programmes
- Workshops – helping you to get the most out of your staff and other resources

Call us to explore how we can best help your organisation.

Contact us

Telephone: 01483 204100
Dr Steve Welch
Email: tmg@mssl.ucl.ac.uk

A world of experience...



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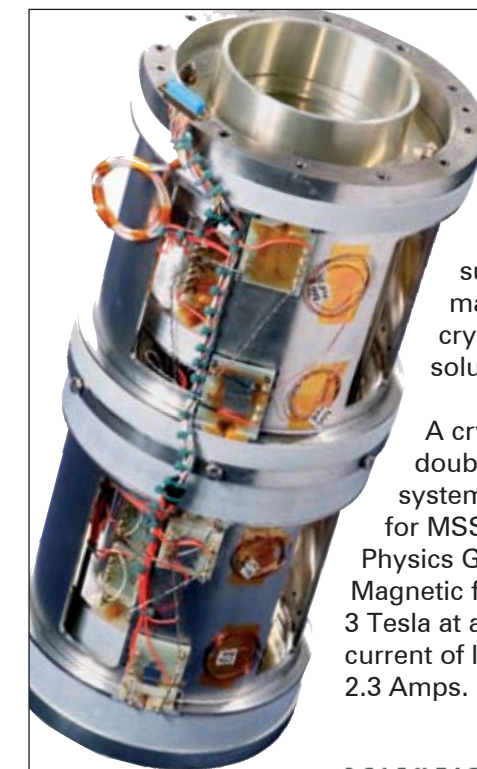
So, if you'd like to know more about how to reduce you or your clients' energy use, call **ICS free on 0800 169 3861** or log onto our website www.industrialcooling.co.uk.



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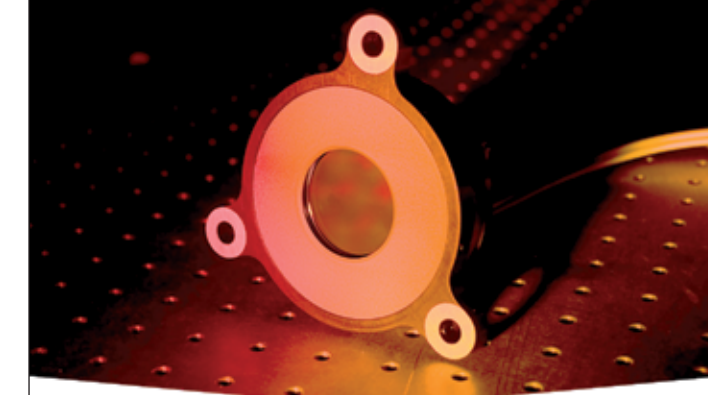
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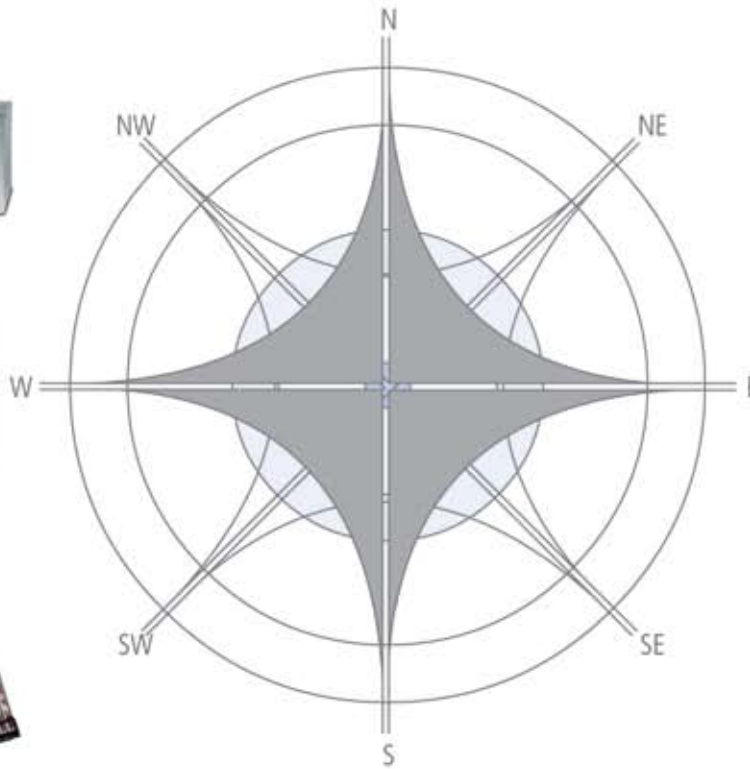
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