ENGINEERING AT CAMBRIDGE

14th July 2000

12-00 -	**Registration**
	Exhibition Open
12-30 -	**Buffet lunch** in Peterhouse
2-00	Marquee
	Lecture Series in LT0
2-00	Historical Video
2-10	Cambridge Engineering
	(Prof. D.E. Newland)
2-30	Sentient Computing
	(Prof. A. Hopper)
2-45	Freehand 3D Ultrasound
	(Dr. R.W. Prager)
3-00	Engineering at the Atomic Scale
	(Prof. M. Welland)
3-15	CFD in Action
	(Prof. W. N. Dawes)
3-30	Manufacturing Engineering
	(Prof. M. Gregory)
3-45	Historical Video
4-00	**Tea** in Peterhouse Marquee
5-45	**Champagne Reception**
5-55	**Speeches**
6-15	**Patron Leaves**
	Conversazione
7-30	Event closes

University Exhibitors

Collaborators and External Exhibitors

STAND - B 01

The Royal Academy of Engineering

The objectives of The Royal Academy of Engineering are to pursue, encourage and maintain excellence in the whole field of engineering in order to promote the advancement of the science, art and practice of engineering for the benefit of the public.

The Academy comprises the United Kingdom's most eminent engineers of all disciplines. It is able to take advantage of their wealth of knowledge and experience which, with the interdisciplinary character of the membership, provides a unique resource with which to meet the objectives.

Its activities include an extensive education programme, research chairs and fellowships, visiting professorships, industrial secondments and international travel grants. It provides expert advice on engineering matters to government and other bodies and administers the UK's premier annual prize for innovation in engineering, The Royal Academy of Engineering MacRobert Award.

Election to The Academy is by invitation only. Up to sixty Fellows may be elected annually, together with Honorary Fellows and Foreign Members who have made exceptional contributions to engineering. All are elected by their peers for personal achievement of exceptional merit and distinction. Fellows are distinguished by the title "Fellow of The Royal Academy of Engineering" and use the designatory letters 'FREng' .

The Academy was founded in 1976 as The Fellowship of Engineering on the initiative of HRH The Duke of Edinburgh and a group of distinguished engineers. It was granted its Royal Charter in 1983 and, with the consent of HM The Queen, adopted the present title in 1992.

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STAND - B 02

Laboratory for Communications Engineering

Rapid developments in communications technology are changing our lives and will continue to do so, While we have made good progress, research still has to be conducted to provide systems for delivery to every home, and to users on the move, alongside increasing total capacity. The discovery and use of new types of information appliance, from wearable computers to wallpaper-like displays will provide the applications which will continue to soak up bandwidth and demand new ideas from engineers and scientists.

Members of the Laboratory for Communications Engineering (LCE) have research interests which range from development of novel networks using new and emerging technologies to the applications that will impinge on communications networks of the future. Research projects are currently being conducted under the following headings which encompass a broad range of communications and applications technology:

- Broadband Wireless Systems
- Low Power Ad-hoc Wireless Networks
- Networked Surfaces
- Sentient Computing
- Middleware
- Distributed Computing

The LCE collaborates closely with and is supported by a number of companies. We specifically acknowledge the generous support received from AT&T, Adaptive Broadband Ltd and ARM Ltd. A rooftop extension to the LCE has recently been completed which provides state of the art facilities and will accommodate its continued growth.

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STAND - B 03/I 01

Engineering at Cambridge

A CD-ROM has been produced to celebrate the 125th anniversary of Engineering at Cambridge. It contains both a brief history of the Engineering Department since its inception in 1875, and descriptions of current research. This material is also on the celebratory web site, which can be accessed from the Department's home page at http://www.eng.cam.ac.uk/. We are intending to develop this site, both as an archive for much of the historical information that might otherwise lie neglected on a dusty shelf and to provide an insight into current exciting research. We welcome further contributions. The production of these pages also represents an engineering development in that we have experimented with the latest techniques in multimedia information presentation, which will increasingly be used as routine teaching aids. We have included many interactive presentations and video clips, to make the whole experience fun. The team will be pleased to demonstrate how to access the site, use the CD-ROM and to discuss the techniques used to produce the web pages.

The production team was Bernie Breton, Sue Jackson and Paul Robertson of the Scientific Image Analysis Group, CUED.

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STAND - B 04

The Future Development Plan

The Cambridge Foundation was established in 1989 to seek and provide voluntary funds for the support of education, learning and research within the University of Cambridge. The Foundation and the University work in partnership to further priorities for the development of the University's activities.

The University of Cambridge Development Office is the operational arm of the Foundation. Its purpose is to interest, inform and directly involve the many alumni, supporters and visitors to Cambridge about the work of the University and its development plans.

Support for the University includes contributions from alumni, individuals, corporations, and trusts and foundations. This invaluable generosity has, to date, helped to fund 12 major building projects and over 50 academic posts. During the financial year 1998-1999 the total philanthropic gifts to Cambridge over the last decade exceeded £250 million.

The development plans for the Department of Engineering are a priority of the University and have the active backing of the Vice-Chancellor, Sir Alec Broers. These plans involve building two new specialist research centres for The Institute for Manufacturing and Advanced Electronics/Optoelectronics/ Photonics/ Nanotechnology at West Cambridge (the University's new site for science and technology), and expansions and enhancements to the Department's current accommodation in Trumpington Street.

These developments will improve the facilities for education, research, and the development of practice and policy in association with industry. The growth and promotion of the Department will also help to ensure that Engineering at Cambridge continues to be an international leader and contributor in these areas well into the new century.

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STAND - B 05

Institute for Manufacturing

The Institute for Manufacturing (The Manufacturing & Management Division) focuses on the interests of the manufacturing industries. IfM is concerned with the full cycle of manufacturing from understanding markets through product and process design to operations and distribution, taking into account economic, financial and people issues.

EDUCATION - The Manufacturing Engineering Tripos (MET) forms the final two years of a four-year undergraduate programme providing a thorough grounding in manufacturing technology and manufacturing management. **The Advanced Course in Design, Manufacture & Management (ACDMM)** - a one-year post-graduate project-based programme developing the skills and experience needed to be immediately effective in industry. **The Manufacturing Leaders' Programme (MLP)** - a two-year, career-integrated, Masters programme designed for those with the potential to move into the most senior management positions.

RESEARCH - The Centre for Strategy and Performance develops tools and techniques for strategy-making and performance measurement system design for industry. **The Centre for Technology Management** is concerned with technology strategy, technology management processes, product introduction and the integration of technological issues into business planning. **The Centre for International Manufacturing** addresses questions of location, manufacturing networks, technology transfer and country characteristics. **The Centre for Economic and Manufacturing Policy** conducts and commissions research into the linkages between economic policy and manufacturing industry. **The Manufacturing, Automation & Control Group** focuses on understanding and improving the ability of production systems to respond in the face of unpredictable disturbances bridging managerial and technical approaches to responsiveness. **The Production Processes Group** develops new approaches to analysis, design, evaluation and implementation of production processes.

THE INDUSTRY LINKS UNIT provides the IfM's professional face to industry organising a full programme of events for industry, supporting the professional activities of the Centres and Groups and planning the factory relationships with key industrial partners.

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STAND - C 01

Photonics and Sensors Group

This Group, comprising approximately 50 staff and students, is concerned with Photonic Devices associated with Telecommunications, Displays and Sensors, and has expertise in semiconductor lasers, guided wave devices, liquid crystal devices and spatial light modulators, optical switches and WDM devices, 3D displays, photoluminescent displays and microdisplays.

Here we show three companies which are exploiting our technology and examples of our collaboration with DERA.

Screen Technology Ltd

Photoluminescent Liquid Crystal Displays (PLLCD) - Screen Technology is a high technology Research & Development and Licensing company that was set up in 1995 to develop and exploit a new Liquid Crystal Display (LCD) architecture invented in the Cambridge University Engineering Department. The company has maintained a close link with the University. Screen Technology has been funded throughout this time by private investment from Thomas Swan and Co Ltd. PLLCD use a near ultra violet backlight and a front phosphor screen in the place of the white backlight and colour filters used in current colour LCDs. This eliminates the degradation in colour, contrast and brightness at oblique viewing angles that occurs with LCDs. This approach enables very large area displays to be made by tiling LCDs made on current facilities in a way that makes the joins between adjacent tiles invisible. This will enable LCDs to penetrate markets for >30 inch displays, an area not considered to be viable using single LCDs or existing tiling methods. Tiled PLLCD is targeted to have a significantly lower cost than the only current direct view display technology contender in this area, the PDP (Plasma Display Panel). Screen Technology has a policy of working with Display Industry Collaborators to make PLLCD ready for manufacture at the earliest opportunity and is looking for both display manufacturing and materials and components collaborators.

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STAND - C 01

Photonics and Sensors Group

Thomas Swan and Co Ltd

A lightning switch - The rapid expansion of the internet is resulting in a huge increase in the amount of information carried in the high speed optical transmission network. Each optical fibre cable is likely to carry many different wavelength channels. When several such cables meet, many optical channels need to be switched. Slowing them down to do the switching in electronics is too expensive when each fibre link might be carrying 300 Gbps (more than the whole UK telephone traffic). What is needed is an optical switch that can be scaled up to switch large numbers of optical channels.

The first scalable optical cross-connect to be developed was announced by the American company, Lucent, last year. This uses a series of tiny mirrors that are moved to deflect the light beam to the appropriate path. Meanwhile, Professor Bill Crossland's group has developed an alternative type of switch that uses holograms to steer the beam, giving far greater precision with no moving parts. Developed as part of a Link research program sponsored by the Department of Trade and Industry in conjunction with Nortel, British Aerospace and Thomas Swan, the holographic light switch is attracting a great deal of attention. In essence, optical channels coming in on one optical fibre need to be diverted very precisely to another fibre. Holographic patterns are written to tiny display devices made by combining liquid crystals with silicon chips. A diffraction pattern (or "Fourier hologram") can then be generated using the miniature ferro-electric liquid crystal display and the data signal routed into the appropriate output fibre by varying the angle of diffraction generated at the liquid crystal hologram. The angle of deflection is determined by the hologram pattern, and it is extremely accurate, down to a fraction of a degree and many such beam deflectors can be combined on one silicon chip.

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STAND - C 01

Photonics and Sensors Group

Cambridge 3D Display Ltd

The Wedge is a novel flat panel display which is being developed by Cambridge 3D Display Ltd and which is little more than a carefully shaped piece of glass and a video projector. The screen of the this display is a slab of glass which is wedge shaped. A light ray injected at a shallow angle into the thick end of the wedge travels down the inside of the glass bouncing off each glass/air interface. Each time the ray is reflected off the angled interface the ray's direction changes. As the ray travels down the inside of the wedge its angle to the glass/air interface becomes progressively less shallow. Eventually the angle at which the ray hits the glass/air interface is so steep that total internal reflection breaks down and the ray emerges.

Video projectors already cost less than $1000 and our hope is that the Wedge will become as big and thin as a window-pane, but as cheap as a video projector.

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STAND - C 01

DERA

One of the most difficult problems in machine vision is identifying and locating an object within a scene in ‘real-time’ (e.g. video frame rate). This is difficult because sophisticated image interpretation algorithms are needed to enable a computer to “understand” the large quantity of data present in each video image. Electronics are too slow to identify an object in real-time from all possible angles of view and object size. A machine typically needs to “correlate” the object with several hundred reference images before obtaining a “match” and therefore correct identification. High correlation values at given scene positions indicate strong correlations, that is, these regions contain the objects that match the reference at particular angles of view and size. Regions with low correlation values indicate that the object and reference are unrelated. The use of optics in combination with electronics allows the machine performance to be more than 100 times faster than conventional approaches employing only electronics. Real-time machine vision can be obtained by employing a hybrid optical/electronic correlator to perform the “correlations”. DERA has built a unique correlator capable of 10,000 correlations/sec and some results are presented here. This has been made possible by development of a critical display called the Fast Bit Plane Spatial Light Modulator (FBPSLM). This world state-of-the-art device was developed by Cambridge University Engineering Dept in collaboration with and funded by DERA.
W A Crossland occupies the DERA Research Professorship of Photonics at Cambridge University Engineering Department. DERA support many areas of research within the Photonics Group.

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STAND - C 02

Cambridge Consultants

Cambridge Consultants Ltd (CCL) is one of Europe's leading technology and innovation companies, employing 350 people. We design and develop innovative products, processes and systems using multi-skilled teams. CCL also offers technology consulting services to clients as part of a process that links our technology development services with our clients' operating environment.

Working in partnership with clients, we solve problems through the innovative application of technology. Our development work takes us into many different markets, with clients coming from telecoms, consumer and industrial products, healthcare, fast-moving consumer goods and automotive industries.

Our clients include Nokia, Ericsson, Orange, Hotpoint, Hilti, Philips, Triton, Tetley GB, AstraZeneca, Pharmacia & UpJohn, Rolls-Royce, The Bank of England, Siemens, Ford and Unilever.

CCL has spawned a number of spin-out companies over the years, a recent one being Cambridge Silicon Radio (CSR) in 1998. CSR's first product, Bluecore 01 is the world's first single chip Bluetooth solution.

Continuing in the theme of close collaboration, you can find both stands located next to each other.

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STAND - C 03

Cambridge Silicon Radio

Bluetooth is a new global, open standard for short-range wireless communications, operating in the licence-free 2.4GHz ISM band. It is controlled by the Bluetooth Special Interest Group S which now has around 1900 members worldwide. Bluetooth's low-power, short-range connectivity is designed to allow very low cost and small size implementations. It provides instant, cableless communications between a huge range of devices, such as mobile phones, headsets, computers and their peripherals, PDAs and other consumer electronics equipment.

Since so many Bluetooth applications are in portable, consumer devices, there is a compelling need to drive down both cost and size of the hardware implementation. Only a single chip, rather than a multi-chip module, can meet the generally accepted cost target of $5 for adding Bluetooth functionality. The key enabling technology behind achieving a single-chip solution at the right price point is RF in CMOS. This, in turn, enables combined radio/baseband/software solutions at similar bill-of-materials cost, and lower total cost of ownership, to separate RF and baseband designs.

CSR has recognised these factors and leveraged over ten years design experience in these specific fields to provide a class leading, first-to-market single chip Bluetooth solution, **BlueCore**^{TM}01.

BlueCore^{TM}01 combines the 2.4GHz radio, the baseband DSP, a 16 bit RISC microcontroller and the RAM needed for a Bluetooth implementation. The chip uses standard 0.35µm CMOS processes, and is supplied in an 81 ball BGA (Ball Grid Array) package measuring just 8mm by 8mm. Together with an external Flash ROM containing the CSR Bluetooth software stack, BlueCore^{TM}01 provides a fully compliant Bluetooth system for data and voice communications.

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STAND - C 04

Pi Group

On display are examples of the on-board electronic systems produced by Pi for various Formula One teams.
The requirements of a modern Formula One team mirror to some extent the requirements of the aircraft industry. Firstly, extensive monitoring of parameters is necessary for fault finding, given that the cars undergo constant rebuilds and are developed with new parts, - all making them inherently unreliable. Typically over 300 parameters will be monitored in this respect. The on-board electronics has the capability to run evaluation algorithms so that only 'uncharacteristic' signals need to be reported back to the engineers. These also can drive automatic shut down mechanisms so that engines and drive trains can be saved from destruction should there be a failure.
The second requirement is for electronic controls. The whole power train (engine, gearbox, clutch, and differential) is controlled by computer as well as an array of other devices (such as the power steering). These elements are constantly being developed and therefore require an electronic platform designed for rapid prototyping and experiment. The control algorithms maybe programmed directly from new fourth generation languages such as Simulink or in the 'C' language.
Finally when all is working well the System serves to provide measurements of performance. These are used to feed mathematical models which indicate where performance gains might be made.
Pi's Sigma Series of race car electronics marries the three requirements of control, measurement and monitoring into one coherent system designed as a tool to enable ever changing needs.
The display also features Pi's new digital communications radio for Formula One, this combines voice and data communications into one small box on the car. Typically the radio will ship 4 Mbytes of data every lap for analysis by engineers sitting in the pits or based at the team factory at the end of a satellite link.
The Pi Group of Companies began life while the two founders were working in the Engineering Department and is typical of a new breed of commercial concerns that have grown up around the University following the examples set by M.I.T. and other American Universities. Motorsport products tend to capture the public's interest, but Pi's activities in the automotive arena have reached the stage where one in four heavy duty trucks in the USA and an increasing number of passenger cars are driven by Pi hardware and software design.

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STAND - C 05

P A Consulting Group

PA Consulting Group is unique among consultancies in its ability to provide the 'sharp end' of product and process development, as well as business and technology consultancy. PA's experience covers a broad range of industry sectors, in particular pharmaceuticals and healthcare, food and drink, fixed and mobile telecommunications.

PA's work involves product development, manufacturing process development (these two often linked tightly in a single programme), and technical advice. Businesses need to get the right product to the right market at the right time and price. PA's integrated approach to product development helps you realise these goals, whether we develop the whole product for you or work on just one selected aspect of it.

Our approach to product development is aimed at reducing time-to-market and managing risk. However, at the same time we work almost entirely with products and processes which give, for their industry sector or for the world, a step change in performance. Most of our clients have excellent development capability of their own, but choose to use PA to provide that extra dimension of managed innovation.

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STAND - C 06

IC Engine Emissions and Control

This exhibit presents current work from a unique multidisciplinary group within CUED combining experts in both IC engine modelling, instrumentation and control system design. The group contains two academic staff (Dr. N Collings and Prof. K Glover) and some 11 research students and assistants, with a long history of industrial support from the Ford Motor Company and from the EPSRC.

The experimental facilities include two fully instrumented dynmamic dynamometers, currently housing one gasoline engine and one diesel engine, and being used to investigate novel instrumentation and control problems.

The poster will include the following:

- Generation and measurement of particulates in the atmosphere: particulates are a major cause for public health concern but there are still very few hard data on which to base standards for automotive emissions.
- Engine idle speed control: it is required to run engines with the minimum losses but with reliable operation during idle and this project shows how a novel controller design can give significant improvements.
- Automotive catalyst modelling and control: the three-way catalyst has been responsible for the dramatic reductions in engine emissions over the last 20 years, however their operation especially under transient conditions is still hard to model accurately for the purposes of control.
- Homogeneous Charge Compression Ignition Engines: this concept which involves retaining large quantities of exhaust gas in the cylinder and producing a 'soft' auto-ignition allows the possibilty of operating a gasoline engine at part load, but unthrottled, leading to significant fuel economy improvements and low NOx emissions.
- Fast CO_2 sensor: the development of this sensor is enabling improved diagnosis of engine behaviour.

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STAND - C 07

Deployable Structures Group

Deployable structures are structures that are capable of executing large configuration changes in an autonomous way. Retractable roofs and kinetic structures are two well-known examples, but the most challenging applications are currently in the aerospace industry.

For example, a state-of-the-art transmit/receive reflector for personal communications, based in geostationary orbit (36000 km above the Earth) has a deployed diameter of 12 m, root-mean-square surface accuracy of about 1 mm, and mass of 50 kg. In the folded configuration, its diameter is less than 0.75m.

The Deployable Structures Laboratory, founded in 1990, has been involved in the development of new technologies for advanced structures for many different applications. Recently completed projects include the development of a family of cable-stiffened space frames that during deployment are a mechanism but become very stiff in the fully-deployed configuration, without any latching elements; a new packaging scheme for solid surface spacecraft reflectors; and a new type of mechanisms that can be used to design retractable roofs with any plan shape.
New areas of current research are in bi-stable and adaptive structures, and ultra-lightweight structures based on thin membranes, particularly for synthetic aperture radar structures. Research in deployable reflectors is also very active.

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STAND - C 08

Combustion Oscillations

In order to meet stringent emission requirements, combustors are increasingly being designed to operate in a premixed mode. Although this is beneficial for chemical emissions, it has the disadvantage that premixed flames are particularly susceptible to thermo-acoustic oscillations and many premixed systems have experienced structural damage caused by combustion instability. Current work is aimed at enabling aero-engines, industrial gas turbines and power stations to operate stably with low chemical pollutants. Approaches include acoustic modelling, computational fluid dynamics and experiments. These are aimed at reliable predictions for the frequency and onset of oscillations so that designs that are particularly susceptible to instability can be avoided.

Both active and passive means of controlling damaging oscillations are being investigated. The most practical means of active control is through the suitably phased addition of fuel. Current work in this area includes the theoretical development of control strategies (model-based and adaptive) and a major experiment on active control of a gas-fuelled lean premixed combustor.

Collaborators: Rolls-Royce Aeroengines, Rolls-Royce Industrial and Marine Gas Turbines, DERA, Hitachi, Kawasaki, Mitsubishi, National Power.
Funded by industry, EPSRC, NEDO and EU Framework IV and V.

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STAND - C 09

Tyre-Road Interaction Noise

Sound generated by road traffic is responsible for some of the most annoying environmental noise. At moderate to high speeds (i.e. in excess of 50km/h for cars and 60km/h for trucks on dry roads), it is the tyres rolling over the road that is the dominant source of noise for most vehicles. Hence there will be considerable benefits and improved quality of life for people living near highways, if tyre-road interaction noise can be reduced. It is necessary to understand the mechanisms of noise generation in order to facilitate the search for combinations of tyre tread and road surface design that minimise noise emission without compromising road safety.

Tyre-road interaction noise is produced by the displacement of air in and near the contact patch. The sound generated is significantly amplified by the horn-like geometry between the road surface and the tyre belt. A combination of analytical and numerical techniques are being developed to model this sound generation. An outcome of this research will be a validated prediction scheme which will be used to design competitive tyres. Collaborations with Dunlop, Landrover and the Transport Research Laboratory (TRL) are an important part of this project. The industrial partners are providing data on road surface texture, tyre geometry, vibration and near- and far-field sound, which are all necessary to develop and validate different stages of the modelling.

Collaborators: Dunlop Tyres Ltd, Landrover and the Transport Research Laboratory (TRL) .
Funded by industry, DAAD and EPSRC.

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STAND - C 10

The Whittle Laboratory

The Whittle laboratory is part of the Engineering Department devoted to research on the aerodynamics of turbines and compressors. The laboratory is located on the West Cambridge site and is one of the world's leading centres for research in this field.

The laboratory has excellent experimental and computational facilities including large low-speed and high-speed wind tunnels and several large-scale low-speed experimental turbines and compressors. Almost all of the research is supported by industry and the laboratory has an especially close relationship with Rolls-Royce via their University Technology Centre (UTC) scheme. However, work on most other types of turbomachinery such as steam turbines, land-based gas turbines, pumps, compressors and turbochargers is also undertaken.

The laboratory is also well known for the development of numerical methods of predicting the complex flow through turbomachines. The resulting software is marketed by Cambridge University Technical Services Ltd (CUTS) and the proceeds are used to support the work of the laboratory. These methods have been evolved over many years and are used by industry world-wide. Some of the predictions are illustrated on the exhibit.

The exhibit also illustrates results from two recent projects. One involved the design of low pressure turbines for aircraft engines in collaboration with Rolls-Royce; by understanding the behaviour of the blade surface boundary layers in the unsteady environment of the engine it has been possible to reduce the number of blades used by 20%. Engines with these new blades are now in production and further reductions of up to 40% are planned. The second project involved the redesign of the high pressure blading of large steam turbines in collaboration with Siemens Power Generation UK Ltd. By using three-dimensional design methods the losses in the blading were reduced by 20%, giving a 2% increase in turbine efficiency. Blading based on this philosophy is now in service in power stations in the UK and overseas, producing savings of order £1.5 million p.a. on a large turbine.

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STAND - C 11

Rolls-Royce

Rolls-Royce plc pioneered gas turbine technology for aero-space, power generation and marine propulsion. Today, it is a global company providing power on land, sea and air, and is involved in major future programmes in these fields: the Trent aero and industrial engines, the Eurofighter Typhoon and Joint Strike Fighter combat engines, the WR21 marine engine and leading edge water jet propulsion systems.

Its core gas turbine technology has created one of the world's broadest aero-engine product ranges, with 55,000 engines in service with 500 airlines, 2,400 corporate operators and 160 armed forces in 150 countries. In the marine power systems sector - with 2,000 customers including more than 30 navies - Rolls-Royce provides a full systems integration capability. As well as new products and capabilities for energy markets, such as oil & gas and power generation, Rolls-Royce also develops its own power projects.

Collaboration is a vital factor of its product development and technology research activity. Its working links with Cam-bridge University grew strongly following Frank (later Sir Frank) Whittle's invention of the gas turbine. In particular, Rolls-Royce has provided a continuous and significant level of financial support to the university's Whittle Laboratory since 1979.

This relationship was formalised when the first of three Cambridge-focused Rolls-Royce University Technology Centres (UTCs) was formed in the Whittle Laboratory in 1991. A second UTC was created in 1994 in the Department of Materials Science and Metallurgy, the third following in the Engineering Design Centre of the Engineering Department in 1998.

Historically, even before the most famous name in engineering was launched, one of its constituents - The Honourable Charles Stewart Rolls - broke with the traditions of his aristocratic background by graduating in Mechanism and Applied Mechanics from Trinity College, Cambridge, in 1898.

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STAND - C 12

CFD Laboratory

Computational Fluid Dynamics - CFD - is an interdisciplinary blend of numerical analysis, fluid dynamics and software engineering. The equations of fluid motion - together with models for the effects of turbulence, combustion etc. - are converted to discrete sets of simultaneous equations on a large mesh which fills the flowfield and are solved iteratively on a computer. The resulting solution can then be interrogated to produce both qualitative and quantitative understanding of the flow physics. Originally the main driver for the development of CFD was the aerospace industry - especially aero-engines and high speed wings. Cambridge was very active in developing turbomachinery CFD and the resulting computer programs became an international standard used around the world by all the blue-chip companies.

More recently we have extended the scope of our research to cover a much wider range of industrially important problems. Within the CFD Laboratory we have worked on a range of issues - especially reading and translating CAD models of arbitrarily complex geometries, mesh generation and solution adaption in time and space for arbitrary domains, unsteady flows, combusting flows and acoustically coupled unsteady combusting flows. This has enabled a wide range of research to be performed in significant industrial areas: aircraft aerodynamics, including multi-element high lift wings, drag reduction and shock control; aero-engines and gas turbines, including engine noise and combustion instabilities in the combustion systems; the oil and gas industry, including gas leaks and dispersion, ignition and explosions, mitigation; racing car aerodynamics, including front wing/endplate/wheel interactions, intake flows and rear wings; design optimisation - automatically modifying geometry to improve aerodynamic performance; and CAD-to-CFD-to-virtual reality as a dream to link everything together in bespoke virtual wind tunnels.

Sponsors include: Rolls-Royce, RR IMGT, Alsthom, BAE Systems, Airbus, Hitachi, BP, Shell, British Gas, Schlumberger, CADCentre, BMW-RR, Ricardo, several F1 teams, Volvo, ANSALDO, DERA, Health & Safety Executive, CAA, NASA, EPSRC, HPCC & the CEC.

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STAND - C13

St John's Innovation Centre

East of England Innovation Relay Centre

The European Commission, national governments and private sector organisations in the European Union commit substantial funding to research and technological development. Thus there is a wide and growing range of research results and technical ideas capable of yielding opportunities for industrial applications in companies across Europe. Part of the innovation process is the translation of these research results and technical ideas into products and services to meet market needs. The Innovation Relay Centres (IRCs) help and encourage organisations to innovate through the development and utilisation of trans-national links. The East of England IRC is one of 8 in the UK and part of a network of 68 regional centres across Europe. We provide companies, universities, research institutes and the public sector with assistance to find partners in Europe for product development, manufacturing and licensing agreements and joint ventures.

Enterprise Link

Enterprise Link is a virtual incubator, providing support for small, technology-based businesses in Cambridge and the eastern region. Formal support, in the form of business advice on all aspects of starting, growing and promoting a technology business is via a telephone help-line. Our advisers are experienced personnel in St John's Innovation Centre and Business Link. So that businesses can learn from each other's experiences, networking is actively promoted by running events with speakers drawn from small technology companies. For added value, offers that benefit members, such as free legal advice, are negotiated with outside providers. Enterprise Link is one year old and membership currently stands at 170.

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STAND - C 14

Granta Design

Granta Design Limited is the global leader in information systems for material and process selection, providing decision support software, reference databases, and customisation services.
Our software/database systems enable design engineers and materials professionals to get the most from their engineering materials and manufacturing processes. They help manufacturing enterprises realise multi-million dollar benefits in reduced product cost, enhanced performance, improved quality, and speedier time-to-market.

Granta has over 400 customers worldwide, including leaders of diverse industry sectors such as ABB, Applied Materials, GE, Lockheed Martin, Moen, NASA and Philips, and leading universities such as Cambridge, INP Grenoble , MIT, TU Berlin, and UCLA.

Granta was founded in 1994 by Professor Mike Ashby and Dr David Cebon, as a spin-out from Cambridge University Engineering Department. Our initial Cambridge Materials Selector (CMS) software, has been superseded by the Cambridge Engineering Selector (CES3) - a powerful, customisable platform for materials and process selection and information solutions for engineering-based enterprises.

At our stand at The 125th Anniversary Exhibition & RAEng Soiree, you can find out more about CES3 and discuss with our staff how it can benefit your organisation - whether you are in aerospace, defence, automotive, electronics, communications, consulting, education, oil and gas, materials, or other engineering-based sector.

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STAND - C 15

Scientific Generics

Scientific Generics is one of three major operating companies in the Generics Group; the other two are Generics Asset Management (GAM) our investment management arm and Catella Generics a world-leading consultancy in the field of battery and fuel cell technology.

We are one of Europe's leading business and technology consulting organisations with an international reputation for enhancing business through innovation and the exploitation of emerging science and technology.

Our services are directed towards increasing our clients revenues and profits and can include advice, development and implementation. Our extensive experience and skills enable us to take a broad overview of the issues surrounding new business development including technical, financial, marketing and strategic aspects.

Our multi-disciplinary culture enables us to provide a fully integrated product innovation and development capability which excels in creating cutting edge solutions and translating these rapidly and cost effectively into commercially successful products.

Scientific Generics is interested to discuss potential opportunities with companies who have the aspiration to make "step changes" in their business performance through innovation driven growth.

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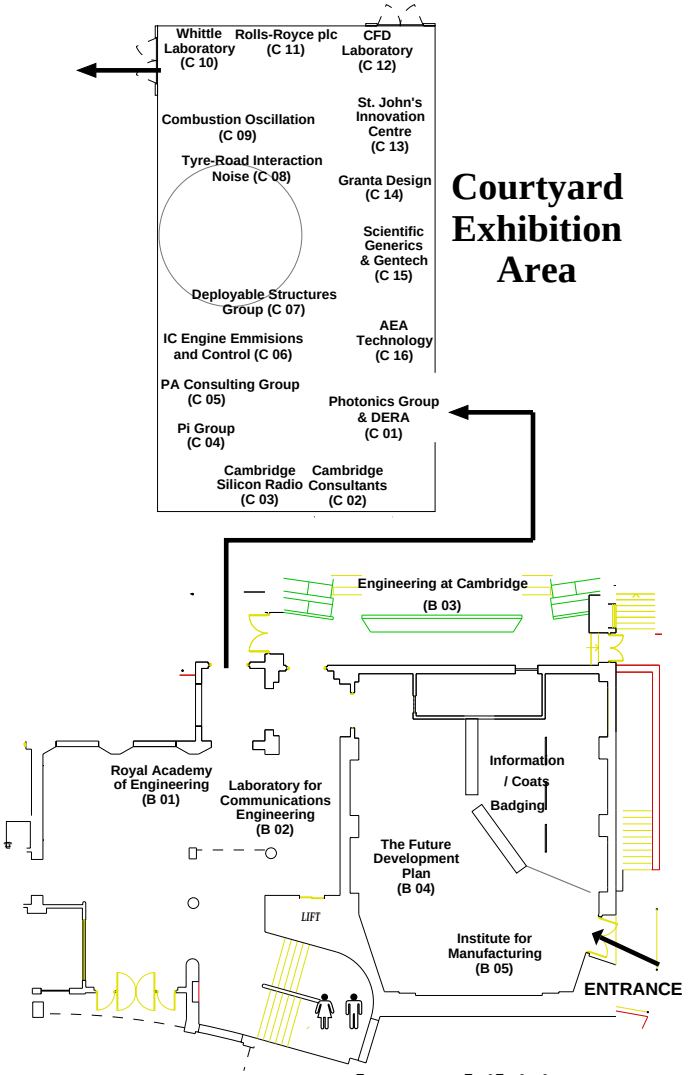
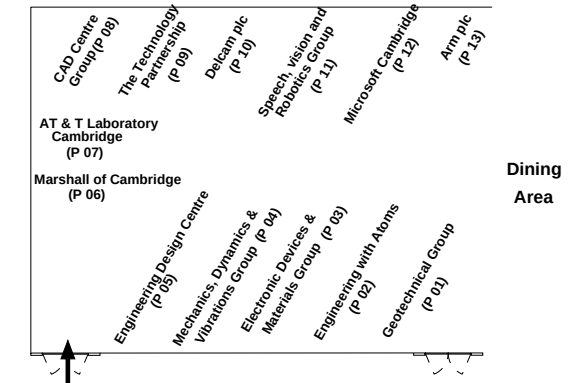
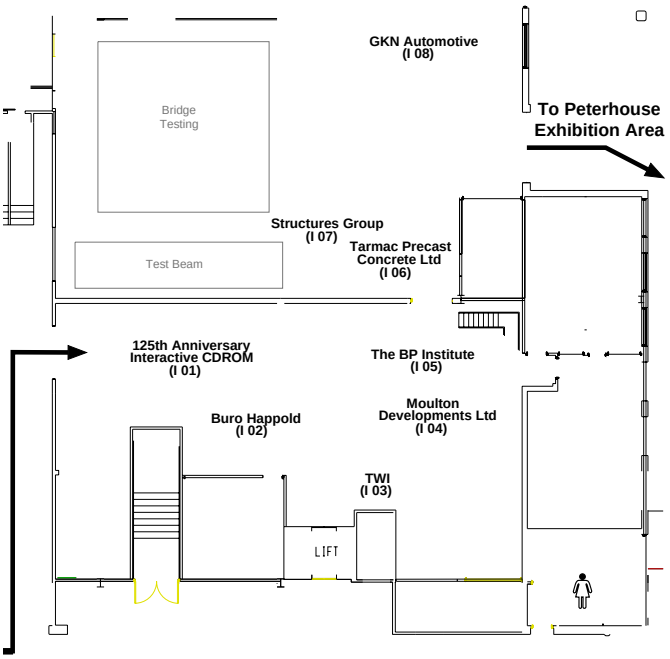

Whittle Laboratory (C 10)
Rolls-Royce plc (C 11)
CFD Laboratory (C 12)
St. John's Innovation Centre (C 13)
Combustion Oscillation (C 09)
Tyre-Road Interaction Noise (C 08)
Granta Design (C 14)
Scientific Generics & Gentech (C 15)
Deployable Structures Group (C 07)
AEA Technology (C 16)
IC Engine Emmisions and Control (C 06)
PA Consulting Group (C 05)
Photonics Group & DERA (C 01)
Pi Group (C 04)
Cambridge Silicon Radio (C 03)
Cambridge Consultants (C 02)
Courtyard Exhibition Area
Engineering at Cambridge (B 03)
Royal Academy of Engineering (B 01)
Laboratory for Communications Engineering (B 02)
Information / Coats
Badging
The Future Development Plan (B 04)
LIFT
Institute for Manufacturing (B 05)
ENTRANCE
Baker Exhibition Area and Reception



Peterhouse Exhibition Area



Inglis Exhibition Area

STAND - C 15

Gentech

Gentech is the part of the Generics Group responsible for investing in intellectual property rights (IPR) and for subsequently helping to exploit the technology embedding the IPR. Gentech has a long track record of successful technology exploitation with substantial returns generated for stakeholders.

Some examples from Cambridge in which Generics has been involved include Cambridge Display Technology (Light Emitting Polymers); Cambridge Positioning (radio frequency location technology) and Cavendish Kinetics (nanoscale switches).

Gentech is interested to discuss an emerging science or technology even at a conceptual stage and is willing to provide earlier stage funding than probably any other commercial organisation in Europe. We do not exclude any area of technology and welcome initial informal approaches by e-mail.

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STAND - C 16

AEA Technology

Cambridge University Engineering Department (CUED) is the largest in the University with about 10% of the total undergraduate population. With 130 staff, 310 research students and 150 postdoctoral research assistants in a multidisciplinary environment, and with a 5* rating in the 1996 Research Assessment Exercise; it is the ideal partner for AEA Technology. The Advanced Technology Centre within CUED was set up in 1998 as the first of our focused university links.

AEA Technology plc is one of the world's leading innovation businesses turning science into profit for the benefit of its customers and investors. The business focuses on five key areas: technology-based products, specialised science, environmental management, improving the efficiency of industrial plant, and risk assessment and safety management. In each area we offer services, products, consultancy, software and technology transfer.

We offer successful exploitation routes for ideas within the science and engineering base through our diverse customer base and business background.

Our current initiatives within CUED are in the areas of: engineering for sustainable development; technology management especially in medium sized science and engineering services companies; materials selection for engineering and from environmental life cycle analysis; metal foams as heat dissipaters and crash protection; atmospheric pollution dispersion modelling; nanotribology; decisioneering, in which decisions are taken real time in an abundance of data; and electrokinetic remediation.

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STAND - I 02

Buro Happold Engineers

Buro Happold

Four engineers from Buro Happold, who worked together to design the world famous Millennium Dome, won the prestigious 1999 Royal Academy of Engineering MacRobert Award. The Award is the UK's most coveted engineering prize, given for innovation.

Project leader Professor lan Liddell, together with Paul Westbury, Dawood Pandor and Gary Dagger of Buro Happold received the annual £50,000 prize and individual medals commemorating their significant achievement from HRH Prince Philip, Senior Fellow of the Academy of Engineering. Buro Happold also received a solid gold medal.

The prize was awarded not just because of the achievement in designing the Millennium Dome, but because of the future potential for such buildings. The judges look for groundbreaking products that could change the world. The Dome's revolutionary design represents the way forward in building large-span, value-for-money buildings. Future applications of "Dome" technology raise the intriguing possibility of covering huge areas of inhospitable land in extreme climate zones.

The Dome follows from 25 years of research and development work by Buro Happold into fabric and cable structures. A key component of this is the interactive non-linear software essential for the processing of these structures.

The Millennium Dome, the largest fabric building in the world, is only the second construction project to ever win during the 30-year history of the MacRobert Award. In 1969, Freeman Fox & Partners won, for building the original Severn Bridge.

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STAND - I 03

TWI

TWI, The Welding Institute, has been involved in research and development of joining techniques for over 50 years. At its headquarters at Granta Park, Great Abington, Cambridge are 400 staff, 200 of whom are graduates and strong ties are maintained with the University of Cambridge.

These days techniques extend far beyond traditional welding of metals. New processes such as adhesive bonding or friction stir welding and new materials like ceramics and composites are also researched and developed for industrial applications.

The award winning friction stir welding process, invented by TWI in the nineties, is of increasing importance in the automotive and aerospace industries. Last year the aluminium alloy fuel tanks of Boeing's Delta II space rocket took the first friction stir weld into space.

A novel material was developed at TWI recently. Called Barrikade™, it overcomes many of the heat transfer problems associated with traditional construction materials and can withstand temperatures of up to 1000°C. This lightweight, non-toxic product is ideal as a core material for sandwich structures, firewalls in buildings or ships or heat shields.

AdhFAST™ is a new joining system which allies adhesives with mechanical fastening. This simple, cost effective process gives greatly increased quality control maximising the benefits of hybrid joint technology.

Coating of materials is another area where recent developments have taken place. In a collaborative project, TWI helped develop a new type of coating for medical biopsy needles which greatly aids accurate localisation under ultrasound examination. Until now this was difficult to achieve with small diameter needles.

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STAND - I 04

Alex Moulton Bicycles

The bicycle displayed on the stand is the current top model of the famous Moulton bicycle designed by Alex Moulton and craftsman made in aero stainless steel on his estate at Bradford-on-Avon, Wiltshire.

The essential features of Moulton bicycles are :-

Conventional riding position
Small wheels with high pressure tyres
Full suspension
Open Unisex frame, universal adult size
Separable frame
Carrying capacity

His first series was introduced in 1962 and was widely acclaimed as the 'first radical advance in bicycle design for sixty years' and 'opened the floodgate' for 'in the manner of' imitations. It was manufactured in large quantities and exported world-wide.

Here in Cambridge in the 60's Ben Hayward, Kings Parade sold many hundreds (some of them survive) and Alex Moulton's lecture before the Engineering Society packed No.1 Lecture theatre.

The design of the Moulton bicycle has been continously evolved over 40 years with his objective of "making a bicycle more effective to use for the shortest or longest of rides, and more pleasing to own, than any other."

The Moulton APB (All Purpose Bicycle) is licensed to W R Poshley, Stratford-upon-Avon. The retail price of this range starts at £600.

Recently Alex Moulton has been engaged as a Consultant by Bridgestone Bicycles, Japan to collaborate in a new Bridgestone Moulton design to be licensed by him.

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STAND - I 05

The BP Institute

The BP Institute in Cambridge is an investment in the fundamental science by BP Amoco. It aims to attract the best scientists in Cambridge and from elsewhere to work on problems critical to BP Amoco's success. The research team will start with 5 full-time members but in time will grow to around 40 by attracting research students and temporary positions. The staff will be free to work on problems related to multiphase fluid flow that offer the greatest possibility of breakthroughs in basic understanding and will be free to publish all their results without asking BP Amoco. The Institute seeks to increase the precision of the prediction of how oil and gas flows out of underground reservoirs, and through pipes. The basic science could be applied to subjects such as:

- reservoir source and trapping mechanisms
- multiphase reservoir fluid movement
- pipe flow to and through the refinery
- customer delivery and impact of emissions on the atmosphere
- building design and ventilation

By the establishment of this Institute, BP Amoco aims to stress that the oil industry faces some of the greatest scientific challenges of any business and need hi-tech solutions to meet customers' and society's needs for clean energy and materials. The BP Amoco Institute will be a Joint venture across 5 University departments (Earth Sciences, Engineering, Chemical Engineering, Chemistry and Applied Mathematics), since it is believed that the greatest advances occur at discipline boundaries.

Facilities in West Cambridge are being built and will be ready by November 2000. To give the Institute the best start in terms of leadership, alongside a Professor who will direct the academic content for the Institute, there will also be a Director to ensure that BP Amoco's connection to the Institute is well founded and that the fundamental science undertaken will impact BP Amoco's business performance.

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STAND - I 06

Tarmac Precast Concrete

Prestressed precast concrete bridge beams are a success story, they have contributed significantly to our national bridge stock since 1945. Concrete beams are usually not slender but recent requirements for beams which can span up to 45m has resulted in designs with top flange slenderness of up to 120 (length/top flange width).

Concrete beams of this slenderness are unusual and precast beams not only have to be stable in their final use but also in transportation and erection. When the new beam design, the SY beam, was introduced, a temporary stiffening frame was used during the transportation and erection phase the frame and beam being tested before the final beams were delivered and erected.

The theory of lateral buckling of prestressed slender beams was deficient and it was required to be developed before useful predictions of ultimate strengths could be made.

An investigation was taken on by Tim Stratford as a 4th year undergraduate project which was part of his degree, the project being supervised by Dr Chris Burgoyne of the Engineering Department. Tim worked for Tarmac Precast for the summer before his 4th year and was able to see the manufacture of beams for a real contract. His project was a great success leading to a development and understanding of the theory up to the final stage of defining a simple design approach. The use of the stiffening frame for the longest beams was shown to be prudent and safety factors during the critical transportation and erection phases were calculated.

The project is an excellent example of the value of a 4th year project which was testing for the student and provided a result required by industry. The project work led to a number of published papers, unusual in an undergraduate project.

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STAND - I 07

Structures Group

The laboratory has facilities for testing a wide range of structural elements, from small-scale tests on fibres where strengths are measured in grams up to large components with breaking loads measured in hundreds of tonnes. A variety of test rigs can be built on the strong floor.

The laboratory conducts research into several aspects of the behaviour of concrete structures. We have an active research group studying the use of advanced composite materials in concrete; these involve aramid fibres or carbon fibres as replacements for reinforcing or prestressing steel, or alternatively as externally bonded plates. Their resistance to corrosion makes them ideal, but they have some undesirable properties, which means that you cannot simply take out a steel bar and replace it with one made from carbon fibre. Other work on concrete relates to the best way of checking existing structures, in particular bridges, where there is incomplete knowledge of the exact state of the bridge components. Much of this work is directed at the assessment of bridges as part of the process of upgrading highway and railway structures.

The laboratory is involved in various aspects of structural dynamics where the disturbing forces are caused either by the wind or by interaction with human beings. This is a poorly understood but is an area of particular interest in bridges and other structures where there are significant human loadings.

The laboratory also carries out tests on shell structures where various buckling phenomena still remain to be explained, and also pipelines, which can suffer failure if the support conditions change.

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STAND - I 08

GKN Automotive

GKN's roots go back to iron making in 1759 and in July it will be 100 years since entrepreneur Arthur Keen laid the foundations of the modern company. Among GKN's undying hallmarks has been it's ability to change with the times and GKN today is a global, industrial company with operations in more than 40 countries.

It has significant operations in the UK, continental Europe and the Americas and a growing presence in Asia-Pacific. In 1999 sales were £4.6 billion and profit before tax, goodwill amortization and exceptional items was £513 million. GKN employs 40,700 people in its subsidiaries with a further 16,700 employed in joint ventures.

The group's activities are focused on the automotive, industrial services and aerospace sectors and it has leadership positions in all of it's major products and services.

GKN is a global, first tier supplier of components and systems to the world's manufacturers of cars, light commercial vehicles, trucks and off-highway vehicles. The Group's Automotive Driveline Division is the world's leading supplier of constant velocity jointed halfshafts with a 37% share of the global market in this key component which is fitted to 85% of cars and light commercial vehicles. It is also a major supplier of advanced driveline systems.

These activities are represented by three exhibits:

- BMW rear axle unit with lightweight monobloc tubular interconnecting shafts.
- Ford Transit front suspension module for which GKN manufactures components and which it supplies as a system.
- Land Rover Freelander rear module - a typical modern lightweight system for a 4WD vehicle.

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STAND - P 01

Geotechnical Group

The exhibits illustrate the wide range of research activities being undertaken by the Geotechnical Research Group. Posters will explain some of the recent industry supported research, such as investigations into the fundamental behaviour of compensation grouting - a new process recently used to prevent Big Ben from leaning during construction of the new Jubilee Line Extension underground railway project in London.

Models will be shown of the apparatus used in centrifuge model tests recently commissioned to investigate the recent collapse of a tunnel in Hull, together with model legs from jack-up platforms used for offshore exploration. The fundamental mechanics of soil particles crushing as a pile is jacked into the ground will be illustrated on a TV screen.

Earthquake engineering research will be illustrated on a TV screen, with dramatic photos of the recent earthquake damage in Turkey. The extensive environmental geotechnics research being undertaken will be illustrated by a video of a pollutant plume migrating through the ground in a centrifuge test, together with new developments in soil mixing technologies sponsored by industry, use of waste materials for construction, and electro-kinetics for cleaning up contaminated ground.

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STAND - P 02

Engineering with Atoms

The tools required to fabricate ever faster and smaller computers are already capable of manipulating single atoms. These tools, the essential foundation of Nanotechnology, are also capable of fabricating and measuring completely new types of devices and structures combining materials from the physical and life sciences. Will the transistor of the future be a single molecule?; can a computer really mimic the human brain?; will quantum computing ever be realized?; how much further can we shrink the microchip? These are all questions which engineering at the atomic scale will be able to answer over the next decade.

What this display is aimed at, is showing you at first hand some of these Nanotechnology tools and some of the types of structures we can fabricate and image using them. Arguably the most important tool of Nanotechnology, the Scanning Tunneling Microscope or STM, can be used to both image and manipulate single atoms and molecules with dimensions below 1 nm. Several example results are shown. Using these sort of results, we hope to answer the question as to whether or not a single molecule can act as a transistor. We have already demonstrated a single-molecule rectifier. Another tool of critical importance is the electron microscope, which can be used to fabricate and image structures below 10 nm. We show a number of example structures made using an electron microscope, to demonstrate its versatility. Using these tools it should be possible to answer all of the above questions within the next decade, making Nanotechnology a very exciting area for some time to come.

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STAND - P 03

Electronic Devices and Materials

This presentation aims to highlight the current research activities involving the development of new materials and electrical devices in Cambridge University Engineering Department. Just over a hundred years after the discovery of the electron, electronic materials have become ubiquitous. The scope of on-going projects to use new materials includes product development in close collaboration with industrial partners, and research projects addressing future technology requirements. For these device developments a diverse range of material coatings are used including amorphous silicon (a-Si), polycrystalline silicon and diamond-like carbon, on substrates such as glass, silicon and silicon-on-insulator. The fabrication technologies involve vacuum deposition, lithography, precise plasma etching and focused ion beam processing. Design and simulation are vital components of a project at each stage of fabrication process as is device electrical testing to ensure yield and manufacturability. There is close collaboration with other groups in the Engineering Department and in related technology departments in the University. Sophisticated control of materials properties and syntheses are vital to develop successful applications, and the group has an extensive background knowledge of a wide range of device technologies. Those under active investigation include a-Si addressed active matrix liquid crystal displays, field emission displays, diamond-like carbon for coating media and magnetic disks, microsystems, using silicon-on-insulator, and novel power semiconductor devices. The product demonstrators include display devices, energy conversion devices, sensors and micro-electro-mechanical systems (MEMS).

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STAND - P 04

Materials and Micromechanics Research Group

The Materials research group along with the Cambridge Centre for Micromechanics brings together researchers interested in predicting the macroscopic mechanical behaviour of materials from an understanding of their microstructure. This involves the application of mechanics to identifiable small-scale structures and the use of analytical, numerical and experimental methods to understand macroscopic responses. This science-based approach enables us to predict the behaviour of new materials without the need for routine experimentation.

Current research themes include:

i) composite design: the mechanics of 3D woven composites, the compressive failure of composites, homogenisation theories to predict the localisation and failure of composites and failure theories for sandwich structures;

ii) processing of engineering materials: powder compaction and the evolution of microstructure during welding;

iii) metallic foams and lattice materials: focussing on their processing, microstructure, engineering properties and end use;

iv) processing of bulk high-temperature superconductors for high-field engineering applications.

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STAND - P 04

Dynamics and Vibrations Research Group

The Dynamics and Vibration research group is concerned with a wide range of problems involving the measurement, analysis and prediction of vibration and dynamic response of engineering systems.

The Transportation Research Group deals specifically with the design of vehicle systems, especially heavy goods vehicles, for improved suspension and handling properties, and with the analysis and design of road paving systems for maximum life.

Other current research interests include:
i) vibration prediction in complex structures, including statistical methods;

ii) groundborne vibration from road and rail transport, and vibration transmission into wayside buildings;

iii) impact dynamics, and mechanisms of progressive destabilising collapse;

iv) vibration monitoring of gearboxes and other machine components;

v) wavelet methods for condition monitoring;

vi) mechanics of musical instruments.

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STAND - P 05

Engineering Design Centre

The Cambridge Engineering Design Centre (EDC), led by its director John Clarkson, is one of 15 major research groups in the Cambridge University Engineering Department. It was established in January 1991, with a 10-year rolling grant from the Engineering and Physical Sciences Research Council. The EDC aims to improve the effectiveness and efficiency of engineering designers and design teams by undertaking research into the theories that will underpin the design methods of the future. For example, the Cambridge Engineering Selector, a software package marketed by Granta Design Ltd, provides advice on the selection of materials, processes and structural sections. In addition, paper-based workbooks are being published to support 'Design for low-volume manufacture', the design of medical devices and 'Design for reliability'.

The EDC's research is organised in five themes, namely: Design Synthesis, Design Optimisation, Materials Selection, Knowledge Management and Knowledge Tools. Particular focus is also provided for the Aerospace, Healthcare and Sports Engineering product sectors.

The EDC enjoys significant industrial support from over 60 collaborators. In particular, the University Technology Partnership (UTP) in Design is a long-term partnership between BAE SYSTEMS, Rolls-Royce, and the Universities of Cambridge, Sheffield and Southampton. The Cambridge team, led by Ken Wallace, focuses on Engineering Knowledge Management with the objective of capturing, storing and retrieving engineering design knowledge and experience. More recently, the EDC has received significant support from The Post Office, undertaking a wide range of research projects, focussing on Inclusive Design, i.e. design for a broad range of user abilities.

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STAND - P 06

MARSHALL
OF CAMBRIDGE

Marshall of Cambridge

Marshall of Cambridge was founded in 1902 as a chauffeur drive company and moved into the motor retail business in 1911. Subsequently, Marshall because the Austin distributor for Cambridge in 1920 and entered the aviation business in 1929. The Group, which remains a privately-owned family company and chaired by the third generation of the Marshall family, has a turnover in the region of £500M per annum. The group currently has an employment of over 3,300 working in the fields of Aerospace Engineering, Specialist Vehicles' design and manufacture, Motor Vehicles sales and after-sales support, Refrigerated Transport Sales and Support, and Airport Property Ownership and Management.

The Marshall Motor Group is one of Europe's largest privately-owned Motor Groups representing 18 motor manufacturers with 40 separate franchise appointments predominantly in East Anglia but with dealerships also in Reading and Croydon.

Marshall Thermo King has 18 depots across mainland Britain with 200 mobile Engineers providing support to transport fleet operations covering 80% of the United Kingdom. Marshall Thermo King is the largest Thermo King dealership in the world.

Marshall Aerospace has specialised in recent years in the design, modification and maintenance support for aircraft such as the Lockheed Martin C-130 Hercules, Boeing 747 400, Boeing MD-11, Gulfstream corporate jets, Cessna Citation, Global Express and the Boeing E3D Sentry AEW aircraft for the Royal Air Force. Marshall Aerospace is also playing a major role in the modification of a Lockheed TriStar aircraft for Orbital Sciences Corporation for the carriage of the NASA X-34 hypersonic space research vehicle, which is a key element in the NASA Re-usable Launch Vehicle (RLV) Programme.

Marshall Specialist Vehicles manufactures buses, specialist delivery vehicles, ambulances and a wide range of high technology military support products which includes specialist shelters for a variety of uses, including mobile hospitals, command and control centres, bakeries and rapidly redeploy-able engineering workshops.

Marshall of Cambridge has enjoyed close links with the Engineering Department at the University of Cambridge over many years.

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STAND - P 07

AT&T Laboratories Cambridge

Telephones have not changed much in the last 50 years. However, things are now moving fast and soon broadband telephone lines into our homes and offices will not only enable us to make calls but will also let us browse the web, shop electronically, play music and video from a central library and many other things. The AT&T Broadband Phone™ bears many similarities to a conventional phone including the familiar handset. But also built into the device is a touch-sensitive, full colour screen that can be used with a finger or pointer.

Like the conventional telephone, the Broadband Phone is a simple device that has no state of its own and can't do anything unless it is connected to the network. Using thin-client technology developed at AT&T Laboratories Cambridge, every pixel or discrete point on the Broadband Phone screen is updated over the network at very high speeds. This means that all the application programs, such as the software to browse a music catalogue, runs elsewhere on the network. So all you have to do is plug in the Broadband Phone and have immediate access to all the services provided over the network.

If a new method of sending email is devised, it can be installed on the network for everyone to use. Furthermore, you can store personalised information on the network so wherever you are and whatever Broadband Phone you are using, you can access your own quick dial phone list and display your favourite applications.

AT&T Laboratories Cambridge is further developing the Broadband Phone and exploring new applications.

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STAND - P 08

CADCentre

Cadcentre is a world-leading developer and provider of process plant engineering IT solutions and services. Industries currently served by Cadcentre solutions include oil and gas, chemicals, pharmaceuticals, pulp and paper, generation of electricity from nuclear and fossil fuels, nuclear fuel re-processing, waste management and ship outfitting.
The exploitation of IT as an enabler for business improvement is high on the agenda of many companies. Cadcentre offers both the tools and consulting services to enables its clients to maximise the efficiency of their engineering IT operations. Providing effective implementation, integration and ongoing global support for these engineering IT operations is the foundation for Cadcentre's longer-term success.
Cadcentre's range of engineering IT solutions and services covers all aspects of project execution and operations. At Cadcentre we believe that reliable, consistent engineering data is the core of an effective engineering IT environment. Cadcentre's solutions are database driven to manage and control the data as it develops - from project conception through detail design, fabrication and erection, commissioning and hand-over to plant operations and maintenance.
As modern process plants are engineered for longer operating life spans, the transition of engineering data to operations and maintenance functions has become an increasingly important issue. Up-to-date as-built data is often required far beyond the initial design and engineering phases of the project. Access to a current and accurate electronic model of the plant assists with maintenance, operations, refit or retrofit work, operator training, safety or environmental inspections, and ultimately plant decommissioning.

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STAND - P 09

The Technology Partnership

The Technology Partnership's (TTP) technology lies behind many products in areas as diverse as mobile communications, printing, drug discovery and delivery, navigation systems and consumer products. Our customers include some of the world's largest and most successful as well as some of the smallest and most ambitious. Our staff of 500 serve the needs of customers in more than 25 countries in Europe, North America and the Far Fast.

We recruit talented staff who create innovative solutions which work. We invest heavily in core technologies, facilities and training. We strive to understand our customers'needs and the competitive marketplace in which they operate. Most importantly, we believe, we have established a working environment in which all staff have a voice, continue to develop as individuals, and enjoy themselves.

High-achievers required

Graduate Mechanical Engineers	Electronics Engineers
Graduate Software Engineers	Mechanical Engineers
Embedded Software Engineers	RF Engineers
Software engineers	Project Leader
Scientists	Consultants
Physicists	Chemists

We offer an exciting, challenging and friendly environment that is superbly equipped. Our high expectations are reflected in the rewards, - which include the potential for very rapid personal development, competitive salaries, excellent benefits, and a variety of social events.

To quote our Chief Executive "We are here to have fun and make money".

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STAND - P 10

Delcam

Delcam plc is the world's leading developer of CADCAM software for the three-dimensional design, manufacture and inspection of complex shapes. Its products are sold in 50 countries and are used by over 10,000 users at about 3,000 customers worldwide.

Starting in 1974, Donald Welbourn, then Director of the Wolfson Cambridge Industrial Unit, catalysed a collaboration between Delta Group, a non-ferrous product manufacturer, and Cambridge University Engineering Department to develop the DUCT software for the design and manufacture of complex shapes. This work led to the formation of a new company within Delta to exploit the technology.

In 1989, an employee buyout led by Hugh Humphreys and Ed Lambourne (the original Delta secondee to CUED) established Delcam as an independent company. Since then, its turnover, profit, and software development expenditure have grown substantially. The company is now AIM-listed, employs 200 staff in the UK and has wholly owned subsidiaries and joint ventures worldwide.

CADCAM software is now a major element in most new product development and Delcam has grown to meet this increasing demand. The new Power Solution range of software has superseded the original DUCT software but still owes much to the original research carried out in Cambridge.

A recent report from leading US industry analysts CIMata found that Delcam is the UK's largest, and the world's number six, supplier of software and services for the generation of NC machining data. These results follow on from another survey, which found that Delcam was represented at 31 % of UK tooling making sites with a CAM system, almost three times as many as the company in second place.

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Speech Vision and Robotics Group

The work of the SVR group is focussed on developing systems and techniques which allow spoken and visual signals to be represented, transformed and manipulated. The guiding principle of all our work is that a well-designed engineering system must be based on a sound mathematical model. Thus, for example, statistical models of ultrasound imaging are used to construct 3-D ultrasound volumes from a sequence of 2-D scans. Similarly, statistical models of the individual sounds of the language provide a basis for recognising the complex patterns of speech. In vision, projective, differential and algebraic geometry are used in processing images of the world.

This exhibit features some examples of our work. Firstly, we show how 3-D ultrasound volumes can be produced from a series of 2-D scans. Not only does this allow the anatomy to be visualised from otherwise unobtainable viewpoints, it also facilitates other operations, such as measuring the volume of an organ or lesion to calculate drug dosages or to monitor the progression of a disease such as cancer. In another application, we show how 3D models can be acquired automatically from two or more ordinary photographs and used in real-time tracking with applications in robotic control for flexible manufacturing. Finally, the Multimedia Document Retrieval system shows how the idea of a web search engine can be extended to allow radio news items to be monitored and stories of interest retrieved. It contains an advanced speech recognizer which can process a continuous stream of audio and accurately transcribe it, and a retrieval engine which uses statistical techniques to match a user's query to transcriptions.

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Microsoft (Cambridge)

In 1995, Cambridge University started a new company in collaboration with a Washington-based company called Entropic Inc. The remit of this new spin-off was to further develop the HTK speech recognition system created by the Engineering Department's SVR Group in order to make it suitable for commercial use. Over the following few years, Entropic grew to over 40 people in Cambridge and developed a range of devices aimed at enabling voice access to information systems, especially the world-wide web. In November 1999, Microsoft acquired the company in order to strengthen its own activities in the area. Entropic Cambridge is therefore now part of the Microsoft Speech Products Group (SPG).

The Microsoft SPG stand features three examples of its work. Firstly, VoiceExplorer is a plug-in for Internet Explorer which allows entirely hands-free web browsing. It works by converting all of the available menus, visible links and buttons on the displayed web page into a grammar which it passes to a speech recogniser. This grammar is continually updated so that anything you see you can speak. The second demonstration is an example of phonebased access to an information system, in this case, a system to provide film listings and times for cinemas in Cambridge. This illustrates how simple natural dialogue can be used to provide information efficiently to any caller. The third and final exhibit is the HT1K Toolkit itself. This package designed for research and development is where Entropic started in 1995. It was written originally in CUED, then transferred to Entropic and sold commercially. In the year 2000, it still provides a valuable framework for further research in the field. In recognition of this, Microsoft have completed the circle by giving HTK back to the University and provided funding to allow HTK to be distributed free of charge to the community.

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ARM

ARM is the industry's leading provider of 16/32-bit embedded RISC microprocessor solutions. ARM has created a scaleable microprocessor architecture - a high-level blueprint of an electronic system which includes hardware, software and silicon details - for the Digital Age.

We license this architecture to semiconductor and systems manufacturers worldwide, as well as provide supporting software and development tools.

By creating this IP business model and developing long-term partnerships, we have set ourselves free from manufacturing and are able to remain a dynamic company, with global reach. The ARM architecture is emerging as the defacto volume RISC standard which, in the foreseeable future, may well be used by billions of people worldwide. As our family of partners continues to expand, so will the range of electronic products in tomorrow's digital market place

Our goal is to establish ARM as The Architecture for the Digital World, through close and continuous collaboration with our global network of partners.

The ARM stand at the Cambridge University Department of Engineering 125th Anniversary event will show a selection of ARM-powered products. More information on ARM is available at www.arm.com

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