Knowledge Transfer Networks Accelerating business innovation; a Technology Strategy Board programme

UKDL Newsletter

Issue 3 **April 2008**

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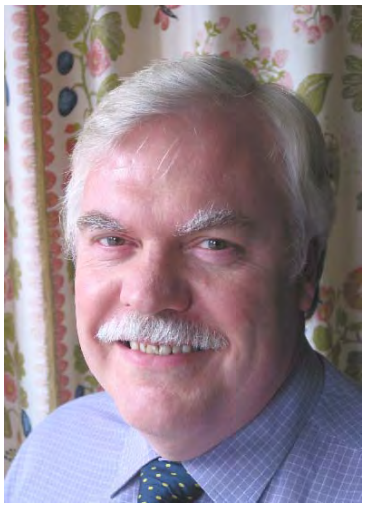
*The **UKDL Newsletter** is focused on bringing news and commentary about plastic electronics, displays, and lighting-related happenings in the UK. The **UKDL Newsletter** is published quarterly for the UKDL by Veritas et Visus.*

A view from the director…

by Chris Williams



This third issue of the *UKDL Newsletter* coincides with the year-end for Year 2 of operation (April 07–March 08) of the UK Displays & Lighting KTN.

UKDL is an inclusive KTN, and anyone is free to attend our events without joining as a member, but gaining membership does allow access to more information on the website, and reduced prices for attending UKDL events. Membership of UKDL is free of charge, and is conferred on individuals who have completed in detail the membership application form on our website.

The year in a paragraph: We entered the year in April ’07 with 460 company members and 82 academic members. By March 31st ’08 we had 619 company members and 130 academic members. We had a target for the year to hold 48 event-days, and to have 900 delegate-days attendance. We actually achieved 46 event-days, and had 1,532 delegate-days attendance. During the year we have run strategy workshops at which the plastic electronics and lighting communities have been able to highlight the primary technical hurdles that need to be overcome to facilitate growth. We are delighted to report that the Technology Strategy Board attended each of the workshops and acted upon the input from the community, subsequently making funding of £10 million available for collaborative research and development projects, targeted primarily at the problems raised in the workshops. UKDL took part in overseas missions organized with UKTI to Korea, China, Taiwan, Brazil and Eastern Europe, and delivered “Inward Missions” for UKTI for delegates from Korea and Switzerland. In all respects, we have had a very successful year!

The year in a bit more detail - management structure: During this year we have slightly increased the management team of UKDL to its present level of five full-time and two part-time direct staff, supported with one full-time secondee and one part-time consultant. This group of nine people brings a wide range of skills and resources to bear on developing and delivering our activities, but at the core of UKDL lies our unique governance structure.

Our sectors of activity (plastic electronics, displays and lighting) are managed by sub-group committees manned by volunteers from industry and academia. These industrially-led committees each promote a recommended list of activities and events designed to address the opportunities and threats facing that sector. The full set of proposals are then vetted and prioritised by our steering committee, itself drawn from the sub-group committees together with other stakeholders. This engagement with the community we serve means that we have 47 industrialists and eight academics driving the content and direction of the KTN, ensuring that our programme of activities and events are relevant to meet member’s needs.

Over this programme development structure we have our advisory board, drawn from industry, and charged with the responsibility to ensure we remain compliant with Technology Strategy Board expectations for KTNs in general, and that we cover all areas of the sectors we cover fairly and equally.

The staff level we now have allows us to maintain the current level of events activity for our members, but if we are to continue to innovate and drive forward our plans for additional skills and resources training (as requested by our members); we will need to build the team further. Our first grant period expires at the end of March ’09, and we are already working with the TSB to develop our plans for a follow-on period.

Events activities: UKDL already holds a wide range of events and activities:

- Tutorial events. These are hosted at our members’ own sites, and are usually 0.5 day activities. Limited to small numbers (5–15 people max), they afford visiting delegates an excellent opportunity to get intensive training on why a particular material/process/equipment/product works, and where the future limits may lie.

- Workshop events. Typically with 10-25 people, and limited to a maximum number of 40, these events are fully interactive, and attendance is strictly limited to delegates who agree – in advance – that they will participate in the discussions held, and will not simply "sit and listen".
- Seminar events. These events have now earned an international reputation for the high quality of technical content, and the focus on individual topics that differentiate them strongly from the multitude of commercial seminars that are run in our sectors.
- Training events. Run jointly with universities, UKDL is involved with a number of training events to develop the skills base required in plastic electronics and lighting.
- Missions. UKDL works closely with UKTI to develop and implement both "Inward and Outward Missions" on behalf of its UK members in all sectors.
- Special interest groups. These are the newest activities within UKDL, and are effectively focus activities within each of the primary sectors to drill down and develop more detailed analysis of the value chain, and to identify specific technology and commercial hurdles facing members active in the areas. The first groups becoming active are:
    - Atomic layer deposition
    - Printing electronic functional materials
    - Display manufacturing
    - Solid state lighting (LED)
    - Printable lighting (OLED)
    - Organic materials
    - Micro-power generation and storage

  More groups will be formed as the need for them is identified.

The management team takes great care to ensure that there is clear differentiation between our events and the commercial seminars that take place across our sectors of activity. Where appropriate we work in collaboration with the commercial event organizers to promote their activities, and will also deliver talks and chair sessions for them. Our mission here is to run a series of complementary activities that will educate, inform and train, often in an entertaining way, to progressively build the skills base of our members. We are also increasingly engaging with the companies and organisations outside our normal sphere of operation who may be the early adopters of the technologies being developed by our members. To this end we have been widely involved in the current review of plastic electronics as a case study for the House of Commons DIUS Science and Technology Committee.

As mentioned before, the programme of events and activities delivered by UKDL is generated by the sub-group committees, and from individual inputs from members. Anyone who has a suggestion for an event, or for a new activity that would benefit a number of members, is welcome to contact us and we will promote their suggestion into the review process. Members who would like to take part in this process of determining the direction and activity of the KTN and would like to join a sub-group committee are warmly encouraged to get in touch with me or any of my members of staff, and to come along to the next quarterly committee meeting. For the year April '08 to March '09 we have a target of holding 48 event days; 28 of these are already in planning and provisional details can be found on our website!

Archive data: We have comprehensive archived data on individual CDs for the seminars and training courses that we have run. Short summaries of many of the full range of events are also included as reports on our website. If you would like to access this archived material, please contact Kay Davenport at our Bletchley Park office. There is a charge for back copies of event CDs, but data held on the website is free of charge to our members.

Rain, cold, heat, sunshine: There's an old saying here in the UK – if you don't like the weather, wait 10 minutes! The weather in the last few weeks has certainly given us a wide range of exposure, but as always, it is very unpredictable. Whatever the weather, customers will expect their widgets and gadgets to work perfectly and without letting them down, so for members who are working in plastic electronics and lighting we are pleased to offer access to the UKDL Environmental Test Laboratory based at Bletchley Park.

Established with the gift of equipment from Kodak, and supported with contributions from Microsharp, this lab facility is run to support UKDL members who need to run tests to establish the effects of heat, humidity and high levels of UV exposure on their products. If you would like to use this facility, or to come and see what it might be able to do for you, please contact Ric Allott or Nick Kirkwood. Details are on the UKDL website.

Smile please… As well as having photo-album reviews of the events we hold, UKDL is developing a very wide range of high-resolution pictures of displays, lighting products and (as they emerge into the market) plastic electronic products in use for which we hold the copyright. Members of UKDL are welcome to use any of these pictures in their own presentations or documents subject to proper attribution being given. Please contact Nick Kirkwood for more information about this service.

Conclusion: Last year was good, but this year will be even better! Inevitably, as a network activity grows and matures, it develops a cohesive traction in the market that allows it to evolve to the next level. Look out for the new ideas and activities we will bring to the market in the next few months. From government we are charged with the responsibility to help our members commercialise Innovation – and to do that we must lead from the front with innovative ideas and actions ourselves.

Capturing value from research networks in emerging technologies

Dr. Zella King, senior lecturer and AIM Innovation Fellow at the University of Reading, is currently undertaking a research project in collaboration with UDKL. Her research, which examines research networks in the emerging technologies of plastic electronics, is funded by the Economic and Social Research Council (ESRC). For more information about the project, see www.printedelectronics.net

The objective of the research is to address the following questions:

- What makes a "good" collaboration in plastic electronics? How is the value created in collaborative projects affected by the characteristics of the individuals concerned, and of the organisations they work in?
- What is the payoff to participating in formal research networks such as KTNs? Does being part of a KTN increase the chances of finding research partners efficiently, establishing other business relationships, and/or accessing public support for collaborative R&D activity?
- Given that participation in networks like UKDL requires investments of time, what makes it worthwhile for individual members? Do members who are central to the network (e.g. on the UDKL steering committees) or highly active (attending many meetings) gain more from their membership than peripheral members, or vice versa?

Activities to date include the following:

- Data on membership and event attendance supplied by UDKL to Zella King
- Preliminary analysis of these data using social network analysis, and discussion of findings with the UDKL team and with Peter Dirken and Mike Biddle of the Technology Strategy Board (TSB)
- Negotiation of access to data on applicants for successful and unsuccessful bids for collaborative R&D programmes (in progress; meeting with James Clipson planned for 14 May)
- Preparation of a web-based questionnaire to be completed by UKDL members (in progress)
- Preparation of a competence matrix to categorise organisations within the plastic electronics community in the UK in terms of their technical, functional and commercial capability (in progress)

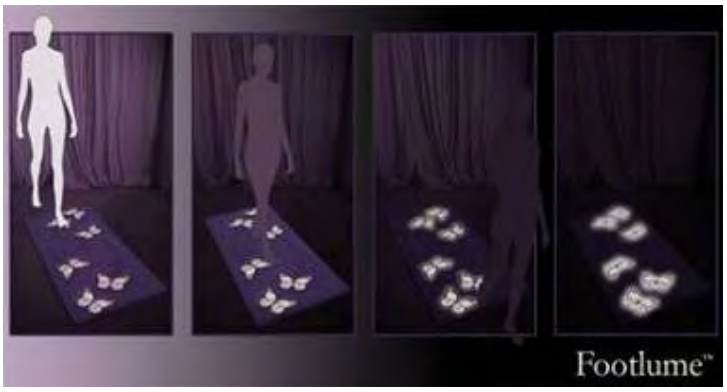
As the project is in its early stages, it is not possible to report conclusively on findings. A questionnaire will be circulated to UKDL members during the summer of 2008, and findings will be reported to UKDL members, the TSB and others thereafter. For further information, please contact Zella King on z.m.e.king@reading.ac.uk

Display and lighting news from around the UK

excerpted from Veritas et Visus newsletters

London South Bank University develops FootLume glow rug

Researchers at the London South Bank University have developed a rug that helps illuminate paths in the home or darkened public walkway. The FootLume, created by Zoe Robson and Leona Dean, is an illuminating rug that adds a touch of contemporary style for the design conscious home. Pressure sensors in the rug activate light patterns with electroluminescent technology. The sensor will activate light patterns with each step showing the way in the dark. EL technology gives off soft light just enough for indication without illuminating the whole room. According to Leona Dean "… the glow that the rug emits is very soft which could make the rug useful as a child's night light. Another use could be to help the elderly to find their way in the dark. A great idea is to use the glow rug to light the way to bed after a night in the pub without waking up your partner." http://www.lsbu.ac.uk



Atmel completes acquisition of Quantum Research Group

Atmel Corporation announced that it has received all necessary regulatory approvals for and has completed its acquisition of Quantum Research Group Ltd. The acquisition of Quantum provides Atmel with an immediate presence in touch sensing, one of the fastest growing markets for microcontrollers. Quantum, based in Hamble, England, is an independent developer of capacitive sensing IP and solutions for user interfaces. Quantum's touchpad navigation technologies are sold to an extensive base of blue chip customers and support a wide range of markets and applications, including mobile phone handsets, consumer electronics (such as personal media players and audio/video systems), home appliances, home security, PC peripherals, medical, automotive, and industrial equipment. http://www.atmel.com

ZYFILM enables LCD shop-window displays to go interactive

ZYFILM, a new through-glass touch sensing film announced by Zytronic, adds touch capabilities to TFT-LCD screens up to 30 inches in screen size mounted behind shop windows or similar glass panels. The film attaches to the window unobtrusively without adhesive, and provides an industry-standard USB interface for fast and convenient installation. ZYFILM enables retailers to quickly add interactive features to window-mounted LCD displays. Touch capability allows these displays to transact sales and collect customer information. The ZYFILM sensor detects user interactions through up to 20mm of glass, which allows installation on the inside of the shop window for extra security. ZYFILM adheres using an electrostatic surface treatment, so that repositioning or removal leaves no permanent residue on the glass. It also features a convenient USB connection for data as well as power, which eliminates the cost and complexity of an external power supply. ZYFILM touch sensors incorporate Zytronic's projected capacitive technology (PCT), which uses an array of embedded micro-fine wires to create a capacitive touch sensor within a clear, laminated structure. http://www.zytronic.co.uk

Zytronic invests over £3 million in a new UK manufacturing facility for ZYPOS

Zytronic, a manufacturer of Projected Capacitive Technology (PCT)-based touch sensor products, announced the completion of a £3 million plus investment in a new manufacturing facility, dedicated to the manufacture of its new ZYPOS touch sensor product. The new 1,850m² facility is adjacent to the company's headquarters in Blaydon, near Newcastle upon Tyne in the UK and includes a 625m² clean room manufacturing area. Zytronic has two existing manufacturing facilities at this same location, enabling the company to draw on its designers, engineers and other specialists currently employed there. The initial production line now installed in the new facility will enable the company to produce approximately 250,000 PCT-based touch sensors per annum. Zytronic will invest in two more lines as demand increases, raising the production capacity to three quarters of a million units a year. ZYPOS is based on the same technology employed in the company's flagship touch sensor product, ZYTOUCH. In recognition of designers requiring the durability and low maintenance properties of projected capacitive technology sensing in high-volume, increasingly cost-sensitive applications, Zytronic developed the ZYPOS product line, which was further complemented by the migration of all of the touch sensor processing electronics into a self-contained remotely sited controller. This controller is based around a microprocessor, which generates simple XY co-ordinates that can be used without the need to write high-level application drivers. http://www.zytronic.co.uk

Newcastle University researchers demonstrate that cellphones can be used as a 3D mouse

A camera-equipped cell-phone can be used to control a computer as if it was a three-dimensional mouse, thanks to prototype software developed by UK researchers. The software makes it possible to move and manipulate onscreen items simply by waving a handset around in front of a screen, a bit like the motion-sensitive Nintendo Wii controller. "It feels like a much more natural way to interact and exchange data," says Nick Pears, of York University, UK, who made the system with colleagues Patrick Olivier and Dan Jackson at Newcastle University, also in the UK. Pears says the current prototype, which can be used to control a desktop computer, is just the first step. He says that the invention really comes into its own when you realize that modern large public displays are really just computers with big screens. For example, the software could let people interact with video advertisements. To control a screen, a user simply aims their cell-phone's camera at it. The handset then connects, via Bluetooth, to the computer that operates that screen. Once a connection is established, the computer knows exactly where the phone is pointing because it places a reference target on top of the normal video feed and compares this to the phone's picture (*see top right in the image*). The distance between the cellphone and the screen is based on the way the screen's size changes due to perspective. The computer translates the phone's movement and rotation in three dimensions into the actions of an onscreen cursor. It is possible to use the phone like a 3D mouse, interacting with objects by pressing the phone's buttons or rotating the phone. SensAble Technologies' touch-enabled devices propel advances in surgical simulation. http://www.ncl.ac.uk

London Underground and CBS Outdoor develop cross-track projection systems

London Underground and CBS Outdoor teamed up to pioneer a new form of digital advertising on the Tube. Three cross-track projection units were installed at Euston station. Cross-track projection (XTP) advertising is a new technology that allows moving advertising messages to be digitally projected onto the wall opposite the platforms in high definition. It's expected that the 150 XTP systems will be rolled out across 24 London Underground stations in 2008. In addition to be able to post changeable advertisements, the replacement of cross-track bill posting will bring significant environmental benefits with a reduction in paper and paste, which renders the paper adverts non-recyclable. 4.1 tons of waste per year will be saved from landfills. http://www.cbsoutdoor.co.uk

The XPT projector can be seen in the image on the left; on the right is a screen capture from a video ad

Promethean and Oxford University Press announce strategic partnership

Promethean announced a strategic partnership with Oxford University Press (OUP). Building on their existing relationship, which saw the publication of the extremely successful Read Write Inc Speed Sounds range and a significant increase in school penetration for both companies, OUP and Promethean are set to develop a number of initiatives during the next 12 months. The partnership combines the experience of two of the UK's leading names in the global education market. http://www.prometheanworld.com/uk

PolyVision announces a strategic partnership with Anders + Kern

PolyVision announced a strategic partnership with Anders + Kern UK Ltd (A+K). A+K is a leading audiovisual (AV) distributor. The partnership provides the trade channel full access to PolyVision's Walk-and-Talk and TS Series interactive whiteboards which feature the patented, calibration-free Lightning technology. A+K is responsible for the sales and first line trade support of PolyVision's interactive whiteboards, and positioning both series as their flagship brands. http://www.polyvision.com

Whiteboard sales continue to accelerate reports Decision Tree Consulting

2007 sales of interactive whiteboards matched expectation across the world as demand continued unabated according to a report from Decision Tree Consulting (DTC). The two big success stories in the year were the US and EMEA outside the UK, where the respected growth figures were: 52% and 42%. Over the next three years the interactive whiteboard product category is expected to see a doubling in volume growth worldwide. From the 66 key countries in the world half will reach the tipping point of 3% classroom penetration by 2008. The report noted that SMART increased its 2007 product category share in the education segment by 4.4 points over 2006. The company's closest competitor has less than half of SMART's category share. SMART now holds 53% of the product category share in the education segment in the US and 57% in the UK. http://www.dtc-worldwide.com

British Airways commissions digital artwork for new Terminal 5 at Heathrow Airport

On March 27, 2008 British Airways officially complete its move into Terminal 5 at London Heathrow airport. Although plagued with baggage handling problems, the new terminal opened to rave reviews related to BA's commissioning of emerging artists and designers to create major artworks. Troika, El Ultimo Grito, Christopher Pearson and Oona Cully are the selected artists who unveiled their new permanent site-specific commissions to the public. These emerging British-based artists are receiving significant recognition for their technologically ground-breaking practices. Works by Troika and Christopher Pearson are depicted below. An additional piece by Troika, featuring Elumin8's EL technology is shown on page 36 as part of the summary about Mood & Lighting. http://www.artwisecurators.com

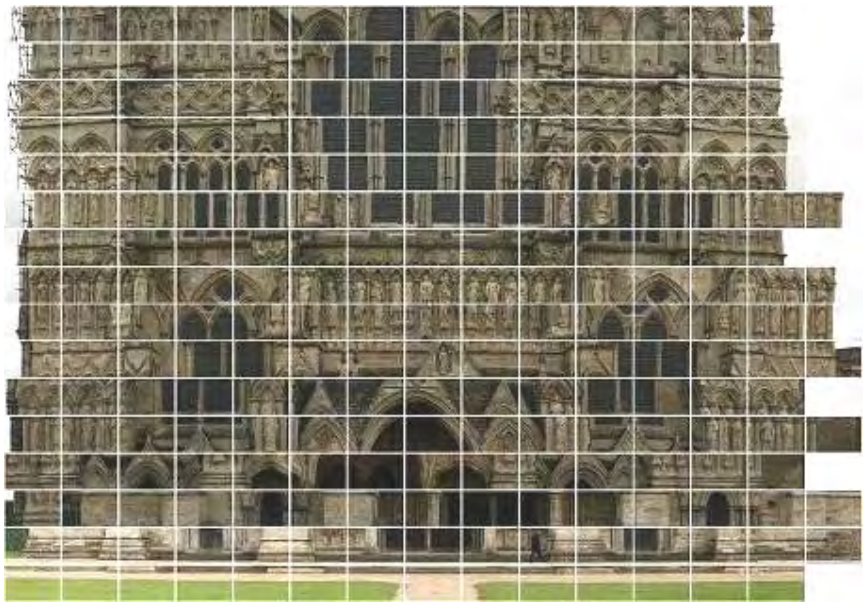
Troika was commissioned to create a signature piece at the entrance of the new British Airways luxury lounges in Heathrow Terminal 5. "Cloud" is a five meter long digital sculpture whose surface is covered with 4638 flip-dots that can be individually addressed by a computer to animate the entire skin of the sculpture. Flip-dots were conventionally used in the 70s and 80s to create signs in train-stations and airports. The sound they generate is instantly reminiscent of travel. By audibly flipping between black and silver, the flip-dots create mesmerising waves, transforming the piece into an organic form that appears to come alive, shimmering and flirting with the onlookers that pass by from both above and below.

Christopher Pearson is considered to be a modern pioneer in the field of digital interfacing and motion graphics that at first glance appear to be still pieces. A textile designer turned digital artist, his admiration for William Morris is clearly evident in the incredibly delicately three-dimensionally laser etched screens depicting three seasons in the life of an Oak tree, with hidden details including a football replacing an acorn, a leaf imitating a roadmap of the UK and swig suspended from a branch injecting extra elements of English culture.

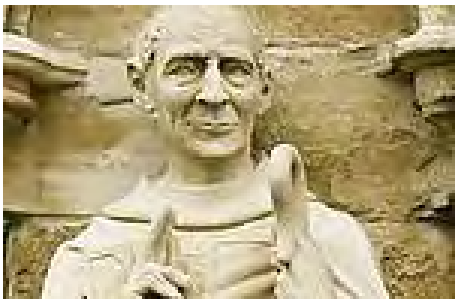
Max Lyons Photography shows off 2-gigapixel image of the Salisbury Cathedral

Salisbury Cathedral, built almost 800 years ago, is a breathtaking structure that is captured in tremendous detail by Max Lyons, who stitched together 245 images to create a 2-gigapixel mosaic of the entrance to the church. Lyons explains his artistic goals as well as some of the technical details:

- "By introducing a new level of detailed, artistic observation to the subject, I hope to help viewers progress from simply pressing their noses against the window to actually stepping inside the worlds of both natural and man-made beauty".
- "The process of correctly aligning photographs that have been taken in a sequence isn't as simple as just joining them together. Objects at the edges of adjacent images don't line up correctly. Align the top halves of two images and the bottom halves aren't aligned; align the bottom half, and the tops are misaligned. The solution to this problem involves computer processing to manipulate the images in just the right way that allows them to be perfectly aligned. Further processing is needed to blend each image with its neighbour, producing a completely seamless final composite with no evidence that any images have ever been joined".



This photograph is a composite, created by stitching these 245 "component" images into one final image. The final image size is 50545 x 38594 pixels (1950 megapixels). This image can be printed at sizes up to 168 x 128 inches.



The upper image is an un-resized crop from the full size image. The lower image shows the incredible detail that can be seen in the photo.
http://www.maxlyons.net

IPHAS Consortium releases high resolution digital survey of the Milky Way

A collaboration of over 50 astronomers, the IPHAS Consortium, led from the UK, with partners in Europe, USA, and Australia, released in mid-December the first comprehensive optical digital survey of the Milky Way. Conducted by looking at light emitted by hydrogen ions, using the Isaac Newton Telescope on La Palma, the survey contains stunning red images of nebulae and stars. The data is described in a paper submitted to the Monthly Notices of the Royal Astronomical Society. To date, the IPHAS survey includes some 200 million unique objects in the newly released catalog. This immense resource will foster studies that can be at once both comprehensive and subtle, of the stellar demographics of the Milky Way and of its three-dimensional structure. This initial data release is of observations of the Northern Plane of the Milky Way (the star filled section) that cover 1600 sq deg, in two broadband colours, and a narrow band filter sensitive to the emission of hydrogen in the red part of the spectrum (H-alpha emission). The image resolution is high enough to permit the detection of individual stars exhibiting H-alpha emission, in addition to the diffuse gas that makes up the often-beautiful glowing nebulae that lower spatial resolution surveys have made known to us before. The IPHAS survey will eventually be extended to cover the entire galactic plane of our galaxy, with a coverage approaching 4000 square degrees (for comparison, the moon on the sky as seen from Earth covers ~0.1 square degrees). http://idr.iphas.org http://www.stfc.ac.uk

This is an image of the center of the Rosette Nebula, as imaged in hydrogen alpha emission in the IPHAS survey. The center of this HII region, where the exciting star cluster (NGC 2244) is located, lies at the middle-bottom of this image (N is to the left, and E down). The longer dimension in this image is approximately 30 arc-minutes.

Peratech acquires Eleksen

On January 10, Peratech announce the successful acquisition of the business of Eleksen from Deloittes. Eleksen developed a wide range of textile fabric sensors – used in the manufacture of “smart clothing” and consumer electronic products such as the Eleksen Bluetooth Fabric Keyboard. Peratech also acquired the business of intelligent textile pioneer, SOFTswitch, in mid-2006. These acquisitions are combined with Peratech's QTC (Quantum Tunneling Composites) which are electro-active polymeric materials which enable “touch” to be translated to an electrical reaction. http://www.peratech.com

TenCate acquires controlling interest in Xennia

Xennia Technology announced an agreement to sell a 75% stake in the company to TenCate. This is a strategic investment by TenCate for whom inkjet offers significant benefits across its smart and technical textile businesses. TenCate will use Xennia to drive the implementation of inkjet technology into several of its core textile businesses. At the same time, it will support Xennia's plans to become the leading integration company and solution provider for the fast emerging industrial inkjet sector. In addition to an increasing focus on inkjet technology for textiles, Xennia will accelerate its industrial printer and ink offerings through OEM partners and direct to end-users in key niche applications, such as ceramic tiles, product decoration and printed electronics. http://www.xennia.com

OLED-T transport material outperforms industry materials

OLED-T, a developer and manufacturer of organic light emitting diode materials and device structures, announced the launch of its organic electron transport material E278ST. E278ST has been developed as a like-for-like replacement in manufacturing lines for aluminium quinolate (Alq3), the electron transport layer most commonly used throughout the OLED industry. E278ST provides significant technical and performance benefits compared with Alq3. The new electron transport material has lower toxicity, lower voltage, higher electroluminescent efficiency, longer lifetime and lower voltage drift. In customer trials, OLED-T has demonstrated a two-fold increase in device lifetime and a 25% reduction in device voltage. A fluorescent red device's voltage was reduced from 8V to 6V at 500cd/m2 and showed a 20% power efficiency improvement. Voltage drift was reduced by 25% over the first 500 hours of operation. The new material is organic and contains no metals. OLED-T will begin customer sampling of E278ST from the second quarter of 2008 and will commence volume production from the fourth quarter of 2008. http://www.oled-t.com

Tesco orders ZBD EPOP displays for new milestone store

Tesco has ordered 2,500 electronic point of purchase displays (EPOPs) from ZBD for its latest milestone store. Continuing a relationship that has already seen ZBD's displays trialed in two Tesco stores in central and southern England, the new orders will be deployed in the dry groceries area. http://www.zbd.co.uk

CPI/Cenamps merger unifies North East England's bid to become world class processing centre

The Centre for Process Innovation (CPI) and the Centre of Excellence for Nano, Micro and Photonic Systems (Cenamps), have announced that they will merge with immediate effect in a move that reinforces the region's position as the lead driver for innovation in the UK's processing sector. CPI aims to become a national centre of international importance, with over 70 high-calibre scientists, engineers and support staff. Their unique approach to stimulating market-led innovation brings together market "pull" from industry with technology "push" from academia, to address the real needs of industry, the centre says. Together, the newly merged CPI will be championing four key technology areas that offer the most sustainable growth potential. They are: advanced processes, low carbon energy, functional materials and printable electronics. CPI's CEO Nigel Perry said, "This is a highly positive move for North East England in a sector where we already have a real international presence. Processing is moving forward at a great pace and only those organisations which continually innovate and evolve will keep up with the marketplace." Processing has been the UK's fastest growing sector over the last ten years growing at an average rate of 2.6% per annum, and is now worth £70 billion to the national economy. North East England's contribution is some 25% of this national total, with the sector representing 30% of the North East industrial base. http://www.fuelcellmarkets.com/cpi/1,1,7855.html

Molecular Vision and Acrongenomics unable to finalise acquisition

On April 7, the Board of Molecular Vision announced that discussions with Acrongenomics on the proposed acquisition of Molecular Vision have now ceased. Acrongenomics has been unable to complete on the terms and timetable agreed. Given this, the Board of Molecular Vision believes that the best interests of the company are served by bringing these discussions to a conclusion. Acrongenomics remains a significant shareholder in Molecular Vision, having recently acquired a 10.9% stake in the company, and work continues on the joint development agreement between the two companies that commenced in March 2006 relating to BIOLED technology. http://www.molecularvision.co.uk

British men pick HDTV over sex

According to a mid-February report revealed by Reuters, nearly half of British men surveyed by a CE retailer in London stated that they would give up sex for six months in return for a 50-inch TV. Comet, the retailer in question, said it quizzed about 2,000 male and female about what they would give up for a large television. In results perhaps not too surprising coming from a merchant eager to sell large-screen HDTVs, Comet found that 47% of men would give up sexual relations for half a year – compared to just over a third of women surveyed. A quarter of people said they would give up smoking, with roughly the same proportion willing to give up chocolate. Comet couldn't overcome the temptation to sum up its survey by simply stating, "It seems size really does matter more for men than women."

JCDecaux partners with Daktronics to launch digital billboard network

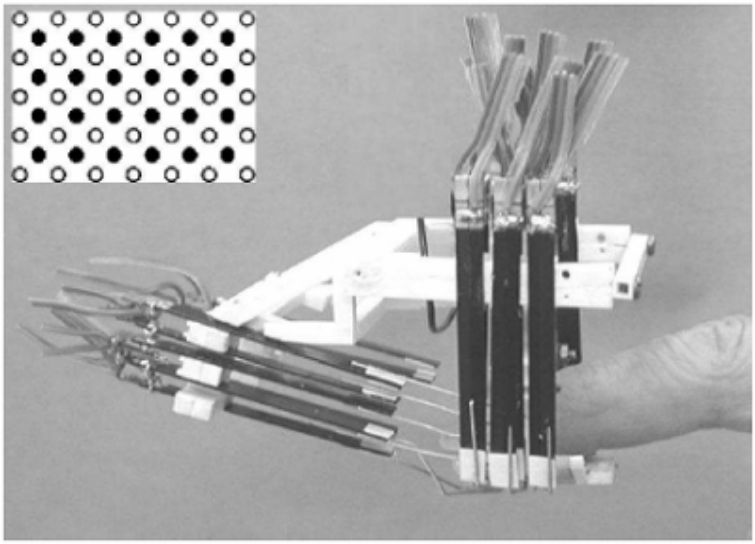
Daktronics announced that JCDecaux, a leader in European outdoor advertising, has chosen Daktronics to provide the company with 20 digital LED billboards for installation in the United Kingdom. It will be the largest deployment of roadside digital screens in Europe, and it marks a significant step in the growth of digital outdoor advertising on that continent. This is the second time Daktronics has supplied digital billboards to JCDecaux in the past year. JCDecaux purchased two digital displays in late 2007, which were installed into a structure uniquely designed in the shape of the Olympic torch. The structure, known as the "Torch", quickly became a landmark in the United Kingdom. The digital billboards will be installed at existing locations throughout London and will replace the scrolling displays currently in use. The new billboards will provide advertisers with the best digital outdoor displays in the United Kingdom, with unparalleled product quality and performance. Each digital billboard measures approximately 6 meters wide by 3 meters high (19 feet wide by 9 feet 6 inches high). The network is scheduled for completion in April 2008. http://www.daktronics.com/billboard

Swarovski adorns London buses with LEDs

Swarovski is a company involved in the world of quality crystal, focused on developing high-end ways to newly use crystal as a creative material. In late 2007, the company developed an advertising campaign that utilized London's buses by inserting LEDs within a bus advertisement. The resulting lights were visible during both the day and especially at night. Naomi Campbell appears to be wearing a shimmering necklace and headphones with blinking lights. See a video of the Swarovski LED advertisement at: http://www.swarovskisparkles.tv/video/swarovski-fashion-rocks/london-2007/led-buses/

Tactile rendering of virtual objects developed at University of Exeter

Using the hands for active exploration of an object can provide information about the object's surface texture and about surface features such as edges and corners. In a virtual scenario, such information can be delivered by an array of contactors on the skin. Tactile rendering is a software description of surface properties, which specifies appropriate drive signals for the array during active exploration of a virtual object. The design of such an array is discussed in the paper, together with a possible strategy for tactile rendering. The stimulator array developed in the ENACTIVE network and the HAPTEX project is shown in the figure. Piezoelectric bimorphs are used to drive 24 contactors in a 6x4 array on the fingertip, with a spacing of 2mm between contactor centres. It can be seen that the drive mechanism is placed to the side of the finger and ahead of the finger, rather than below the contactor surface (which, at first sight, appears to be the most convenient location). With one such array on the index finger and another on the thumb, this positioning of the drive mechanism allows the finger to move close to the thumb so that a small virtual object can be manipulated between the tips of finger and thumb. The contactor surface delivers to the fingertip the small forces associated with touch stimuli, but it must also deliver the larger forces associated with the overall mechanical properties of the virtual object, represented by the output of a force-feedback system. However, the moving contactors that provide touch stimuli are driven by delicate piezoelectric mechanisms and so they are unsuitable for delivering the force-feedback output, which may involve forces of considerable magnitude. Consequently, the contactor surface includes an additional set of contactors ("fixed" contactors – see inset to the figure), which deliver the force-feedback output, in parallel with the tactile stimulation from the moving contactors.



Stimulator array developed in the ENACTIVE network and the HAPTEX project. The contactor surface lies under the finger – contactors are driven by piezoelectric bimorphs (appearing as black rectangles). The inset shows the arrangement of 24 moving contactors, interspersed between the fixed contactors, which transmit global forces to the fingertip.

Digital UK support for switchover legacy project

Digital UK announced its backing for a scheme to build on the success of the UK's first television switchover in Copeland. Two months on from completion of switchover, Ford Ennals, Digital UK Chief Executive, presented a grant to help establish a digital inclusion project run by Age Concern North West Cumbria, which will provide advice, assistance and training in new technologies for people of all ages. The research indicated that all households have converted to digital television and that the program of communication and assistance worked well. http://www.digitaluk.co.uk

Ceravision steps up legal action against Luxim to recover IP

Ceravision announced in early April that litigation against Luxim Corporation's core patents will go to a full trial in both the United States and the United Kingdom. Disputes relate to technologies developed during a joint venture partnership between Ceravision and Digital Reflection Inc (DRI) in 1999. Ceravision partnered with DRI to bring its ceramics expertise to DRI's light source technologies. Ceravision's first patent filing in this field dates back to December 1999, many months before the creation of Luxim. As described in Ceravision's High Court pleadings, Luxim's founders signed a consultancy agreement in April 2000 to provide engineering support to DRI. As further detailed in its US and UK filings, after being paid in excess of $230,000 by DRI during a four-month period, and having information disclosed to them under a Non Disclosure Agreement, the Luxim founders filed the disputed patent application covering aspects of the work previously conceived of by DRI. Ceravision purchased DRI's assets in 2004 in order to acquire full legal title to the technology. http://www.ceravision.com

Surrey NanoSystems enhances polymer luminescence from multi-walled carbon nanotubes

The lifetime of lighting and photovoltaic devices can be improved by incorporating carbon nanotubes (tubes made of carbon atoms, 1000s of times thinner than the width of a human hair) in the polymer to form a composite. The addition of the carbon nanotubes typically comes at a cost. For example, in light emitting materials, the presence of the carbon nanotubes (CNT) reduces the emission from the composite, due to quenching of charge carriers at the nanotubes, which are generally metallic in nature for multi-walled CNT. This quenching reduces the emission efficiency of the devices. Researchers at the Advanced Technology Institute of the University of Surrey, UK, in collaboration with researchers from China and the USA, have recently demonstrated a 100-fold increase in the light emission from a nylon polymer sample, by incorporating multi-walled carbon nanotubes (MWCNT). This increase in light-emission only occurred when they acid-treated the MWCNT prior to inclusion in the polymer. This increase is due to a novel energy transfer mechanism, from the acid-damaged surface of the MWCNT to the emitting sites in the polymer. In addition to the enhanced light-emission, the study also demonstrates that the MWCNT produced an improvement in the stability of the polymer to light-induced degradation. The researchers say that the results show that MWCNTs have enormous potential as a versatile material in future optoelectronic devices, and raise the prospect of utilizing MWCNTs to harvest solar radiation in organic solar cells, in addition to improving device stability. http://www.surreynanosystems.com

UK mobile phone users learn their environmental impact

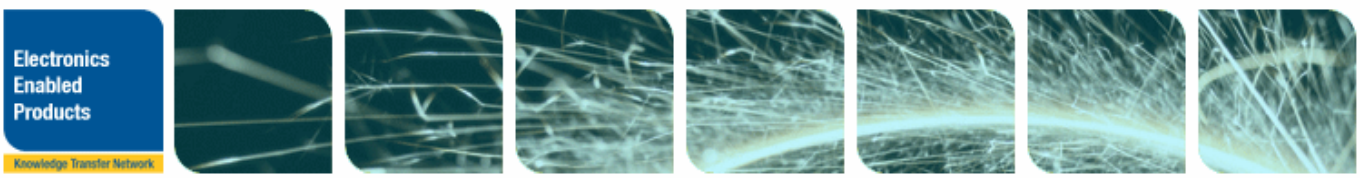
The UK-based NGO Forum for the Future, backed by Fonebak and Nokia, has released a new report entitled “Earth Calling” that examines the impact of mobile phone use. The key statistics from the report are as follows:

- In the Western world, phones made to last ten years typically are discarded after 18 months.
- 105 million phones are thrown out in Europe every year. In Britain alone, about 15 million mobile phones are replaced each year.
- There are nearly 50,000 network base stations in the UK.
- The mobile industry in Britain accounts for about 0.7 per cent of CO_2 emissions.
- Each mobile subscriber is responsible for about 55 kg (120lb) of CO_2 emissions a year.
- To source the gold in a single phone circuit board, about 100kg of mine waste is generated.
- Nokia, the world’s biggest mobile handset maker, says that up to 80 per cent of the materials in its devices can be recycled. Nearly 50% of old phones are sitting in a drawer.
- Two thirds of the power consumed by a mobile phone during its use is lost when the battery is full but the phone is left attached to a charger still plugged into the mains.

The report comes hot on the heels of Greenpeace’s exposure of Apple’s iPhone and its on-going campaign to make the company commit to greening its products. http://www.forumforthefuture.org.uk

EuP Webinar now online

The EuP Directive came into force in August and complying with the new regulations it brings with it will form a mandatory element of the process for obtaining the EU’s CE Mark. Implementation begins in January 2008 so watch this space for more news to follow soon. Eco-design guidelines for the first 15 of the first 20 product groups covered under the directive are now being finalised, with the remaining five expected around the time you’ll read this. To help electronics manufacturers adapt to the directive the UK’s Electronics Knowledge Transfer Network is developing a series of design guides, and has a free 45 minute Webinar to download at: http://www.electronics-ktn.com/pub/sites/erg/EuP/EuPDirective.aspx



Thorn Lighting and University of Durham aim to replace conventional lighting with OLEDs

Thorn and the University of Durham (Photonics Materials Institute) are developing a new form of general purpose artificial lighting, which emits a glow closer to that of the sun than existing technologies and has low power consumption, with a target for mass adoption by 2020. Wafer thin OLED panels are one of the key technologies touted to displace conventional light sources, such as fluorescent and incandescent lamps. OLEDs offer the potential for large area white lighting. The materials can be printed onto either solid or flexible glass or plastic substrates with long life (20,000 hours), reduced energy consumption and less waste (1kg of material will coat 10,000,000m² of lighting area). Electrical efficiency should be close to fluorescent tubes. "The target is 50 lumens per watt in four to five years, with a color rendering index (CRI) better than standard fluorescent lamps," said Geoff Williams of Thorn. "The eventual target is 150-200 lm/W. In 2015 we will be near this level and by 2020 OLED lighting will be the first choice." http://www.thornlighting.com

Polymer Vision acquires Innos to integrate manufacturing of rollable displays

Polymer Vision announced that it has acquired the whole of the business activities of Innos Limited, the manufacturing subcontractor of the company's rollable displays, for an undisclosed sum. The acquisition comes at a time when demand for larger mobile displays is accelerating as telecom players push mobile content, mobile marketing and mobile applications to accelerate growth in data revenues. With its rollable display solutions, Polymer Vision will triple mobile display sizes over the coming years - while maintaining pocket sized mobile devices. Explains Karl McGoldrick, CEO of Polymer Vision: "Replacing glass based displays as the dominant display option for mobile devices is no simple challenge, but that is what Polymer Vision is going to do. With the Innos activities now an integral part of the team, this will happen even faster." The acquisition comes within one year of Polymer Vision's spin out from Royal Philips Electronics. The Innos business activities will be integrated into Polymer Vision Limited, with the manufacturing facility remaining in its current location at the Millbrook Technology Campus in Southampton, UK. Polymer Vision will bring to market the world's first rollable display enabled mobile device through a partnership with Telecom Italia (TI). This pocket sized device combines a large 5-inch rollable display with 3G/UMTS High Speed and DVB-H IP data-casting connectivity.

Polymer Vision also announced first production level rollable displays from Southampton facility. In less than twelve months the clean room facilities were completed, the first complete manufacturing tool set was installed, and the process was successfully transferred from Eindhoven to the Southampton facility. The first batch of rollable displays produced resulted in immediately delivered functional displays and from December onwards volumes have ramped up to meet growing demand. http://www.polymervision.com

EU Commission releases energy efficiency study for computers and monitors

The Commission of the European Union (EU) has released an extensive technical study of possible eco-design approaches that could be used to produce more energy efficient computers and computer monitors. The study, Preparatory Studies for Eco Design Requirements of EuPs, is one of several developed for the Commission to assist manufacturers in their efforts to comply with the essential provisions of the EU's energy using products (EuP) directive (2005/32/EC). The stated objective of these studies "is to find out whether and which eco-design requirements could improve the environmental performance throughout the (product's) life cycle". This 300+ page report refers to directive 2005/32/EC of the European parliament and of the council of 6 July 2005 with the main objective to establish a framework for the setting of eco-design requirements for energy-using products. To get a better knowledge about energy using products, and their environmental performance, and to prepare the coming implementing measures, there was a call for tender from the commission for preparatory studies in September 2005. These studies cover different product groups. The objective of the studies is to find out whether and which eco-design requirements could improve the environmental performance throughout the life cycle of the products relevant to that study. This is the final report within the EuP preparatory study, Lot 3, Personal Computers (desktops and laptops) and Computer Monitors. The methodology developed: http://extra.ivf.se/ecocomputer/downloads/Eup%20Lot%203%20Final%20Report%20070913%20published.pdf

HD VMD now shipping in the US

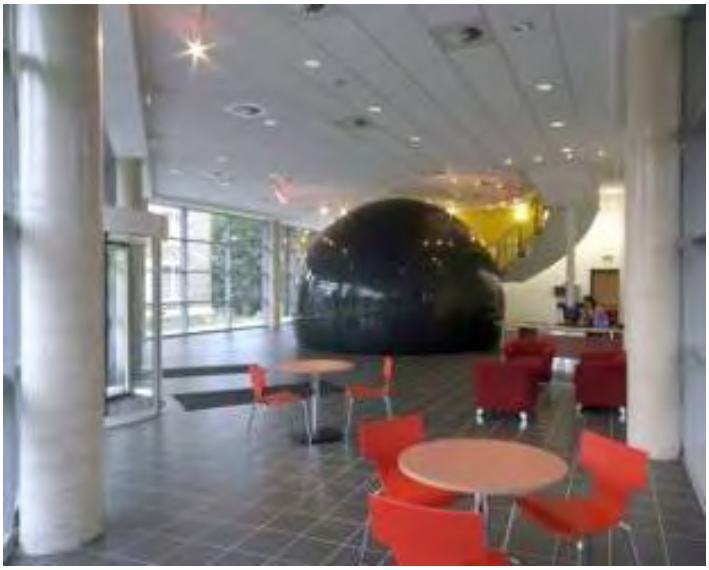
England-based New Medium Enterprises (NME) announced in early January that HD VMD players are shipping into the US market. HD VMD is delivering 1080p players to consumers for $199 via PCRush.com and NMEStore.com. All orders for HD VMD players in January will come with two complementary titles, "Mother Ghost" starring James Franco and cult hit "Cutting Room." HD VMD is based on a patented multi-layer disc, (up to 30GB) which allows for the utilization of red laser technology to provide high definition, versus blue laser technology that competitors are forced to use due to disc space limitations. With only one laser (red), HD VMD players can upconvert existing DVD collections for better viewing quality, as well as play true high definition content. NME also this week announced its worldwide distribution deal with SFM Entertainment for the release of rare and classic film and TV titles never before seen in HD on NME's disc format. VMD players are also currently shipping to Australia and Europe. http://www.nmeinc.com

Sunplus and Ocean Blue collaborate to develop interactive mobile TV platform

Sunplus Technology and Ocean Blue Software, the UK-based digital TV software specialist, have collaborated to develop a portable Freeview DVB-T platform with full interactive features. The new development will provide "red button" functions such as text services and access to alternative video streams in Freeview DVB-T TVs, for use in cars and trains, for example. Sunplus worked with Ocean Blue to port its MHEG-5 software onto Sunplus' SPHE1002 series chipset, which has low power consumption, ensuring good battery performance, essential in mobile devices, as well as static applications. The chipset, with both backend MPEG decode SPHE1002 and front-end demodulator SPDC210/230, also features fast channel scan and good echo performance, also critical factors for mobile devices. http://www.sunplus.com

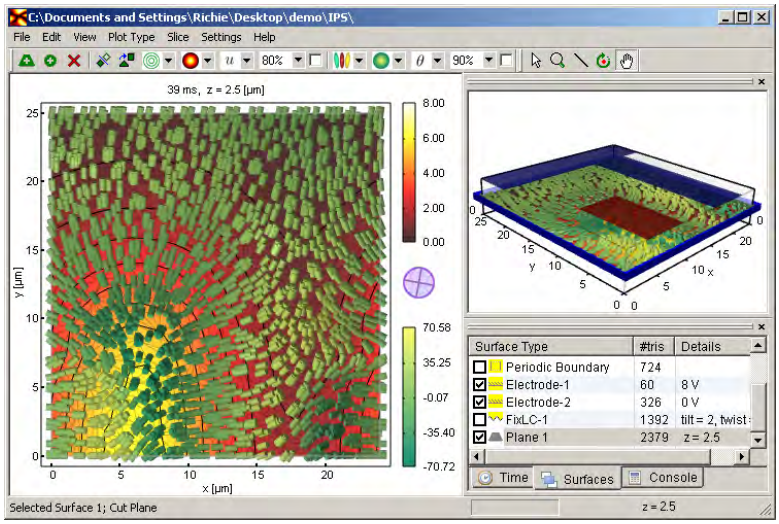
Wales (UK) home to new See3D visualization centre

A new scientific visualization centre at the University of Wales is helping engineers envision the impact of wind farms and enabling scientists to see NASA produced 3D imagery of the sun. Mechdyne designed and installed two high-resolution display environments at the centre. Mechdyne Corporation has installed a custom 4.6-m (15-ft) dome and a 4.6-m (15-ft) wide Fakespace PowerWall immersive display system at See3D, the state-of-the-art computer visualization centre at the University of Wales, Aberystwyth (UWA). The facility, which officially opened in October on the Penglais campus of UWA, makes a world-class virtual reality environment available to academic and commercial researchers throughout the region. The new See3D Centre (http://www.see3d.co.uk/) has already performed breakthrough work in immersive display, including viewing stereo imagery of the sun using data from the NASA STEREO (Solar TErrestrial REelations Observatory) mission, which was shown for the first time in April 2007 on the PowerWall. Other work at See3D includes development of visualization techniques for evaluating wind farm locations, as well as urban planning and historical preservation simulations. Mechdyne designed the 4.6-m radius dome to seat up to ten people. The two monoscopic projectors in the dome, each with 1400x1050 resolution, are blended to fill the screen with a total continuous resolution of over 2.5 million pixels. The stereoscopic PowerWall utilizes two projectors, also with resolutions of 1400x1050. Projectors in the Dome and the PowerWall are seamlessly blended using Mechdyne's proprietary optical blending system that eliminates the need to electronically set up and constantly adjust blended projectors. Computing resources tied to the visualization systems at See3D include an SGI Prism Graphics Engine (configured with 28 processors, 56 GB of RAM, 12 graphics outputs and four image compositors), a 24-processor SUN V40z high-performance computing cluster, and a three Terabyte (3TB) RAID storage system.

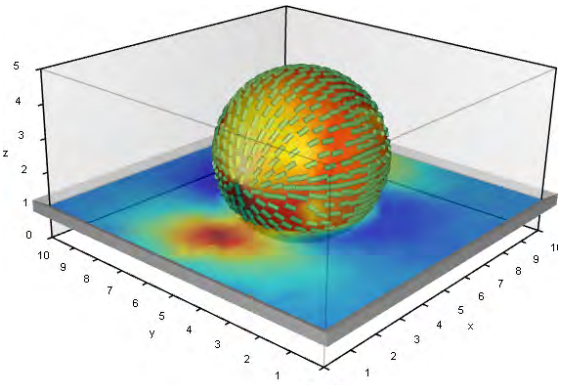


University College London develops modelling package for LC display cells

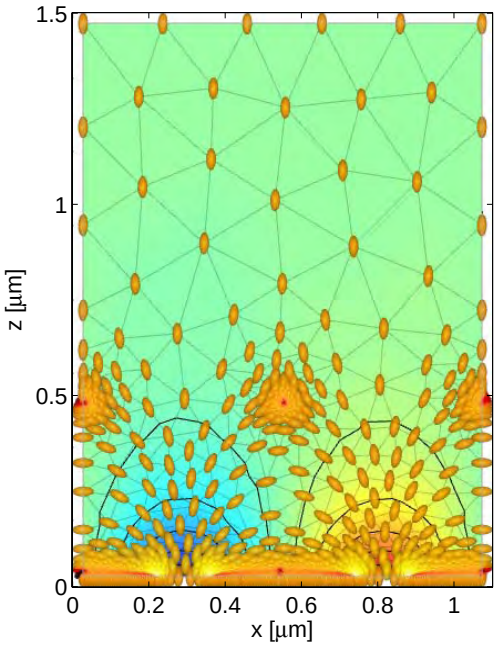
A comprehensive modelling package of liquid crystal structures for display cells and other applications has been developed by researchers at University College London's Department of Electronic and Electrical Engineering. The package, which will soon be released commercially, comprises two modules: the actual modelling program and the visualization tool.



The modelling program calculates the dynamic evolution of the orientation of a liquid crystal material within a containing structure, subjected to time-varying voltages applied at electrodes. The containing structure can be of arbitrary shape. In the two-dimensional mode, this is a cross-section while in the three-dimensional mode, it is a full cell, and can contain curved surfaces and protrusions. A tensor formulation is the basis for the model, allowing for changes in the degree of order of the liquid crystal as well as for local biaxial ordering. This representation, in conjunction with adaptive meshing and a stable time integration scheme allow for the accurate simulation of small-scale features, such as defects, and their associated trajectories within relatively large container sizes. Also included in the model is an accurate treatment of the flow of the liquid crystal as well as anisotropic weak anchoring and the flexo-electric effect.



A visualization package is provided for the post processing of results. The 3D tensor, vector and scalar fields calculated by the model can be visualized over cut planes and iso-surfaces, which can be created, moved or deleted with ease. Incorporated in the package is an extended Jones code, which can be used to plot maps of the optical transmittance as well as viewing angle plots.



The top figure shows the visualizer window with the results of the calculation of directors at one end of interdigitated electrodes used in the IPS display mode. With the right hand pane cut planes can be created, moved and rotated. The left hand pane shows the orthographic projection of the selected cut. Alternatively, this pane can be used to display surface or line plots. The central figure shows the results for the director and electric potential around a spherical dielectric spacer. The surface chosen for the display in the visualizer here is the surface of the spacer. As devices become smaller, the high electric field present in the shrinking inter-pixel gaps can give rise to defects within the liquid crystal. The figure (shown on the bottom right) shows defects induced by these fields produced by closely spaced narrow interdigitated electrodes. The program is able to model accurately the evolution of these defects taking into account both the reorientation of the liquid crystal and its flow. For bistable devices these defects play a critical role in the switching between stable states. http://www.ee.ucl.ac.uk/LCmodelling

Julian Beaver's sidewalk chalk paintings continue to astound

In past editions of the *3rd Dimension*, we've shown images of Julian Beaver's amazing chalk paintings, (see issues #12, #13, and #20), which so clearly show us the importance of perspective. In the below images, the lines in the sidewalk serve to remind us that these really are 2D paintings. http://users.skynet.be/J.Beever

Microsharp installs new surface-structured optical film production line in UK

Microsharp recently installed a new, "state of the art", precision microstructure coating line at their Oxfordshire manufacturing unit. The new unit, unique in Europe gives Microsharp the capacity to manufacture a wide range of UV cured, nano/micro-structured films on a continuous reel-to-reel basis. The line was designed to Microsharp's exact specification and is intended to be used for new film development projects and cost effective short production runs. The machine will also be made available to customers to conduct their own development and production projects. Some of the early development projects for which the line will be used include:

- Optical out-coupling film for OLEDs
- Fresnel lens structures for solar concentrators
- Prismatic structures for clients in the defense display/security industries
- Production of nanostructured self cleaning films

Microsharp is a privately held company with expertise in designing, testing and manufacturing micro-structured optical films. http://www.microsharp.co.uk

Model-based coding of 3D head sequences presented by University of Surrey

A recent paper presented by researchers at the University of Surrey describes a novel technique for model-based coding of 3D head and head-and-shoulders sequences. First, 3D frames are analysed and registered using a 3D face model, fixed and known also at the decoder side. Then, shape and texture information are compressed in a lossy fashion in order to reduce spatial and temporal redundancy. Results show that efficient compression can be achieved for this type of data.

The paper focuses attention on the compression step, introducing a novel technique for model-based 3D video coding. The method presented here is not an extension of a 2D video coding scheme to match the higher dimensionality of the data, but a fully three-dimensional process which uses 3D models in order to understand the actual geometry of a scene and to provide efficient representation and compression.

Deformable surface fitting methods have been widely used to establish dense correspondence across different 3D objects of the same class. The technique used here to register each 3D frame is based on a face dense registration algorithm. It establishes dense correspondences between a generic face model (*see Figure 1*) and a 3D image containing a face. The registration algorithm also produces a texture image, which is generated by using the correspondence between shape and texture in the input 3D face scan. As this texture corresponds to the generic model, the texture map is the same for all input faces. An example of the matching result including texture is shown in *Figure 2*.

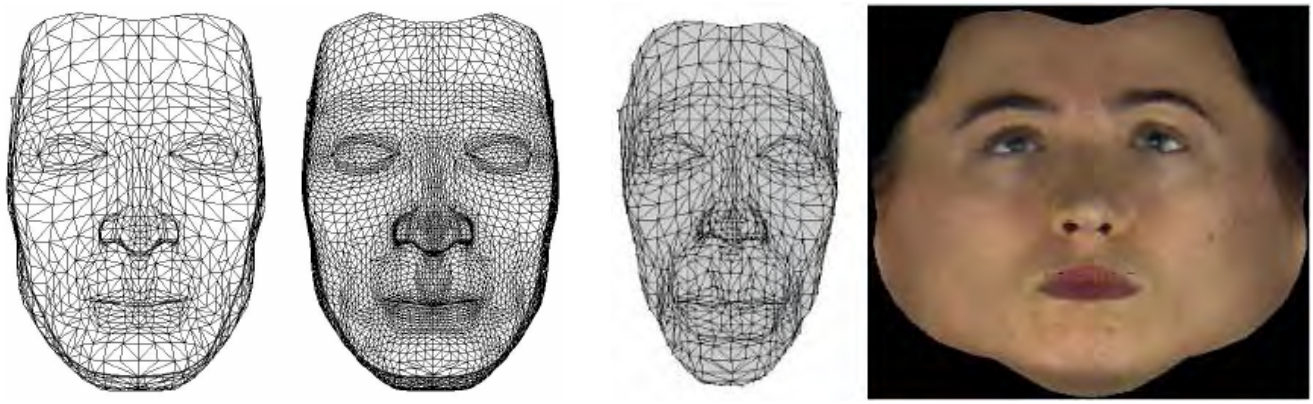


Figure 1 is comprised of the two images on the left – a generic 3D face model: coarse version, 845 points far (left); fine version, 3300 points (middle left). Figure 2 is comprised of the two images on the right – a registered shape (middle right) and texture (far right)

One way to improve performance is to reduce temporal redundancy in a more effective way. The simple differential operator used now can be replaced by a more elaborate 3D motion estimation, which takes into account further details of the face model. Another issue to be considered is the coding of non-face information and the background. Finally the researchers emphasize that the proposed scheme would also work with other 3D models. This means that a better 3D face model can be used to perform the registration. In general the method is also extendable to other sequences by using a different model, e.g. upper body.

Brock shows UK Ordnance Survey in Google Earth

Gavin Brock recently put the UK's Ordnance Survey's mapping tiles to good use -- as a dynamic overlay in Google Earth. This serves as an example of what such data could do it if it were open and freely accessible. Brock's KML file links Google Earth to the OS map site, basically allowing users to overlay the Ordnance Survey Maps onto their current Google Earth view. Similar terrain detail is apparently also available for Japan's terrain. Adding two-dimensional data to three-dimensional terrain is difficult, but this add-on looks to be useful. http://www.brock-family.org/gavin/google-earth/

Interview with Steven Abbott from MacDermid Autotype

Steven Abbott did his Oxford PhD in chemistry at Harvard then went on to post doc in Strasbourg. He joined ICI's Central Research lab and went on to develop coating technologies for optical data storage and digital color printing with ICI Imagedata. He became research & technical director for MacDermid Autotype in 1992 with responsibility to continually reinvent the company with a stream of new products. He identified the need for a close partnership with U. Leeds on the science of coating and web handling in order to raise Autotype's coating capabilities to a new level. He was later appointed Visiting Professor in the School of Mechanical Engineering and is actively involved with his colleagues there in applying nanostructured surfaces to a wide variety of engineering problems. The new science of screen printing emerged from the partnership with Leeds and has made him a well-known figure for his passion for transforming screen printing's image as a black art. He is equally passionate about the need to inject realism and science into production of flexible and printed electronics, believing that creating hype is easy, but creating sellable products requires not just invention but lots of hard production science.

Please give us some background information about MacDermid Autotype. MacDermid Autotype has been around for a long time as precision coaters of polyester and polycarbonate films for applications in the screen printing, membrane touch switch, and touch panel markets. More recently, we have developed novel films for the manufacture of 3D parts for mobile phone and automotive applications and "Precision Nano Replication", a process where we can make micro and nanostructures in high volume using a roll-to-roll process.

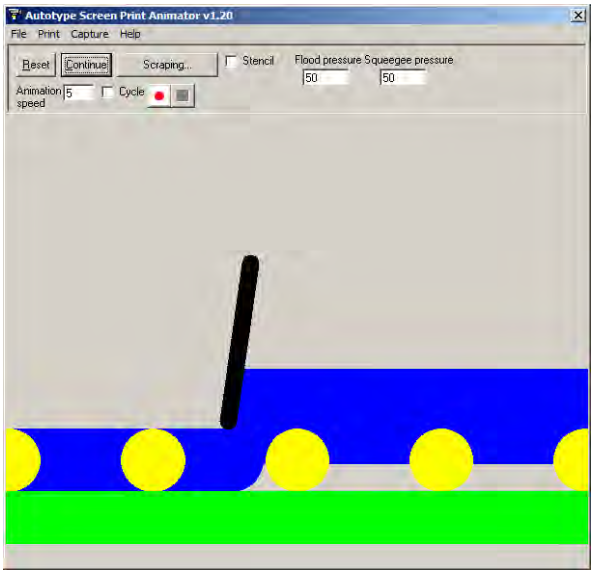
Usually when people in the displays and flexible electronics industry discuss printing they are referring either to photolithographic processes or to inkjet printing. Tell us how MacDermid Autotype has managed to find a niche using screen printing processes in the displays community. All printing and imaging processes have their strengths and limitations. Inkjet is great for putting small amounts of ink into particular areas but is, in my opinion, hopeless for many of the process steps used to make large volumes of products. Screen printing's three key strengths are relatively high speed, versatility and the ability to put down thick deposits of just about anything – especially conductive tracks which require a significant volume of material (silver) to give adequate conductivity.

Screen printing is often associated with T-shirt designs. Is what you're doing at all similar? What's remarkable about screen printing is that the process for putting designs onto T-shirts is identical to that required for printing 40µm lines on a flexible electronics panel. That's what I meant by versatility in the previous paragraph. Screen printing is used for fine ceramics, printed circuitry, RFID tags, diabetes sensors, mobile phones – it has even been used for printing decoration onto cakes!

In the overall science of screen printing, is there one area that is more important than others, (e.g. inks, stainless meshes, presses). The word "science" is important. Most printers assume that screen printing is an art. In fact, work done over recent years with my colleagues at the University of Leeds, where I'm a visiting professor, has shown that the science of screen printing is crystal clear and a powerful tool for predicting how to produce high quality results time after time. The science says that the important thing is to let each part of the process do one thing, and do it well: let the stencil define the printed shape, the mesh define the ink deposit and the ink provide the required functionality (color, conductivity etc.). Most printers get the three aspects horribly confused, trying to get, for example, the ink to compensate for problems in the stencil. As soon as you "separate the variables" the process becomes highly reliable. The final aspect, the press, then becomes rather simple, too. If it's well built and set up properly then it can be run with very light settings and with no need to twiddle with the settings. We are so passionate about the science that we've created a suite of software models that describe every aspect of the process. The suite is freely available to anyone who wants to better understand what's happening on the press.

The UKDL has put a set of my technical articles on precision, fine-line screen printing onto their website. These articles are intended as a starting point for anyone who is serious about doing high quality screen printing, and go well together with the software suite.

Do you see a bright future associated with the screen printing of functional electronic materials? I'm realistic about screen printing's strengths and its limitations. For parts in the 40µm+ width range, requiring significant quantities of material (especially conductors) it seems to be the pre-eminent process. I find it very frustrating that many printers seem to find it difficult to go reliably below 100µm features. They fail because they don't understand the rather simple science of screen printing and therefore do things I can guarantee will result in failure. If they work with the science, then going down to 40µm features is rather straightforward and, of course, at the same time they can easily print any larger features required in these products. It has dismayed me over the years to see a disproportionate amount of development money going into utterly hopeless inkjet plans. If a fraction of that resource had gone into screen printing then everyone, including inkjet, would be in better shape. I'm a fan of inkjet when it's used to do what it does best – small areas with great registration. Any practical device requires multiple printed levels and the combination of screen and inkjet seems to me a really powerful one.



Typical screen shot from the software showing what happens during the squeegee stroke

You do most of your coating on polyester films. Why is that? We're predominantly driven by the high quality demands coming from Asia. There are currently only three types of film available in high volumes that can attain those qualities: polyester, polycarbonate, and PMMA. We're happy to handle PMMA, but it is a delicate film, easily torn or shattered, so it is not popular with downstream processors from a process perspective. But it does have other properties that make it attractive, for example its clarity. Polycarbonate is tougher than PMMA but because it is (relatively) soft its surface gets easily damaged with micro-scratches. That leaves polyester. It is tough, even as a very thin film, and as devices get smaller, thinness is highly prized. It is chemically and physically much more robust than the other two films and we have many years of experience in getting the best from it. So coatings on to polyester, not surprisingly, are our most popular products.

How important is the quality of the film to your coating process? In other words, can coating compensate for micro-scratches, occlusions, and other flaws in the film? Quality is about the whole chain from raw base to final process steps at the customer. Any weak link in that chain makes the product worthless. We work closely with our base film suppliers to reduce defect levels in every aspect of their film. Similarly, we have to watch and inspect every aspect of our process to limit the number of defects we add. Even apparently trivial details of how a roll of film is packed can make all the difference between a product being accepted or rejected. And we have to teach our customers how to handle the films so they minimize their added defects. But the teaching is two-way. We might ship a product that passes every one of our criteria, only to find that the way the customer uses the product makes previously undetectable defects stand out. It is, and will continue to be a learning process. So, to answer your specific question, micro-scratches that were easily masked by our coatings for one application may stand out as defects in another application. We now have six different types of lighting/viewing conditions that we use to inspect our coated films, each of which is relevant to a particular application, each of which can show up just a few specific types of defects. Agreeing on these with our customers and suppliers is time consuming, but it has to be done. Only when all the details are agreed and everyone in the chain can see the same problem can they work to fix it. If you find yourself in a blame game then you're in trouble – it has to be an active partnership in order to succeed.

Approximately what portion of your business is related to touch screens? We don't find the term "touch screen" to be of much use to us these days. Touch is involved in a large range of products from the ubiquitous mouse pads through to the latest ways to interacting with your mobile phone (at the small scale) or interactive whiteboards (at the large scale). A lot of what we do requires an engineered top surface so the finger has a positive "touch sensation". We're even involved in research work at University of Leeds where they are using a special artificial finger to work out what's going on at the moment of touch. So the answer to your question is that a significant, and rising, proportion of our business is related to touch!

Is your market for touch coatings primarily comprised of European customers, or is that business also centred in Asia? Clearly the large volume applications are increasingly being made in Asia. So the growth in our sales in Asia continues to be very strong. For routine parts this means that Europe and the US are losing out. But there is a very powerful dynamic where European and US customers are setting many of the new directions, so we have to work very closely with our Western partners in the early development stages even if the eventual large volume sales are in Asia. We welcome this new dynamic. The chances of Europe or the US returning to large volume manufacture seem small, but mutually profitable business with the major European and US enterprises is a key part of our strategy. This is particularly important for 3D parts where the process is best described as global.

Tell us a bit about the challenges associated with making three-dimensional formable surfaces with integrated touch. That's a whole article in itself, but I'll do my best. What we all want is as much functionality in as small a size as possible. A device such as a mobile phone needs to look good, feel good and function well. "Look" often involves printing and, interestingly, screen printing is still the dominant way of providing good looks. "Feel" involves the top surface (as in the discussion on "touch") and also the 3D shape. "Function", in addition to the electronics, requires output (display) and input (keypads, touch pads…).

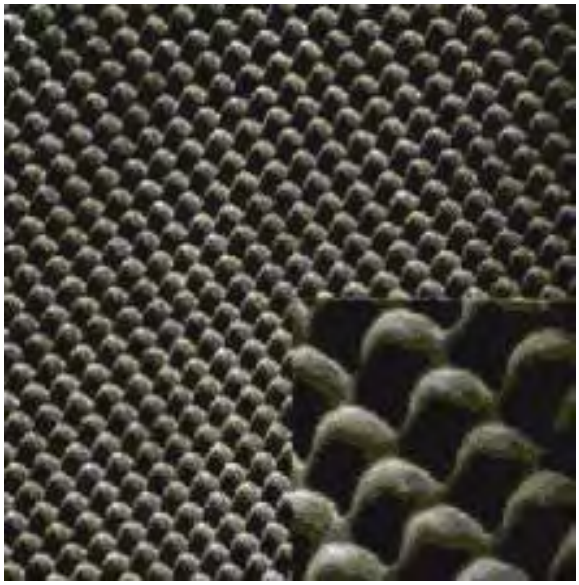
In-mold decoration (IMD), also known as film insert molding (FIM), is a versatile and cost effective method of decorating and manufacturing durable plastic parts. Customers can integrate components such as lens, body and keypads into a single component with IMD formable hard-coated film. Autotype has a range of innovative polycarbonate and polyester film systems suitable for IMD. This hard coat technology provides enhanced scratch, solvent and chemical resistant surfaces, with systems for altering texture and gloss levels on a part surface. The product systems are suitable for a variety of different depths of form, from flat inserts to complex 3D shapes.

Traditionally each of those functions was created with a different technology followed by an expensive integration step. But so-called film insert molding (FIM) allows highly decorated (screen printed) film parts to be created in 3D and locked into the solid shape of the phone via injection molding. This is done via

conventional flat printing followed by 3D forming processes. The problem we're helping to solve is that the top surface of the film has to be tough and scratch resistant for real world use. Traditional hardcoats are great, but cannot (by definition!) be deep formed. So we've created a variety of ways of providing formable films with tough hardcoats. These are being used in everything from rice cookers to mobile phones to prestige automobiles. On the rice cookers, the switches are molded right in to the 3D part, significantly reducing costs. On phones and cars that next critical step hasn't yet taken place but it certainly will happen and we're ready for it.

What are the critical factors to assuring high quality in mass production of nanostructured materials? There are many different ways of making nanostructured materials. Our focus is making nanostructures in high volume production. So we are interested in large-volume applications such as "moth eye" anti-reflection and anti-glare hardcoats. Our success in this is built on a core set of partnerships. At the start is the origination of the nanostructure over a large area. Our partner, Holotools, in Germany is the world leader in creating such large structures to the required "zero defect" quality standard. Then we have a small number of partners who can transform the photoresist masters from Holotools into high-quality nickel "shims" from which we mass replicate the structures. Over the years we have found that it is the tiny details of each step that are important so it has been vital to establish trust within the partnerships so that we can talk frankly about root causes of problems. Finally, when we get the nickel shims onto our production machine all the details discussed earlier about base films come into play. Of course, our own process and formulation technology is vital but in a sense we think this is the easy bit. However good our formulations are, if we haven't resolved all the types of defect in the polyester base, the nickel, the master and the process then there is no point in running the machine. We have got the process and all the origination steps to a very high quality level now. Of course, this is not without its issues, as you have to have confidence that the structures are all essentially perfect, so new challenges to do with inspection is another area of challenge that we are addressing.

What sort of challenges do you encounter in the production of anti-reflection and anti-glare coatings? There is a vast industry making conventional multi-layer anti-reflection (AR) coatings. We have never set out to compete with them. Instead we've offered a package of specialist capabilities that are particularly attractive to sizeable niche markets. For example, sat-nav (GPS) units would clearly be better if they were anti-reflection so the display did not get swamped by sunlight just at some critical junction on a busy highway. But it's not as simple as saying "stick on an AR coating". The whole package of functionality has to work. So our challenges are the classic ones of finding out what package of functionality is really required. It turns out, for example, that FIM is a great way to incorporate AR into some devices and our tough MothEye films withstand the forming and molding cycles with no problem. But the AR surface also has to be resistant to fingerprints (both multi-layer AR and MothEye find this challenging), it has to have a high viewing angle (MothEye is naturally superior in this respect), it must be tough and, finally, it must be cost effective. So our challenges aren't so much the ones of cranking out kilometres of high-quality material (though we do that too!) but, once again, creating partnerships with those wanting to use the technology. We find ourselves, for example, having to teach advanced injection molding techniques to customers who've never before done FIM. We never set out to be injection molding experts, but through our world wide partnerships with FIM in automotive and mobile phone production we've picked up sufficient expertise to help our partners in the nascent industry of FIM AR parts.



MacDermid Autotype is a world leader in producing precision nano and micro structures onto film substrates

Although MacDermid Autotype is not directly involved in sputtering, do you do anything with conductive layers, (ITO, conductive polymers, CNTs, etc)? In other words, can these layers be screen printed? We have to be closely allied with the major sputterers around the world to ensure that our products are fit for today's applications. Although everyone dislikes ITO for the same reasons (easy cracking, yellowness, reflectivity because of its high refractive index, high cost for high conductivity) the alternatives still aren't making any significant impact on today's business. I'd love to say that screen printed or (non-vacuum) coated conductors are appearing on our horizons, but so far their limitations outweigh their strengths, at least in the areas we work on. I'd love to coat a kilometre of graphene some day, but that looks to be some time into the future.

Are you working to support the emergent OLED industry? There has been much hype surrounding OLEDs over the past years. It's always been obvious that there are formidable obstacles to creating large volumes of OLEDS and that the timescales for solving the problems were optimistic. Where there's hype there's lots of wasted investment and so I've largely stayed away from the OLED bandwagon. Even though making an OLED is difficult enough, making *any* decent display is tough because of the need to match the display element (e-ink, liquid crystal, OLED…) with the few million transistors needed to switch them on and off, and with the rather large conductive tracks needed to move all those electrons through the display. They also have the formidable problem of creating very good water/oxygen barriers, which are hard to produce on flexible substrates. But their day will come and like any other display they will need high quality base materials, AR coatings, integrated touch interfaces and, for some flexible applications, printed conducting tracks. We'll be happy to contribute to these generic aspects of OLEDs!

The conventional membrane switch is made from two flexible substrates. However the term "membrane switch" is used, not because both substrates are flexible, but because the top substrate must be made from a thin and pliable material. This top substrate is referred to as the "membrane layer" or "overlay film". When pressed with an actuator or finger the two poles of the switch make direct contact. Upon release, the poles immediately separate as the flexing membrane returns to its original open state. In meeting these conditions of "normally open, push to close, and immediate opening", the switch is considered to have "momentary action".

Do you imagine a day when MacDermid Autotype will be printing displays or are you content with your current focus to provide high performance coatings? We like to stick to our areas of expertise. We know how to make high performance coatings, we know how to form good partnerships, we know how to solve complex mass production issues via printing, coating, forming and molding. We don't know how to manufacture or sell displays so we're happy to bring our strengths to those who do.

What do you see as the biggest shortcoming in the current supply chain related to your coatings? If I thought I would upset our main suppliers by saying so then I would refuse to answer your question. But they know as well as I do that the biggest single problem is high-quality base film. Our US and European partners are doing a great job with the assets they have, and the track record of quality improvement is impressive. But the big Asian suppliers have had the benefit of a massive, local, display-quality industry and have been able to invest in the capital and quality cultures required to produce ultra-high quality base. Because of sufficient demand locally there is no good reason for them to sell to our manufacturing plants in the UK and US, so we continue to use local manufactured base. Although this is a problem it's also an opportunity. The technical capabilities of our European and US suppliers are truly world-class. There is a lot of opportunity for mutually-beneficial business. So the West has a choice: either to

lose out on quality and eventually lose out altogether, or embrace the need for the steady grind upwards in quality and remain major players. The evidence from our suppliers is that they've chosen to follow the upward path.

As a UK company, do you see a big opportunity to find customers in Europe or are your primary customers likely to be in Asia? We've been producing in the UK since the 1860's and we continue to invest in our UK R&T and production facilities. We are also investing significantly in our other production site in the US. Europe and the US are large markets now and will remain so. But of course the major growth opportunities tend to be concentrated in Asia. Happily, we don't see any big contradiction in our current position. As I said earlier, a lot of "Asian" manufacture is driven by Western industry so Europe and the US remain very lively markets for us with lots of opportunities – even if those opportunities tend to drift over to Asia when they start to mature.

As a close observer of the touch-screen market, what do you see as the biggest potential growth areas? The obvious new change is the impact that the iPhone has had on the way that people interact with their mobile phones. This has caused a change in the thinking of the whole interface and hence is another opportunity to get engaged in working with the designers and developers of this and similar types of phone. Using the knowledge we have and bringing it to bear on this interface is an interest area for us. The knock on consequences of people becoming familiar and comfortable with touch screen as the man/machine interface is likely to make them all the more ubiquitous. This may mean that touch screens are found on all sorts of devices that they are not on today.

Tell us about one of the most challenging customer requirements for which you successfully identified a solution. It has to be our deep-formable hardcoat product for the automotive and mobile phone markets. A good example is their use in the switch-gear for the Mercedes S-class. Mercedes have a distinctive "look" and the deep-gloss piano black switches are an integral part of their aesthetic. When we started on the project none of us in the production chain realized just how tough gloss-black products are to produce! It turns out that the slightest defect gets amplified so film that seemed to be of super-high quality could produce low yields of final product. This was a classic example where solving the technical challenges had to be via active partnership. Everyone in the chain was capable of being a cause and a cure of problems. So we had weekly virtual meetings across the European supply chain to identify root causes of problems and provide cures to them. For example, our product worked just fine when printed with standard inks, but one of the printers chose to use a different and particularly demanding ink, which then created problems in our film. As the printer couldn't change the ink, we had to modify our process to reduce the susceptibility to this problem. Another printer had a problem with our film so our team went onto their production line to see why we were causing them a problem. Because we had fresh eyes we could immediately see that the problem was within their process and not within our film. They were then quickly able to fix the problem. They trusted us on their plant because they knew that if the problem had been in our film we would have said so and fixed it back in the UK. Along the way, all of us were able to raise our technical game and improve quality at a detailed level. Although the process was painful for all of us, the result has been mutually profitable business, lots of future growth potential and some very nice looking cars parts!

In five years time, what do you envision as the most advanced sort of coatings that MacDermid Autotype will provide to the displays industry? It's not so much advanced coatings but advanced ways of making products that I see as the defining feature of products in the future. A film will have to be multifunctional in its own right but also fit into a multifunctional manufacturing process. An iconic product would be a mobile phone case made as just two pieces – front and back with lens and touch screen/keypad integrated, with anti-reflection/anti-glare surfaces, all with the right feel to the fingertips (haptics) and the right look to the eyes. Each of these functions already exists but combining them into an efficient manufacturing process will be a lot of work – and a lot of opportunity for improved functionality at lower overall cost. That's a technical, production, and marketing challenge that will keep us and our partners busy for the years ahead.

Interview with Tim Reynolds from Ceravision

Tim Reynolds is chief executive officer of Ceravision, responsible for managing the commercial strategy of the organization and the day-to-day operations of the company. Tim joined Lloyds Bank in 1984 and, having successfully completed the Management Development Scheme, progressed into commercial banking, and, ultimately ran the Oxford Street Business Centre (the largest in the UK) managing a portfolio of over 5,000 companies with total lending exceeding £100 million. In 1993, Tim was promoted to manage product development at Lloyds' head office. Responsibilities included new product creations, strategic planning, pricing and advertising. In 1995, Tim left Lloyds Bank to specialize in funding and advising start-up/early stage businesses. Companies founded or seeded by Tim include: Cognisco Ltd; Create Online Ltd; and Bletchley Park Capital Partners Ltd.

Please give us background information about Ceravision. Ceravision is a privately funded UK-based company developing microwave powered electrode-less lamp technologies. Although much of our time over the past few years has been spent in R&D we are now evolving to become more of a solutions provider. We are still actively developing innovative new IP but now have an active commercial team, which works directly with various clients and industries. Working closely with our clients enables us to seek the best possible solution for their industry challenges and therefore provide a much more tailored approach as opposed to the off the shelf packages currently available.

Tell us about your technology. Our Continuum 2.4GHz technology platform has been designed with simplicity in mind. The whole system is made up of four parts: the burner, the waveguide, the microwave interface unit, and the microwave power source. In simple terms – the burner is a glass or ceramic capsule that contains a noble gas and selected quantities of metal halide salts. The focused microwave energy excites the gas that then forms a plasma channel which in turn excites the metal halide salts to emit light. In traditional lighting systems the main failure mode has been the electroded part of the systems causing systems to dim over time, change their color constancy, and have also proved to be prone to mechanical stresses. We have removed the need for electrodes in our system which in turn has presented us with much more flexibility. No electrodes means: no degradation of color, no degradation of luminance, more uniform spectral content and a greater choice of material to fill the burner itself. While certain materials cannot be used, as they would react with the electrodes, our system allows us to use such materials as Indium Bromide to simulate the spectral output of noon day sun (6500K color temperature) and many other materials to allow us to offer broad spectral emissions.

How does your technology differ from other electrode-less technologies available? Our technology provides advantages that include but are certainly not limited to: greater efficiency, improved color constancy and reduced cost of manufacture.

Considering today's environmentally-charged business focus, what "green" advantages does your technology offer? We have a number of "green" advantages including greatly improved power efficiency compared to conventional technologies, to produce the same lumen output. As we are all aware, reducing power consumption provides significant environmental and societal benefits. Also we have eliminated the need for mercury, which means we are fully RoHS compliant as there are no disposal issues.

What sort of energy efficiencies have you been able to demonstrate with your bulbs to date? What level of energy efficiency do you expect to ultimately achieve? The improved efficiencies that we have demonstrated vary depending on which applicational area is involved. For example, the domestic solutions we are currently developing will be twice as efficient as CFLs, whilst our high power general lighting solutions may exceed the domestic efficiency comparisons.

Currently it seems that Ceravision is focused on developing products to support the professional front projection market. How are the things progressing for you in this area? Our initial focus from a technology perspective was to provide a solution for projection television. The reason for this strategy was that if we were able to overcome the significant issues surrounding lamps for RPTV we would

automatically be able to address the other applications. This strategy has proved extremely successful because we have expanded our offering to cover a number of new areas such as UV lamp sources, high-powered devices (between 200W – 5 KW) and domestic lighting solutions.

The rear projection TV market has not been faring so well lately given the advances made in both PDP and LCD technologies at larger and larger sizes. Do you offer the rear projection folks something that might help jumpstart that market? We are able to offer solutions to the RPTV manufacturers and have been asked to do so but we have chosen other projection applications as our primary focus. The reason for this is due to the fact that we have been able to attract other projection opportunities that offer significantly higher margins.

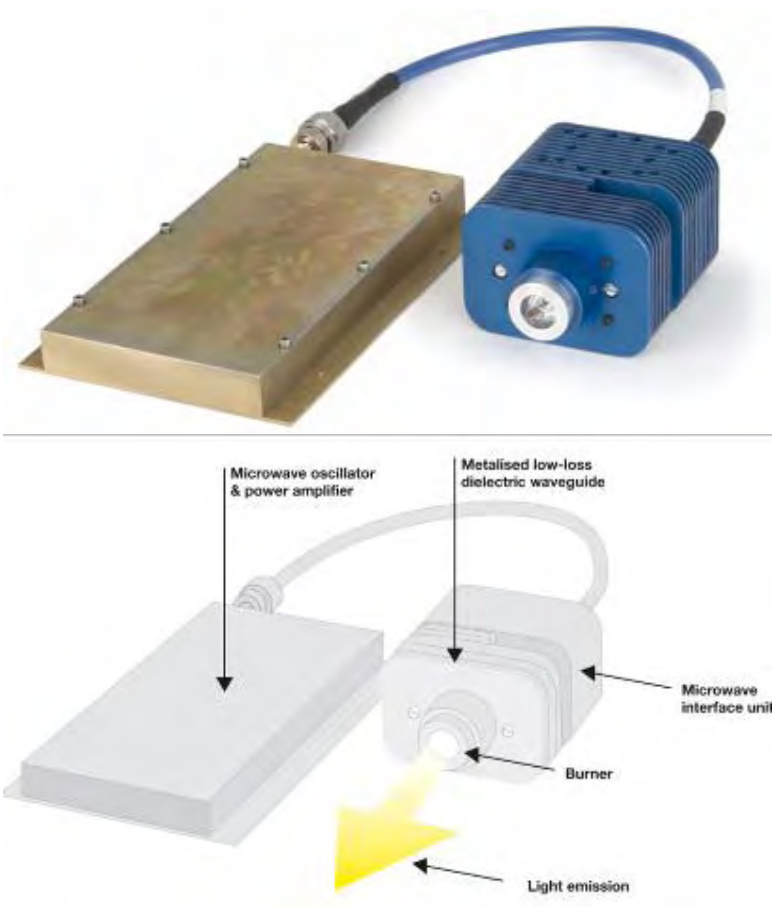
OK. What other markets are you targeting? Since the launch of the Continuum 2.4 we have been overwhelmed by the interest from the different industry sectors. It has certainly been an eye opener for us as to the potential applications of the technology. We already knew that the projection industry would take a keen interest but other opportunities have been presented to us including water and air sterilization, commercial lighting, and domestic lighting. The list of market opportunities grows by the month!

Water treatment seems like a novel market for lighting products. Tell us more about this. The sterilization of water offers enormous global opportunities for Ceravision. Due to our ability to produce a myriad of spectral outputs we are able to change the dose chemistry to produce UV-A, UV-B and UV-C. As a result, we have been able to demonstrate both industrial and domestic sterilization solutions. These provide a number of benefits over conventional solutions such as cost and performance. As the need for clean water becomes more imperative we foresee this as a significant growth area for our business.

In terms of the enormous general illumination market, do you have any sort of timeline as to when you expect to introduce a light bulb that might replace the incandescent lamp bulb? We have already demonstrated solutions in this area and are in a number of active negotiations with companies looking to assess these solutions. Further announcements are due during 2008.

Is it really true that one of your bulbs will never require replacement? Due to the absence of electrodes we are able to provide enormously extended lifetimes. This means that the bulb system will often outlast the device it is being used in. This provides immediate solutions to applications that require constant bulb replacement but may limit our ability, in certain circumstances, to create a profitable replacement market.

What are your plans to move to mass production? Early on we decided that we didn't want to fall into the trap which befalls most SMEs when moving from research and development, into mainstream production. We decided that we would sub-contract our mass production to a facility that had the full technical capabilities along with the relevant quality standards that our customers expect



Representation of the Continuum2.4 evaluation system

with their products. We have signed a deal with the globally renowned Sanmina-SCI who has over 60 manufacturing facilities worldwide. This allows manufacturing to take place near our customers or near the geographical markets we are looking to address.

Key features and benefits of the Ceravision microwave-powered electrode-less metal halide lamp system	
Features	**Benefits**
Burner contains no mercury in its fill	1. This results in an environmentally friendly system that is fully compliant with European RoHS legislation. 2. The burner has no limitation on restart times. It can be turned off and turned on again with no delay.
Burner contains no electrodes	No luminance or color degradation of the emission due to interaction of the burner chemistry with the electrodes. Manufacture of the burner is simple and very low cost.
Burner contains low pressure gas fill	Burner remains intrinsically safe even when subject to catastrophic failure. No explosion risk to users.
Burner chemistry can be tuned to give primarily molecular excitation or atomic excitation	More uniform spectral content that better matches a black body radiator.
Emission can be tuned by modifying burner chemistry	Varying the chemistry of the metal halide salt mix allows the spectral emission to be tuned to the needs of specific applications. This includes various color temperature variants of "white light", "UV light" or exclusively "IR light".
Burner is mounted in a metallized low-loss dielectric waveguide	Use of a metallized low-loss dielectric waveguide allows the microwave component dimensions to be condensed compared to air-based cavities.
Microwave interface unit supplying power to a metallized low-loss dielectric waveguide, limits reflected power to <0.5% of incident power	The simple microwave interface unit offers a low cost solution for protecting the power amplifier at burner ignition. Circuitry is reduced to a minimum, and no feedback system is required to modify the amplifier operating frequency.
Amplifier can be designed using solid state or magnetron power sources	Allows designers to choose a solution that meets the technical and commercial needs of individual applications.

When do you expect we'll be able to see a Ceravision lamp in commercially available product? As a result of our deal with Sanmina-SCI, we expect to produce a number of applications; our first commercial products to be available before the end of 2008.

Tell us how you expect to compete in terms of cost? At every stage of our engineering development, the focus has been on "design for manufacture". This has resulted in the creation of a suite of components that are based on multi-sourceable raw materials, each of which are easy to manufacture using "industry standard" processes and production equipments. Currently there is no-one here in the UK working within the area of electrode-less lamp technology, so competition is generally between us and the incumbent technology and cost has not necessarily been a factor. Due to the nature of our products and the way we

work in close partnership with our clients to develop an integrated solution it is difficult to place a cost on our solutions because it varies from market to market. However we feel that we will be extremely competitively priced within our market segments.

What are the biggest problems you face as you move to mass production? At the moment our potential biggest problem which is also one of our biggest benefits is the myriad of opportunities. We are currently working in several industry areas which face similar challenges when working with light sources but also have their own specific technical requirements. The flexibility of our system allows us to individually tailor each customer's requirement and this therefore leads to the prospect of having many different iterations of our technology. However we feel that this is a good problem – we continue to hear from new companies in new industries with new ideas for our technology. We also feel that we have extensive industry experience that should serve us well in addressing issues related to growth

As the word "microwave" has some inherent connotations, is there any actual risk to the consumer associated with your microwave process? This is a frequently asked question amongst our clients. However our system has been tested for microwave leakages and meets FCC regulations. The technology operates at a frequency of 2.4GHz, which is globally recognized as a license-free operating frequency. This frequency is also shared with domestic and commercial microwave ovens and mobile phones. The design of the system ensures that the microwave power it generates is completely confined within the components of the system. There is no leakage of microwave energy from any part of the system and there is no interference whatsoever with other devices in the immediate vicinity. The 2.4GHz frequency enables us to operate our technology globally license free.

In terms of improving performance, is there one area in which you are focusing your development efforts? I think as a company you are always continually striving to improve product performance, technical performance and functionality solutions for any of the chosen market segments and products. Our focus has been to drive forward our customer projects whilst still developing significant innovative IP and technology to add value to our company.

Any comments about your pending litigation with Luxim? The origins of Luxim's core patent filings have always been disputed and we will continue to do so until the grave concerns that we hold have been fully tested. We expect that a full trial before both the High Court in London, and the US District Court will properly examine for the very first time the fundamental matters affecting the integrity of Luxim's core intellectual property. Pending the outcome of the Entitlement proceedings, Luxim's core international patent application will remain suspended in Europe. We would like to take this opportunity to correct any misapprehension that either of the patent proceedings has been fully determined or that Luxim has prevailed, or ultimately will prevail, in this dispute.

Your offices are located in Bletchley Park; home of World War II's famed efforts to crack the Enigma encryption codes. Do you ever feel inspired by the ghosts of those creative scientists? Bletchley Park is an excellent location to base your business for a number of reasons. It is steeped in history, both military and computing, and enjoys an excellent international reputation, which has greatly increased our profile. I feel sure that the levels of innovation we have produced have been helped be being based at Bletchley Park.

Please describe what you think Ceravision will look like in three years time? Our strategy is to deliver world-leading solutions to a number of industries and applications. In three years time we expect to have a profitable business based on this multi-applicational approach. However, considering how far our technology has progressed over the last three years it is difficult to predict what the technology will look like in the future as we are only now beginning to unlock the plethora of opportunities that this new and novel lamp system offers.

Lighting for mood, health & well-being workshop

April 1, 2008, London, England

The first of many LABL (Lighting and Backlighting) sub-group events that are being organised for 2008 was held at the Hesperia hotel in London. The title of the event gives some indication of the wide remit. Presenters from many diverse fields in academia and industry gave some very informative talks including the use of light in horticulture, urban landscapes, medicine, well-being, for design requirements, and additionally sustainable lighting choices were outlined. The initial event summary is by Robbie Sharpe from the UKDL, followed by more detailed presentation summaries.

At the recent Lighting for Mood, Health & Well-being Workshop, each presenter had twenty minutes to convey their information; this was then followed by a question and answer session, which proved to be particularly lively and active discussions developed, indeed to keep the presentations on time some questions had to be deferred.

Discussions at the workshop on lighting for mood, health and well-being inspired some lively audience participation both during question/answer periods and during the networking interaction periods throughout the day.

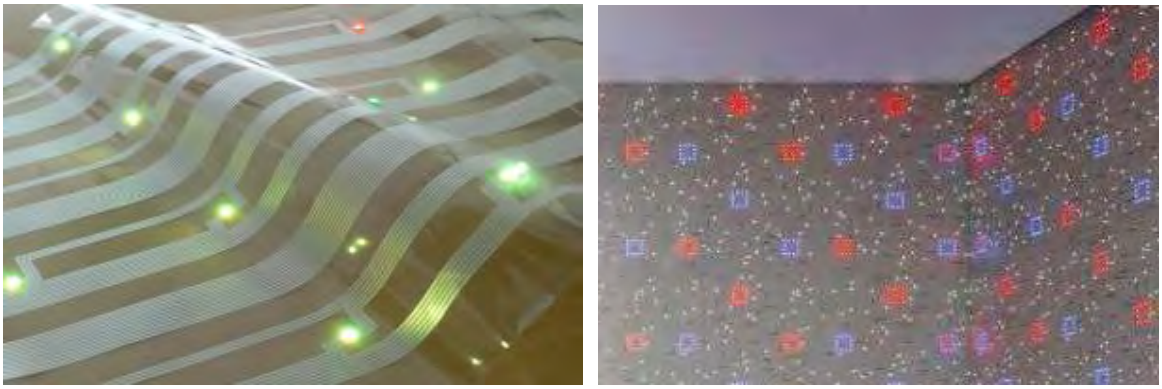
One of the aims of this event was to bring together as many interested parties as was possible in the very disparate and at present disjointed lighting industry in the UK. As an indication, the following organisations, in no particular order, currently have an interest in some of these lighting activities: LIF (Lighting Industry Federation), LA (Lighting Association), ILE (Institution of Lighting Engineers), SLL (the Society of Light and Lighting), CIE-UK (National Illumination Committee of Great Britain), and the PLDA (Professional Lighting Designers Association). This event achieved the bringing together of some of these interested parties.

For the future, the LABL sub-group has scheduled two other major events. A SSL (Solid State Lighting) event is planned for June 24 entitled “Solid State Lighting: Challenges and Barriers to take up for Architects and Lighting Designers”. The main aim for this event is to encourage dialogue between the SSL industry and members of the Architectural and Lighting Designers community. This event will take place in the East End of London, home to many architects and lighting designer practices. Later in the year we will be holding a “Future Lighting Debate”, this event will take place in the North East of England; exact location to be confirmed.

All in all a very successful event; with much networking and dialogue between the delegates and the presenters. The following is a quote from Tong Zhang, Sharp Labs of Europe “Overall a great deal of very interesting information covering many relevant aspects” and “…potential for collaboration with another delegate gained during a talk at lunchtime”.

Making LED lighting flexible
Bertrand Jannon, **Alcan Packaging**, Bristol, England

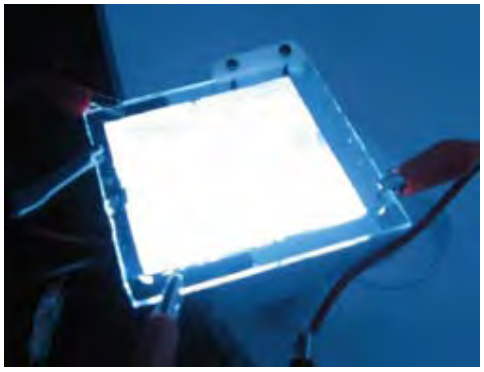
Alcan has developed a way to make LED lighting cheaper utilizing silver-based conductive patterns and graphite-based series resistors that are printed in a single pass in a rotogravure process ((roll to roll). SMD LEDs can then be mounted with conductive glue in an automated process. The process has been designed for flexible substrates up to 200µm gauge. A broad range of film materials can be used including aluminium film (which is ideal for heat dissipation), transparent PET film, paper/aluminium laminate, or engineered films with water barrier functions. Standard SMD LEDs (up to 3W) can be used (white, color, or RGB). Alcan believes the process can open up new applications for LEDs due to the stable and fast production process, environmentally friendliness (additive process), low price, and built on a flexible substrate in a roll-to-roll process. Jannon also introduced Alcan's newly developed high barrier film which uses a silicon oxide layer on a PET substrate and already enables OLED lifetimes of several months. ALCAN has patented an enhanced solution that combines their high barrier film with a "water scavenger" which will further increase lifetimes.



On the left is Alcan's RGB transparent film with single pixel control; on the right is LED wallpaper designed by Ingo Maurer and printed by Alcan.

Project Topless: Thin Organic Polymeric Light Emitting Semi-conductor Surfaces
Geoff Williams, **Thorn Lighting**, Borehamwood, England

Project Topless was sponsored by a UK government grant from the Technical Strategy Board, Department of Innovation, Universities and Skills with partner companies Thorn Lighting (Lead Partner), Sumation UK (Industrial Partner), and the University of Durham (Academic Partner). The goal of Project Topless is to produce materials and devices (small area 5cm^2) which are efficient and emit high quality white light from a single material (polymer). The polymer is solution processable, so that the devices can be printed, eventually on several different substrates including glass and plastic film. The three year project is funded by the UK government at £3.3 million. In three years, Project Topless aims to create large area white light emitting polymer panels at 20 lm/W^{-1} at 1000 cd/m^{-2} with 10K+ hr lifetimes. Williams' presentation reviewed the technical challenges for white light applications, advising the major issues are related to repeatability and reproducibility; colour temperature; brightness; determining whether to print, evaporate, spray or spin; liasing with emerging renewable energy technologies; developing international standards; and continuously produce the next generation of material. Solid state lighting is the future, but for it to be successful, Williams advises that it must work with other technology platforms to offer holistic solutions, the community must engage with architects, designers, and others that influence the market, with novel, creative, and performing products.



Achievements after the first year of Project Topless include a two-fold increase in efficiency and life, >7 lm/W^{-1} at 500 cd/m-2 life at about 21Khrs, a single white light emitting polymer in a single pixel device (25cm2), showing good brightness and colour uniformity.

Lighting for mood, health and well-being: a lighting designer's perspective
Kevan Shaw, **Lighting Design**, St. Andrews, Scotland

Shaw discussed the evolution of lighting and how it impacts mood and health. He described light therapy and light treatment to aid overall well-being and described several projects related to the design of lighting systems. He noted that natural light has a physical impact on the body, resulting in skin pigmentation, freckles and sunburn, as well as diurnal effects related to melatonin and seratonin and associated Vitamin D production. Shaw noted that light therapy is well known in simple therapies such as killing bacteria with direct sunlight. Other examples include the UV in natural light which cures lupus, is used to treat tuberculosis, and improves recover of heart disease, depression, and chronic pain. Artificial light is used frequently, including Blue Light Phototherapy for neonatal jaundice. Such lighting factors are important considerations for lighting designers, who must be aware of the effects of light to create healthy buildings.

Examples of friendly lighting environments, a mall on the left and a wellness centre on the right.

A New Light Source for Medicine
Ifor Samuel, **St. Andrews University**, St. Andrews, Scotland

Samuel revealed some startling statistics related to skin cancer particularly that it is doubling every 10-15 years and affects 15% of UK, 40% of American, and 75% of Australian population. A common and effective treatment for skin cancer is Photo-Dynamic Therapy (PDT), in which a tumour region is illuminated with a high intensity light source which can enable local cellular destruction (within the tumour only). Current PDT methods have proven to be quite effective in that they are non-invasive, selective, repeatable, and can be conducted on an out-patient basis with excellent cosmetic results. Unfortunately, current PDT sometimes results in pain, requires expensive and bulky equipment, is hard to control in terms of brightness uniformity, doesn't allow the patient to be mobile during treatment, creates eye safety issues, and is quite expensive, as it requires a hospital stay.

Based on pilot trials, clinical advantages of OLED PDT include:

- Equivalent effectiveness to conventional PDT
- Achieved with 1/10 the intensity for ten times as long
- Avoids pain
- Ambulatory treatment demonstrated
- More comfortable
- Possibility of treatment at GP practice or home
- Low cost, disposable
- Plus all benefits of regular PDT

PDT is also promising for other indications, including acne and infection.

OLED offers several advantages over conventional PDT, including uniform illumination, lightweight, allows low intensity/long treatment, reduced pain, increased effectiveness, low cost; disposable, attractive for hygiene, and it enables the patient to be treated while still being fully functional at work and home. It can be applied as a simple bandage with a portable battery.

Light for well-being
Pauline Allen, **The Sound Learning Centre**, London

Allen took up the theme that lighting can significantly impact our physical well-being. Light can influence human developmental progress, learning ability, physical well-being, and emotional well-being. She provided examples of patients that suffered severe problems resulting from such things as light intensity and contrast sensitivity that were successfully treated through light therapy programs.

One of the tools used in light therapy is the Lumatron Machine which takes measurements of visual fields of awareness. The device measures for four colours, (red, green, blue, and white) at 7 axes for each eye, both before and after treatment.

The Lumatron Machine takes measurements of visual fields of awareness to help identify visual problems associated with lighting conditions.

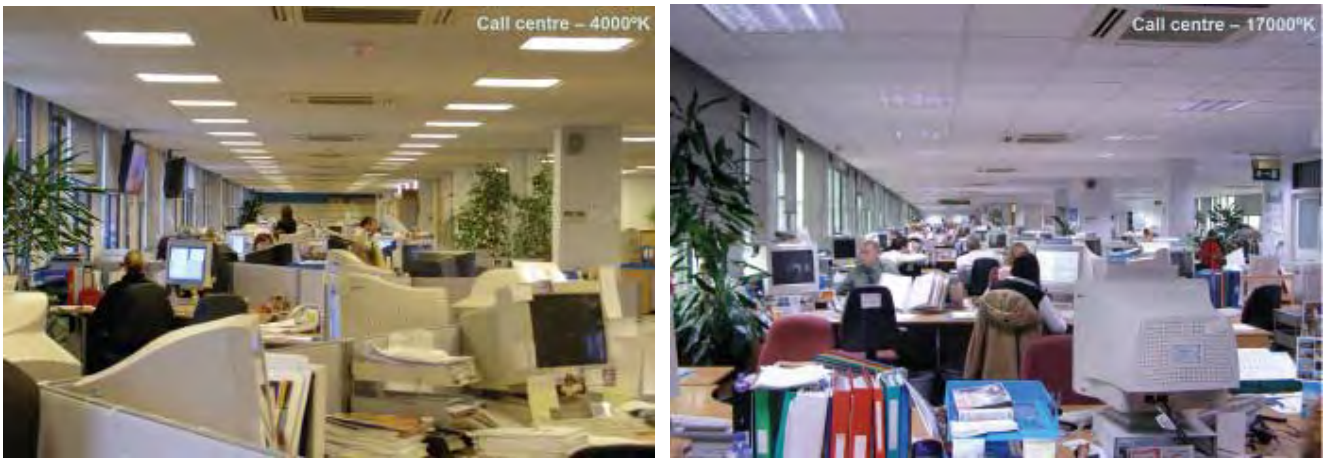
Allen issued a "call for action", suggesting that light therapy can be influenced and enhanced through more cooperation and interaction and by instigating and publishing more research in the area.

Sustainable Lighting Choices
John Aston, **Philips**, Guildford, England

The visual effects of artificial lighting are highly important, whether at work, for pleasure, or in the home. In many businesses over 70% of costs are related to staffing so it's particularly important to recognize the biological effects of lighting – creating ambiance, mood, or even re-assurance. Moreover, demand for sustainable lighting sources are being voiced loudly. According to Aston, 75% of Europe's indoor lighting is inefficient and does not comply with EU quality standards, with similar opportunities related to outdoor lighting.

Aston reviewed many of the improvements in lighting efficacy over the years, with some truly significant improvements now commercially available. But adoption has been slow due to a lack of awareness of high lifetime energy costs, initial acquisition cost premiums, and an impulse by people to resist change.

After discussing several examples, Aston asserted that improvements in lighting are one of the most efficient and easiest ways to significantly cut CO_2 emissions. The lighting industry is responding to the need for sustainable solutions and lighting technology offers both sustainability and quality. Moreover, the end user saves money while enjoying more productive lighting.



On the left is a picture showing typical office lighting (4000oK). The right image shows an office at 17000oK. A recent study showed that the improved lighting increased work performance by 19.4% and reduced concentration problems by 36.9%. In addition to improving working conditions, new lighting solutions can be less expensive and improve the carbon footprint.

Liverpool City Centre – Architectural Feature Lighting Programme
Graham Festenstein, **Lighting Design**, Haverhill, England

Graham Festenstein from Lighting Design talked about a special architectural lighting effort in progress n downtown Liverpool. Officials from Liverpool sought to create a more pleasant environment while showcasing Liverpool's architectural heritage. Expected side effects are to increase tourism and to build the night-time economy. So Lighting Design worked with the City Centre Movement Strategy to aid regeneration of target areas, routes and corridors, to encourage pedestrian use of the city at night, and to help draw residents back into the city centre.

A Phase 1 Impact Assessment was commissioned by Liverpool Vision in 2005, and suggested proved its value to the city with:

- 88% of visitors agreeing that the lighting scheme had increased their enjoyment of Liverpool
- 84% of visitors feeling safer after dark because of the buildings being lit
- 57% of visitors state that they would spend more time in the city centre because of the lighting
- 89% of visitors stated they were more likely to walk in areas where buildings are illuminated

The study also confirmed the hard economic benefits of the first phase; its calculations suggest that lighting had generated additional spending in the city centre of some £3.2 million per year. Based on these figures the public funded element of the programme is money well spent at £2.4m.

After reviewing the Liverpool project, Festenstein discussed vertical illuminance and reflected light more generally. He advised:

- Show off attractive and historically important architectural features – pride in and respect for public spaces and buildings
- Help to eliminate dark and consequently dangerous corners and alleyways
- If correct lamp sources are used, it can improve colour rendition – the correct perception of colours and the interpretation of facial features and expression
- Improved perception of safety
- Potentially an actual reduction in crime
- Greater night time enjoyment of the built environment and our public spaces
- Contribute to our cultural life

Most importantly, good architectural lighting forms a part of sustainable and integrated public realm design and as a consequence contributes to the regeneration of inner city areas

Phytophotonics: Lighting for plants and horticulture
John Alllen, **University of St. Andrews**, St. Andrews, Scotland

John Allen from the University of St. Andrews talked about phytophotonics – the impact that lighting has on plants. He explained that plants react to various parts of the spectrum, including shape (for example, whether the plant is open or compact), time to flowering, and chemical content (which can affect flavour, colour, and nutritional and/or pharmaceutical value. He further described a number of way by which the spectrum can be manipulated with regard to plants:

- Spectral claddings: Plastic sheeting with special transmittance spectra for poly-tunnel greenhouses.
- Reflective mulches: Plastic sheeting with special reflectance spectra for floor- or bench-covering. Examples of reflective mulches include white to increase light intensity at the plant, but which absorbs UV; red, which is designed to improve flavour in soft fruit; and silver, which reflects throughout the near-UV, visible and near-infrared regions. Silver is commonly used in France to improve grape quality.
- Light emitters with special emission spectra. Examples include LED's and fluorescent lamps with special phosphors.

John Allen discussed the field of phytophotonics – using lighting to help stimulate plant growth and characteristics.

Advantages of LEDs for plant lighting include:

- Narrow emission spectrum – good matching to plant light sensors.
- Peak wavelengths available from ultraviolet through visible to infrared.
- Spectrum does not change with age.
- Intensity can be varied by varying the drive current without changing the spectrum.
- Efficient – low running cost.
- Long life – low maintenance and replacement costs.
- Mechanically robust.

The only real disadvantage associated with using LEDs for plant lighting is the high initial capital cost, but Allen noted rapid decreases in costs which might stimulate further work in the fields of phytophotonics.

Designers' use of light designed to influence us
Sara Burns, **Ambient Space Design**, London, England

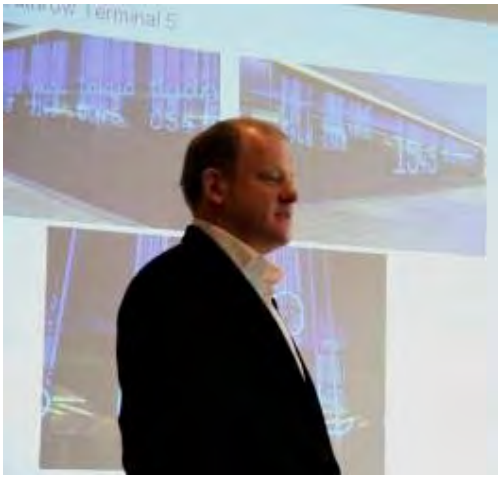
Sara Burns discussed how the creative community can use light and display devices to influence human behaviour and emotions. She showed examples by numerous artists, most of which depends upon the close collaboration between scientists, technicians, designers and artists. She advised that today, most of the mechanisms used to display the technology-based art forms "are inefficient, expensive, very complicated to set up and maintain. We are waiting for the technology to make seamless affordable, sustainable user friendly transitions possible. I look forward to the day when I could supply my designs to be displayed someone's living walls, which they could turn off or on or change patterns or colour as simply as changing a track on an iPod".

Sara Burns discussed how designers and artists use light to affect or alter us, or to condition our development…

Art Lights London
Richard Kirk, **Citylights**, London, England

Richard Kirk introduced a program called Art Lights London, which intends to create stimulating and innovative world-class artist-led light in the City of London. The intent is to "celebrate the city's rich diversity and make a living outdoor museum of light for generations to come". Partners include the British Council and Transport for London, working in association with Design for London. An annual Festival is planned during the winter months (commencing in November 2008) and will feature national and international artists. There will be a mix of permanent and temporary installations. Kirk advised that 5-8 commissions are expected to be awarded each year, such that by 2012, London will enjoy 30-35 projects across selected bridges, waterways, London gateways, streets, courtyards, squares, buildings, parks and open spaces. Aims of the program are to create a practical research and development platform for city lighting projects; driving cross fertilisation between the arts and sciences within the academic forum; developing new forms of technology, recycling existing technologies, monitoring, analysing and problem solving on projects; and furthering sustainable lighting design and renewable energy amongst artists.

One of the upcoming projects sponsored by Art Lights London is called "Visionary Bridges" and is being conducted in association with the London Festival of Architecture. It's an international competition to be launched 2008 inviting architects, and architects working in collaboration with artists and designers, to create a futuristic bridge over the River Thames. Each year (2009 to 2012) three concepts will be selected by an eminent panel and visualised in lights during November to February. On the right is another example of the sort of artistic work the Art Lights London program intends to support.




Richard Kirk also discussed various lighting projects that have been showcased by Elumin8, including a new installation at Terminal 5 of London's Heathrow Airport. The EL-based timepiece, created by Troika, includes 10,500 circuits, and is 22 meters in length.

Investigating 3D and Projection Displays

March 11-12, 2008, De Montfort University, Leicester, England

This was a two-day event held at De Montfort University, which has many excellent 3D facilities on site. The host during the event was Professor Mohammad Ibrahim from the Fused Media Lab. The introduction here is from Robbie Sharpe, UKDL knowledge transfer coordinator.

Day one concentrated on 3D activities; speakers from academia, mainly but not exclusively from De Montfort University (DMU), were complimented with speakers from industry, and indeed it is thought that we had more or less a sizable proportion of the whole 3D community in the UK at the event. Professor Ibrahim (DMU) gave the keynote; his talk covered 3D/volumetric applications, media and systems. We were given an excellent insight into the work at DMU, also how he sees the future developing for 3D.

On the left, Ric Allott and Robbie Sharpe from the UKDL welcome delegates; on the right the attendees enjoy an immersive 3D presentation.

The 3D day ended with a tour of the facilities at DMU – this was for some of the delegates the highlight of the day. Comments similar to the following included, “It is fair enough to talk about 3D and give presentations on a 2D medium, quite another to see the 3D facilities/exhibits for real.” I agree wholeheartedly with this comment and indeed some of the delegates had specifically attended for the purpose of seeing this part of the proceedings. Delegates at the conference were also given the opportunity to tour DMU’s new Creative Technology Studios (CTS). This £3.7 million facility features state of the art equipment, including video, audio and radio production suites, fully-equipped recording studios and laboratories with the very latest broadcast and audio analysis technology.

Day two concentrated on projection technologies; this was the first projection specific event held by UKDL since December 2005, most of the leading companies involved in projection were present and gave presentations; additionally academics involved in leading edge research gave their presentations. Bob Simpson, Electrosonic, gave the keynote for this day. It gave a fantastic history of projection starting in the 1930s; we were then brought right up to date with a very well informed overview of current technologies. During the course of the day speakers from academia and industry gave many interesting talks on what is available now and in some cases what is coming up in the near and maybe not so near future. Again much interest was evident from the many and varied questions the speakers received.

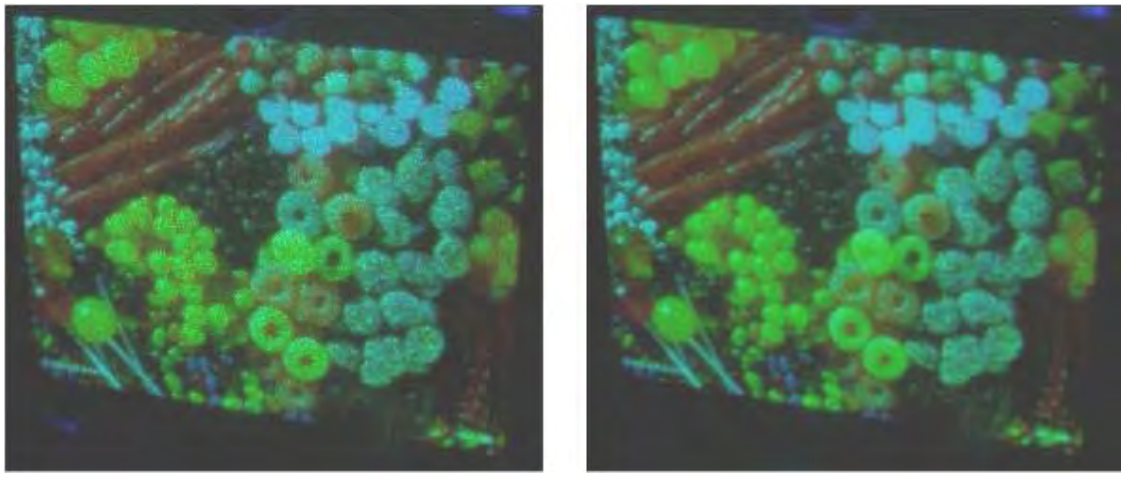
A well attended event, 32 in total on day one and 29 in total on day two. On the evening of the 11th a networking dinner was very well attended, 24 people enjoyed networking and discussions with colleagues, friends, and new acquaintances alike. UK Displays and Lighting Knowledge Transfer Network look forward to organising similar events in the future.

LBO's Holographic Laser Projection Technology
Adrian Cable, **Light Blue Optics**, Cambridge, England

Adrian Cable from Light Blue Optics *made a* presentation about LBO's holographic laser projection technology. Two common techniques are used for laser projection: scanning systems use one or more mirrors to raster scan a narrow beam to form an image; imaging systems use projection lens to magnify and focus an image from a microdisplay onto the viewing surface. LBO's patented projection technology is unique, the company says, forming images entirely using diffraction. Computer generated interference patterns - holograms – are displayed rapidly on a phase modulating microdisplay. Laser light is used to illuminate the microdisplay, forming a projected image by coherent interference. There are no moving parts, no complex beam shaping, no polarisers, and no projection lenses.

Cable explained that holographic projection using phase holograms is not new. The technique (including some corresponding algorithms) for computing phase holograms to form images has been known for a long time: Lesem, Jordan, Hirsch (1969, IBM J. Res. Develop.). Because phase holograms form images by "steering" light using interference rather than "blocking" light, very high system efficiency is possible. Historically, phase hologram computation algorithms tended to be either very demanding computationally, produced poor results, or very often both. The relationship between hologram and image is complex, and computing holograms that form high-quality images is a difficult problem. Generally, images produced exhibit quantisation noise that results from constraining the solution to unity amplitude and/or a finite number of phase levels. Fast multi-phase microdisplays, required to display holograms to form flicker-free full-color images, are not yet commercially proven. Fast binary-phase microdisplays are available and proven, but with conventional approaches achieving low noise has proved impossible. The conventional line of attack has been to look for algorithms that find holograms that minimize the reconstruction error. If a fast spatial light modulator (SLM) is used, on the other hand, which can display more than one hologram during the temporal integration period of the eye (around 30ms), then the reconstruction error of the image perceived by the viewer will actually be a much easier problem to solve. This realization – while seemingly straightforward in hindsight – was first made in 2003 by two of LBO's founders, and patents were filed on the core methodology. At this time, LBO presented the first algorithm to generate hologram sets which, when displayed sufficiently rapidly on an appropriate modulator, resulted in high-quality image reproduction. This algorithm was termed OSPR. LBO's current algorithms exhibit significant improvements in computational performance and image quality, but are still based on this fundamental approach.

The result is high efficiency (high brightness for video and photo content); ease of use (focus free image plane enabling hand-held applications, large throw angles possible, 100º demonstrated, speckle reduction incorporated in the projector, 4x resolution option capability for a given microdisplay; small footprint, robust design and implementation, and low cost.



LBO's multiple-subframes technique provides speckle reduction. Each of the (thousands of) holograms displayed per second can be calculated to produce an uncorrelated speckle pattern, so speckle averaging occurs within the eye. The result is considerably lower speckle than all other laser projection systems.

Firefly: LEDs with attitude
Alan Dix, **Lancaster University**, Lancaster, England

Alan Dix of Lancaster University gave a presentation entitled “Firefly: LEDs with attitude”. The Firefly concept is that of applying autonomic computing to display technology through processor control of a display down to individual pixels so that they collect together to form self-configuring displays and allow the development of a new medium. Imagine, he said, every pixel on this display being a computer, any collection of light sources as a coherent display surface, and, ultimately, spray on displays.

The requirements are the integration of simple, low cost devices, versatile yet low cost interconnects and infrastructure, and scalability. “We applied a pragmatic, prototype driven approach to this research,” Dix said. The lighting elements are 22x9mm “smart fairylights” incorporating 5mm ultrabright 30mA white LEDs and a PIC12F629 microcontroller (4MHz internal RC, 1k Flash program memory, 64 bytes RAM, 128 bytes EEPROM, individually addressable). Many devices can be chained on a bus. Currently there are ~100 devices per bus limited only by software processing and line switching time.

Using “smart fairylights” such as pictured on the left, it is possible to model “true” 3D imagery. Typical deployments might include light curtains, but they could now contain 3D components. 2D planes can also be “sliced” from a 3D model to define a plane. Objects can then be projected onto that plane to give targeted messaging to a point in 3D space. The techniques lend themselves to large displays and large viewing distances.

Dix explained that, unlike regular displays, a pixel’s address is not its location. There is no correlation between infrastructure and location and no need to provide a mapping between ID and location. Lights can (on demand) beacon their address visually using LEDs with beacons identified and located visually via CCD cameras. This allows the pinpointing of lighting elements in space so that data can then be gathered and used to create a display surface. In three dimensions, multiple cameras can isolate the location of a light in 3D space allowing us to move away from 2D displays, potentially enabling a new range of applications. These include deploying lights around any 3D object (wrapped or through interior); locate the lights (either at build time or in the field); using as a display surface. As the system is networked, it can also be interactive.

Approaching Visual Acuity for Simulation Systems
Keith Murray, **SEOS**, Burgess Hill, England

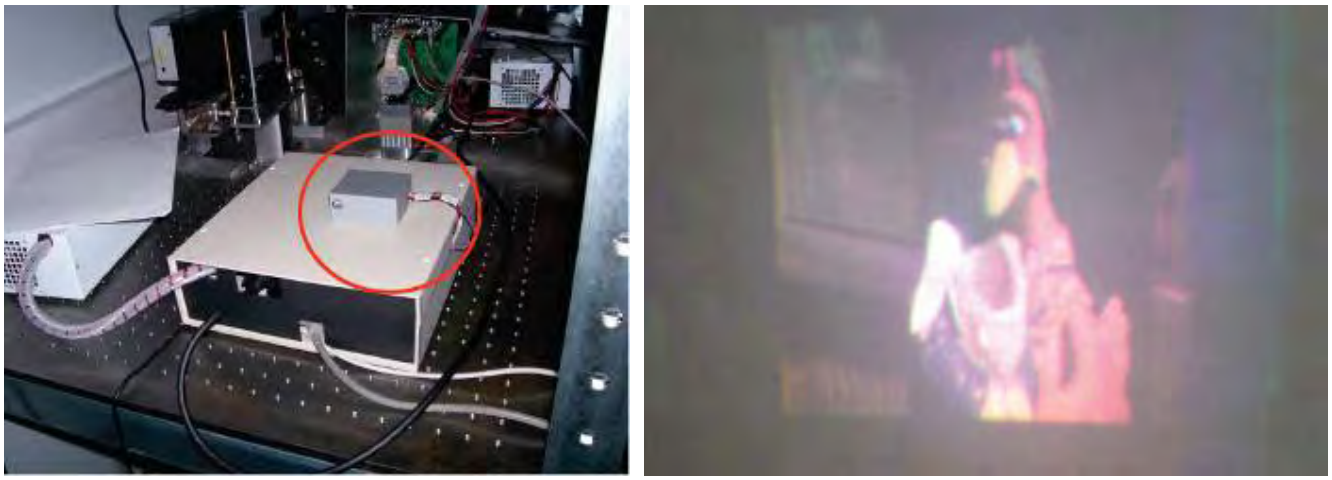
Keith Murray of SEOS presented on “Approaching Visual Acuity for Simulation Systems”. He said that the aim of simulation was to reproduce dangerous scenarios for cost effective training. It uses motion and visual cues to fool the brain that it is in the real situation and visually provide a reproduction of the out the window scene during real flights. Issues were resolution, colour, contrast/dynamic range, bit depth, latency, motion blur, system Kell factor, and other unpleasant artefacts such as vergence, etc. The agenda dealt with eye/brain sensor; system factors; resolution; modulation transfer function; blending; distortion; motion blur; and testing and regulations.

The wide-ranging presentation covered eye-sight charts; wide-angle, multi-channel, collimated projected display systems; 4-panel projection; dome display resolution plots; geometric distortion; FAA test patterns; and many other topics. He said that there were many factors that contribute to resolution, some out of the control of the system designer. Fixed matrix projectors have advantages but CRT is still a hard act to follow. There is a great reliance on simulation training and regulation is under review. There are clear definitions but the catch-all should be “no other visible artefacts”.

The Projection of Video Images from LCoS Phase Screens
Bill Crossland, **Cambridge University**, Cambridge, England

Bill Crossland of Cambridge University gave a talk on “The Projection of Video Images from LCoS Phase Screens”. He asked what is the simplest phase screen (or phase-only hologram)? The advantages of phase screen projection are higher optical efficiency; it is robust to device imperfections and fill factor; noise is re-distributed; soft pixellation; fewer components (optics can be incorporated in the SLM). But, Crossland pointed out, there is more computation and a non-standard SLM. He then went into the physics and mathematics of noise redistribution, and the relative efficiency of amplitude, binary phase, and analogue phase holograms, before looking at the history dating from 1972 of the Gerchberg-Saxton algorithm and the Fienup algorithm (1978). The Cambridge work is on FiDoC (Fienup with Don’t Care Algorithm). Fienup has no amplitude tolerance whereas FiDoc introduces magnitude tolerance in areas that will be blocked by the aperture.

Crossland then went into some detail about the development of early-stage experimental color projectors in conjunction with partner Alps Electric Co. Multi-phase-screens are capable of projecting high quality video images, early stage experiments support this view, however we are not yet their, he said. The next stage in the technology is further optimisation of LCoS devices, light engines and acceleration hardware to get close to theoretical results. The technology offers remarkable simplicity and efficiency, unrivalled robustness and unique flexibility, he stressed. He finished by saying: “In the long run, perhaps its most important attribute is to bring practically all image parameter under software control on a frame-by-frame basis in order to maximize image quality and minimize bandwidth.”



On the left is an early-stage experimental colour projector: a 720x720 pixel hologram is tiled onto a 1920x1080 pixel array. The image on the right was taken at a 60Hz frame rate, 32 phase levels, analogue LCoS backplane, and custom nematic liquid crystal.

3D Surface Image Capture for Medical & Entertainment Applications
Colin Urquhart, **Dimensional Imaging**, Glasgow, Scotland

Colin Urquhart of Dimensional Imaging presented on “3D Surface Image Capture for Medical & Entertainment Applications”. His talk was split into five sections: human body 3D surface image capture; passive stereo photogrammetry; medical applications; entertainment applications; and 4D surface image capture/facial performance capture.

In the first section, Urquhart looked at the company's DI3D passive stereo photogrammetry system and the company's Di3D facial 3D camera (*see photo*). He said that the advantages of passive stereo photogrammetry were:

- Instantaneous capture of 3D shape and colour: 3D shape and colour are captured simultaneously and instantaneously in a single photographic flash.
- Extremely high resolution and accuracy: resolution up to 14 megapixels per captured image.
- Child and infant friendly: does not use structured light projection or scanning.
- Robust and easy to use: employs standard off-the-shelf digital stills cameras.
- Flexible and portable: quick and easy to set-up and use.

On facial performance capture, the objective was to capture (into a computer) the "animation" of the human face. The challenge is that facial expressions can be subtle and transitory. The requirements are high temporal resolution (fps), high spatial resolution (number of points), and unconstrained capture. Urqhuart concluded by saying that passive stereo photogrammetry is a very (the most?) promising method for facial performance capture. The disadvantages are that it generates a huge amount of data and is very computationally intensive. The advantages are that it has very high spatial resolution, high temporal resolution, unconstrained capture (marker free, re-targetable), can be extended to multiple views, and texture maps are "for free".

3D in Medicine
Harry Hatzakis, **Biotronics3D**, London, England

Harry Hatzakis, CEO of **Biotronics3D**, gave a talk on 3D in medicine. Dealing with the evolution of healthcare IT, he said it should be digital, mobile and virtual from workflow management to disease management. The focus was on personalized healthcare and on efficiencies and cost reductions. Medical imaging plays an important role. Evolution is from 2D to 3D to 4D to 8D++. Monitors follow the progress. In the past there was a storage problem – the solution was PACS. Today there is an information overload problem. The solution is advanced medical imaging. He gave as an example angiography where 2000+ 2D images can be incorporated into one 3D image. In terms of market growth, healthcare IT will grow with 15% AGR in the next 10 years. Software based 3D visualization is growing by 24% AGR but is estimated to go down to 15% in the next five years. 3D medical devices are estimated to grow by 73% annually to 2012.

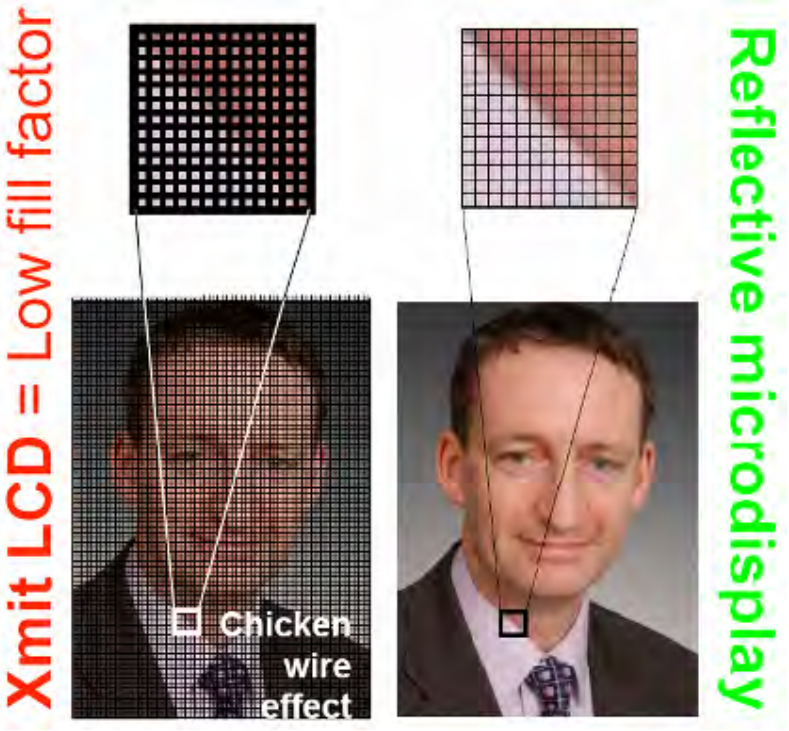
Examples of advanced medical imaging used in the Biotronics3D presentation

The challenges are user acceptance – the market is at the stage of early adopters. There are a wide diversity of operative environments in medicine: from a radiologist (single viewer, dark room, dual monitors, constant performance, comfortable user experience, high resolution and accuracy, ability to calibrate) to an operating theatre (multi viewers, bright environment, need for sterilization). Medical standards need to evolve for stereo displays, he said.

Microdisplays for projection A descriptive review
Ian Underwood, **MicroEmissive Displays**, Edinburgh, Scotland

Ian Underwood of MicroEmissive Displays talked about microdisplays for projection – a descriptive review. He pretty well covered the waterfront of all the technologies - a daunting task in half an hour - but suggested at the end that the audience should read "Introduction to Microdisplays" by David Armitage, Ian Underwood and Shin-Tson Wu, one in the Wiley/SID series.

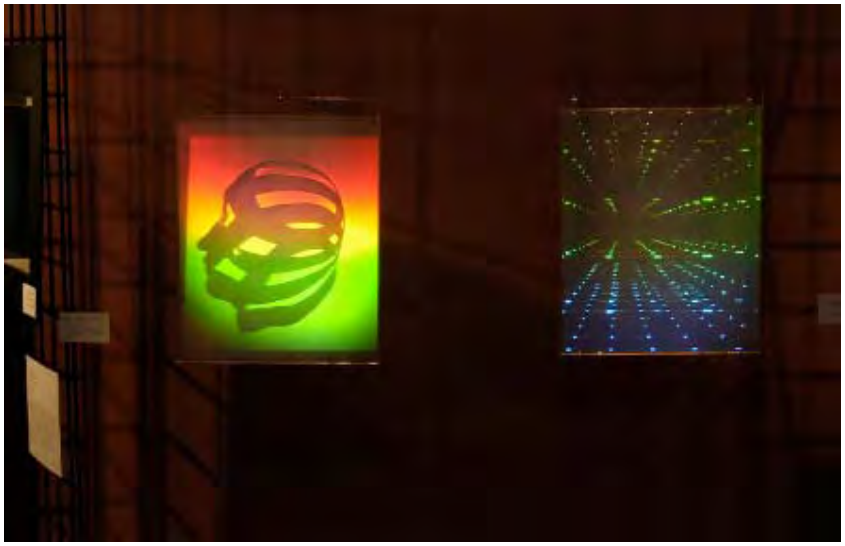
Underwood defined microdisplays as physically small, but high information content, active matrix substrate (often CMOS), low power consumption, and enlarged image viewed through magnifying optics. He went on to classify microdisplays by electronic/backplane: miniature TFT on glass, CMOS on x-Si, CMOS on glass; by optical/frontplane: microsystems/MEMS, liquid crystal, OLED, etc; by configuration: transmissive, reflective, deflective, emissive; and by application. He went on to discuss the various applications and markets for microdisplays and all the different technologies, including his own polymer OLED microdisplay licensed from CDT.



Ian Underwood used his own image to demonstrate the difference in terms of fill factor between LCD chip technology and a reflective technology such as MED's "eyescreen"

Holographic Futures
Martin Richardson, **De Montfort University,** Leicester, England

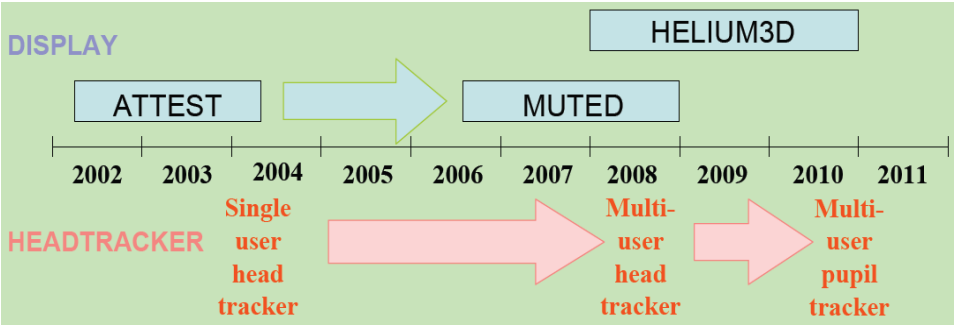
Martin Richardson of DMU gave a mainly visual presentation on holographic futures. He itemised the methods of holographic and lenticular origination: Adobe's Plen-Optic fly eye lens, moving HD cameras, digital rotational scans, time-splice using 100 SLR cameras, direct recording of wave front using lasers, and computer synthetic cinema 4D – Studio Max. He asked if we could imagine for a holo future an advanced holographic object that performs multiple optical functions; is a directional diffuser; is lightweight/space saving; has the ability to bend light; will enable next generation technology such as a ultra high definition flat screen display; is affordable for R&D production; and is the ultimate in optical security.



An unspecified image from Richardson's presentation taken from his book "The Prime Illusion: Modern Holography in the New Age of Digital Media"

3D Displays Employing Novel Projection Techniques
Phil Surman, **De Montfort University,** Leicester, England

Phil Surman of the Imaging and Displays Group (IDRG) at DMU gave a presentation on 3D displays employing novel projection techniques. The background to DMU's research is that DMU is involved in four European 3D projects: ATTEST, 3D TV Network of Excellence, MUTED (co-ordinator), and HELIUM3D (co-ordinator). He gave a detailed overview of all the technologies used in these programmes. In a summary of IDRG 3D research, he highlighted a multi-user proof-of-principle prototype; an LCD with optical array and 5000 white LED backlight; an intrusive head tracker; a multi-user prototype for initial use in medical applications; an LCD with optical array and holographic RGB laser projector backlight; and a non-intrusive multi-user head tracker.



Optical Measurement of Visual Displays
Ken Vassie, **National Physical Laboratory**, Teddington, England

Ken Vassie of the **National Physical Laboratory** talked on "Optical Measurement of Visual Displays". The presentation covered NPL involvement in display measurement; why measure displays; what's different about projection displays; and measurement of projection displays. The primary objective of the NPL Display Metrology Group is to increase the competitiveness of the UK display industry through the provision of accurate and traceable measurements. One of the reasons for measuring displays, he said, was to establish performance of new projector design and/or technology; verify whether the projector is operating according to its specification; and compare its performance with other projectors.

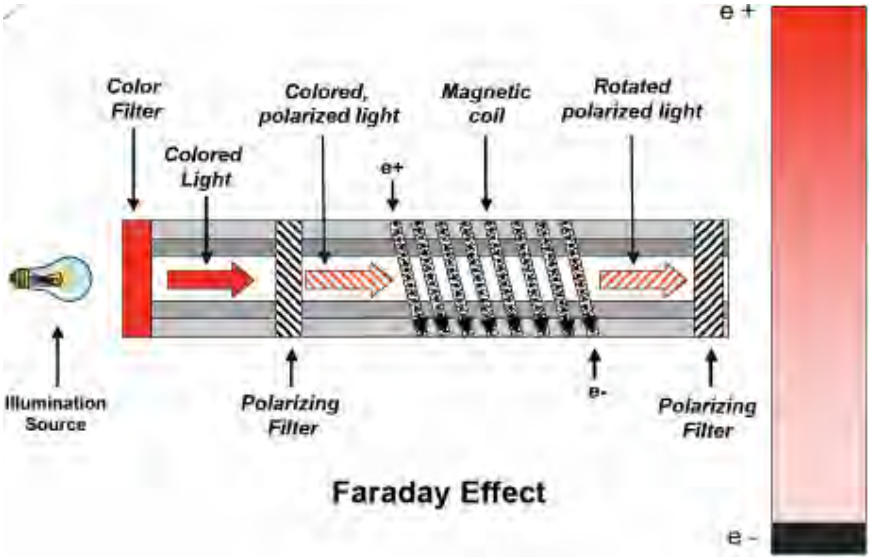
Looking at measurement methods of different types of display, Vassie said that, for flat panels, measurement methods had been defined over many years but were still evolving. Rear projection will use the same methods as for flat panel (probably). Near-to-eye was measured for military applications (HMD/HUD) but was poorly defined for commercial displays. As for front projection, some methods exist but they are possibly controversial. The challenges for near-to-eye are that a common luminance meter will give totally erroneous results. A wide range of luminance values can "look" the same and colours may be hard to match as well.

A "simulated eye" is being developed at NPL for use to measure radiation safety issues associated with the Physical Directive (Optical radiation). It could be developed as a near-to-eye photometer/colorimeter. The challenges for front projection are that image brightness is due to two independent systems: the projector and the screen. In order to measure the projector it is necessary to measure the illumination falling onto the screen. In order to measure the display system, you have to measure the luminance of the image coming off the screen. There are also problems related to stray light when measurements are not performed in a dark room. One solution is the mask method, another is the stray light elimination tube developed by NIST in the States.

For front projection displays, there is a standard, said Vassie - ANSI IT7.228 – but it is no longer available. However, the IEC lumen standards IEC 61947-1 and IEC 61947-2 are basically the same as they were under ANSI. For this reason, an IEC lumen is the same as an ANSI lumen, and a projector that measures 2,000 ANSI lumens of brightness will also measure 2,000 IEC lumens of brightness. To measure the projector only, in a projector/screen display system, an imaging photometer or a lux meter can be used. In conclusion, Vassie said that optical measurements of projection display is more difficult than most people think. NPL is ready to develop methods and procedures, but he stressed that there had to be a demand from UK industry.

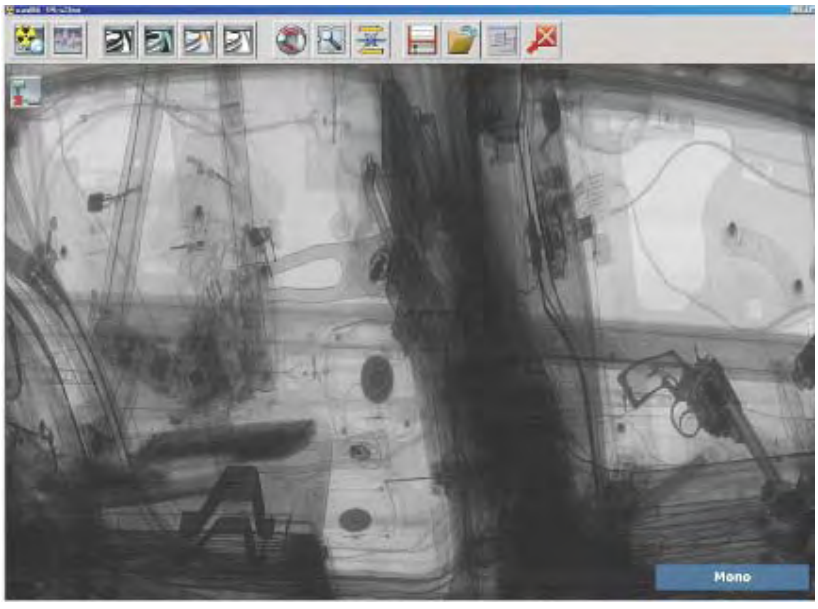
Magneto Optic materials: A new projector technology?
Neil Grice, **ST Synergy,** Balcatta, Australia

Neil Grice of **ST Synergy** explained that ST Synergy is a major sponsor and now 100% owner of Panorama Labs. It is a software company based in Perth, Australia and is reconfiguring its business. It is moving into the area of magneto-photonics for displays, communications, and holographic memory, and establishing a European presence. He briefly covered existing projection technologies before going into details of how magneto optic technology works: simple coating, solid state, fast switching, thermally stable with switching speed in nanoseconds. Grice said that Europe (and in particular the UK) has a recognised capability in photonics and that his company is seeking potential European partners: suppliers (services, materials, and equipment), R&D collaborations, business development opportunities, funding leverage, and personnel recruitment.



Applications for 3D in the Security Sector
Nick Fox, **3DX-Ray Limited,** Nottingham, England

Nick Fox of 3DX-Ray Limited covered applications for 3D in the security sector. He pointed out that the features of a normal X-ray image commonly used in airport baggage checking suffer from: relative density, objects are superimposed, complete lack of depth information, and the fact that images are truly two-dimensional. He argued that it is possible to possible to introduce binocular parallax into conveyor belts. This would result in improved detection and reduced false alarm rates. Being able to understand the three dimensional shape and relative position of objects within a container has been shown by the TSA/DHS in independent trails to produce a significant reduction in false alarm rates. Operator training time reduced. The ability to see objects in three dimensions immediately helps the operator to understand what they are looking at and rapidly relate the X-ray image to real-world objects instead of having to learn how to interpret an X-ray image. Evaluation time per bag is reduced leading to higher throughput. The operator can easily interpret the position of items within a bag which reduces the confusion when viewing cluttered images thereby minimising the number of images that have to be paused to take a closer look.



Result from a random automobile inspection

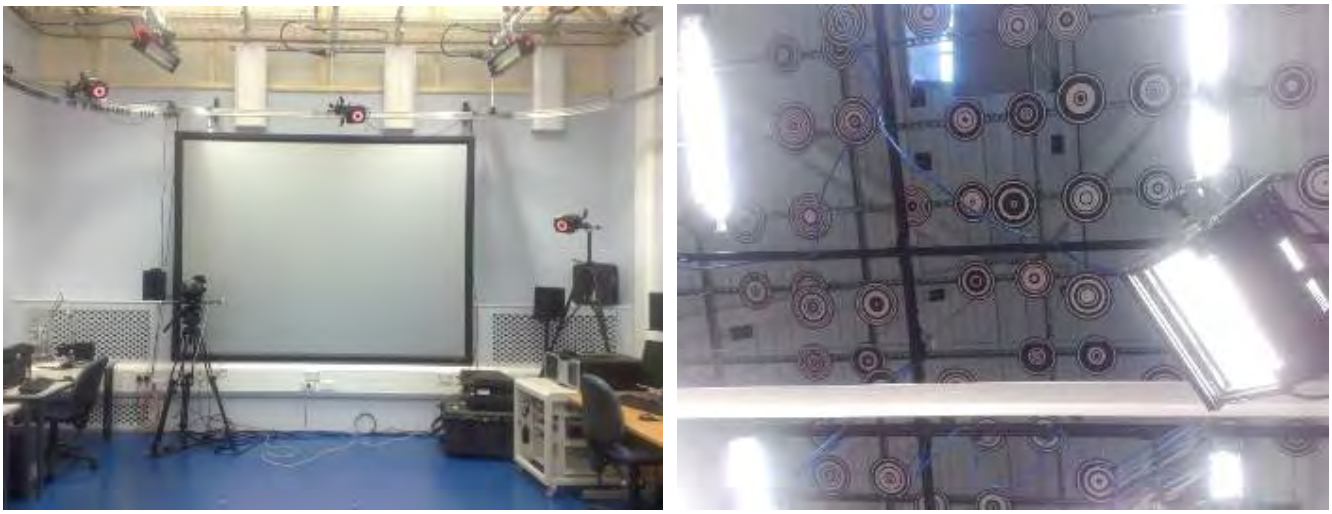
Baggage and freight units already in service from the company include regulators (Home Office - Police Scientific Development Branch, TSA (Transport Security Administration) and airport customers include Dubai, Moscow, Rumania, PR China (Beijing Olympics), and Saudi Arabia.

Technolife Grid
Mohammad Ibrahim, **De Montfort University,** Leicester, England

Mohammad Ibrahim of the Fused Media Lab at De Montfort University entitled his talk “Technolife Grid”. He said that “Technology in Life” (Technolife) represented significant opportunities to enhance every aspect of our lives and environments leading to a safer, more secure, healthier, happier and more productive and engaging life. Some of the drivers are the aging society, quality of life and work, and ecology. He talked about multiple worlds where we live in a physical world as well as cyber-space/virtual worlds. The boundary between cyber-space and physical world is becoming more blurred. There is closed loop real time operation in both the physical and virtual worlds leading to a fusion of worlds.

The DMU Technolife Grid is architecture for technology provisions vs. life services, Professor Ibrahim said. The grid will have the following provisions: multi-modal capture and tracking; body motion, facial and eye tracking; context and situation awareness; and temporal and spatial information - working, living, social situations. The grid will have the following provisions: multi-modal mixed reality visualisation; mounted, desk top, wearable; multi-modal interactivity; natural human interaction, haptic devices; platforms and engines; and virtual graphics engines, RTOS.

A DMU test-bed was established in November 2007, part of a £4 million investment in state-of-the-art media facilities with three members of staff, one research fellow, three PhD students and several MSc students. Ibrahim went on to discuss in some detail the research activities and facilities of DMU.



The scale of DMU’s facility is impressive – this is for 3D tracking, with numerous camera views and ceiling markers

Interestingly, Ibrahim’s talk showed a stereo pair and a depth map – to demonstrate the same 3D visual effect

Grand Challenges for Emerging Technologies

January 30-31, 2008, Møller Centre, Cambridge, England

A major event in January was our "Grand Challenges for Emerging Technologies in Displays" held in Cambridge. This was the first full-scale event organised by the Emerging Technologies sub-group and we were extremely pleased to have it fully subscribed with over 80 attendees on each of the two days. Ric Allott summarizes the event, followed by brief descriptions of several of the presentations. Remaining summaries from the Grand Challenges event will appear in the next edition of the UKDL newsletter.

The aim of this innovative 2-day seminar was to present a vision of the future and identify the technical breakthroughs needed to make that vision a reality. Microsoft opened the seminar with a look into the future of interactive displays and how the user experience will change over the next 5-15 years. This was followed by a fact packed and fast paced presentation of future trends in the displays market by Michael Lebby of the OIDA. The session concluded with a lively discussion lead by a panel of leading display experts with plenty of contribution from the floor. In the afternoon of day 1 key Industrialists and Academics from companies and institutions including University of Cambridge, University of Wales, Imperial College, Electrosonic, Plastic Logic, Pelikon, GEM and Hewlett Packard presented the Grand Challenges facing the displays industry in the areas of materials, colour reflective displays, manufacturing processes and large area high information content systems. This informative session lead to plenty of lively debate and discussion during the tea breaks and especially over dinner.

Members of the discussion panel included (from left to right): Alex Butler (Microsoft), Shahram Izadi, (Microsoft), Ian Underwood, (MED), Michael Lebby, (OIDA), Adrian Giesow, (HP Labs), Chris Fryer, Pelikon, and Chris Williams (UKDL). The photo on the right show an attentive audience house during the finance session where speakers highlighted various funding opportunities for technology companies.

Day 2 of the conference began with an entertaining talk from Mark Fihn of Veritas et Visus providing the audience with his alternative views of the future. This was followed by frank and honest talks on funding opportunities by VCs, Nesta, EPSRC and The Technology Strategy Board. Stuart Evans of Plastic Logic gave an engaging and informative talk entitled "An Entrepreneurs Tale". Poster presentations were available to view throughout the seminar and a dedicated session on Emerging Technologies was well received. Here 8 talks of 15 minutes each gave the delegates a flavour of some of the new technologies that are emerging in the displays arena in the UK.

The event was highly rated in terms of the content and the networking opportunities it provided. The level of interest and value provided by our events is reflected in both the attendance figures and also in the way that companies and institutions wish to engage with UKDL. For the Grand Challenges event we were able to secure sponsorship from Nesta, EPSRC, and EEi.

Future User Interfaces
Shahram Izadi and Alex Butler, **Microsoft Research,** Cambridge, England

Shahram Izadi and Alex Butler from Microsoft's research labs in Cambridge discussed the changes underway in the user interface, suggesting that fingers and hands are likely to increasingly be used as an input device, rather than keyboards and mice. The two identified a revolution that is currently underway with regard to displays, (citing new form-factors, reduced prices, higher resolution, thinner designs, and lowered power consumption as primary drivers of this revolution).

Microsoft's "Surface Computing" initiative is targeted at the notion that display input is every bit as important as output, focusing on natural interaction by way of fingers and hands, multiple user to directly interact on-screen, and to improve user productivity. They noted that in computing, there is an intimate relationship between the user interface and the hardware, so that to really innovate the user interface, designers must also innovate the hardware.

Microsoft envisions that "displays will be like wallpaper", but that to be successfully implemented throughout the home and office, we need to "closely integrate sensing capabilities with displays".

Large area, high information content displays
Robert Simpson, **Electrosonic,** Dartford, England

Robert Simpson from Electrosonic talked about the challenges associated with developing very large displays for public information applications. These displays are intended for 24/7 indoor operation and typically represent more than 4000 pixels in width, measuring 3-metres wide, with typical view distances between 2 and 12 metres. He advised that such displays are becoming increasingly popular, particularly as working methods change and as surveillance systems continue to grow rapidly. Two of the biggest issues are related to the influence of networks and the resulting bandwidth bottleneck, and the difficulty of assuring proper alignment with multi-projector displays.

The vast majority of these large area systems are comprised of rear-projection devices. Rear projection represents the lowest cost per square metre. They are constructed in a modular approach that allows displays of almost any size -- easily meeting resolution requirement (in terms of information content. Rear projection is also now adequate in terms of contrast, size, and running cost. He reviewed the pitfalls associated with PDP, LED, LCoS, and front projection, concluding that DLP is currently the best overall solution for tiling together such enormous systems.

Simpson noted, however, that displays cannot be considered in isolation. Display systems should be designed backwards from the intended appearance/application; not forwards from a technology concept. There is a struggle associated with information overload.

82 "cube" videowall, based on 50-inch modules, at Delaware Park Racecourse – 63m^2 display area

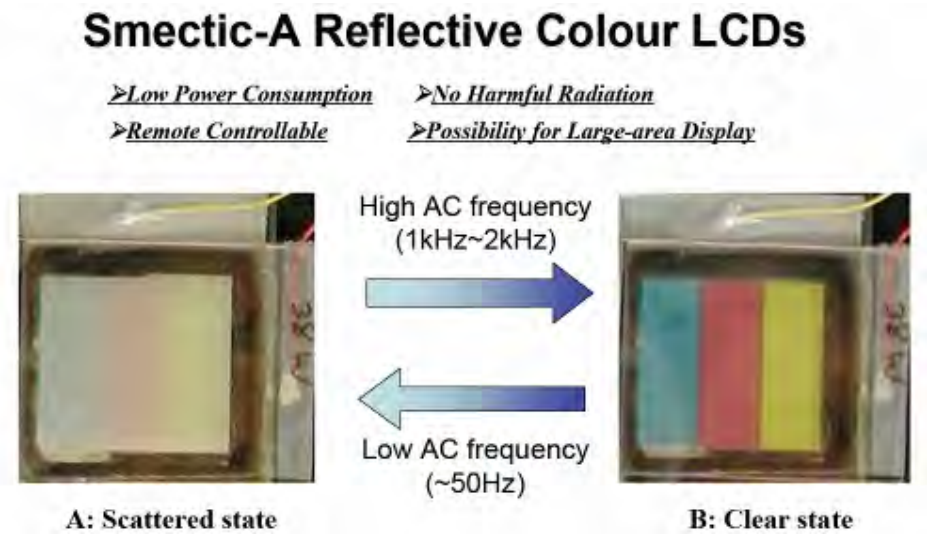
180m^2 display at the China Millennium Monument

Reflective colour displays using smectic-A liquid crystals
Bill Crossland, **Centre for Advanced Photonics & Electronics,** Cambridge, England

Bill Crossland from the CAPE talked about using smectic-A liquid crystals for electronic billboard applications. He explained that this reflective technology achieves a background brightness and reflective contrast comparable to newsprint – arguably eliminating all polariser-based LC display and the use of colour filters. The technology also boasts a very low power and carbon footprint, which is essential to meet future legislative requirements for "municipal information networks". It's difficult for LEDs and emissive technologies to match these performance attributes. The major advantage favouring bistable and multi-stable electro-optic effects is related to cost, especially for large pixel arrays. Crossland argued that directly driven pixels (e.g. LEDs) and active matrix addressing are quite expensive – if pixel circuitry plus access lines cost 10 cents per pixel, then $1m^2$ of 5mm pixels would cost $4000 to drive. A reflective, bistable, passive-matrix solution, conversely, could be manufactured at a small fraction of the cost. Smectic-A liquid crystals still have some issues, particularly related to color, where there is a need for improved colour mixing.

A CAPE initiative called PLACORD (PLAstic COlour Reflective Displays) aims to develop a technology for a plastic envelope liquid crystal display. Smectic-A has been chosen because it requires no pre-aligned surfaces, any transparent plastic can be used (e.g. polyesters) as no polarisers are needed, and it is insensitive to small thickness variations. No active matrix, polarisers or colour filters are compelling advantages for the technology.

PLAstic COlour Reflective Displays



Two extreme states of the Smectic-A LCD sample cell

Material challenges in organic TFT devices
Iain McCullough, **Imperial College,** London, England

Iain McCollough from Imperial College discussed some of the material challenges related to organic TFT devices. One of the biggest problems is in customising ink formulations for printing techniques. He noted that electrophoretic displays are the most compatible technology for organic transistor performance -- low mobility requirements, reflective effect (transistors can be larger), low refresh rates (lower pixel charging speeds), lower duty cycles, and bistability, (longer lifetimes). AM-LCD is more challenging than EPD, but it is expected that LC technology well developed an opportunity for faster introduction. For OLED, the transistors can be top emitting devices, but require multiple transistors per pixel. As a current driven device, OLED demands high efficiency transistor output uniformity and stability. Even so, today's best lab mobilities for OLEDs are now good enough for 1st generation devices.

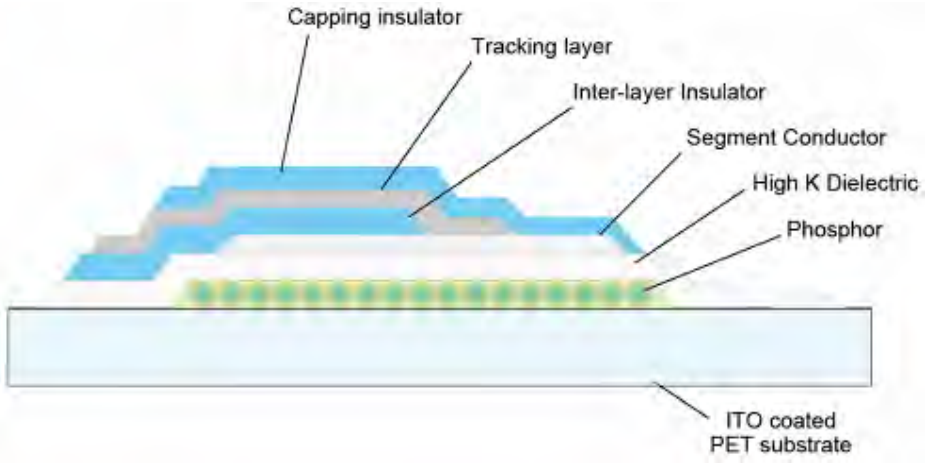
Printing as a production process
Chris Fryer, **Pelikon,** Cambridge, England

Chris Fryer from Pelikon engaged the audience with the question "why print displays"? He asserted that printing offers much lower cost than alternatives, requiring fewer processes, lower capital equipment costs and higher throughput. Printing, however, currently comes with the downsides of relatively large feature sizes, relegating the technology to lower value applications. As production processes develop, feature sizes are expected to improve to enable higher value displays solutions.

Pelikon offers a product called pSEL – an emissive display technology used primarily for keypad displays for remote controls. The pSEL production process involves screen printing of up to 13 printed layers. The process utilizes reel-to-reel and sheet fed presses with hot air and IR drying and UV curing. The devices can be die-cut/laser cut into non-rectangular form factors. Pelikon's current production capacity is based on a sheet size of 620 x 700mm with a batch size of 300 sheets. Cycle time is typically about 12 hours. The capacity per line is 50,000 m^2 on a line that costs about $1 million. Fryer noted several areas for improvement in the pSEL process:

- Reduce feature size
- Layer-to-layer alignment is currently the limiting factor
- Increase throughput
- Single most important process improvement is to move all layers to UV cure inks

The UV cure options exist today but fall some way short of required performance.



The pSEL structure involves numerous printed layers. Insulating inks are UV cured. High dielectric constant inks and conductors are solvent based inks.

Manufacturing flexible displays
Catherine Ramsdale, **Plastic Logic,** Cambridge, England

Catherine Ramsdale from Plastic Logic identified the key challenges associated with manufacturing flexible displays:

- **Substrate quality:** High substrate quality is required as defects will protrude through layers, causing shorts.
- **Scalability:** Heat stabilised PET is needed to reduce distortion with temperature change. Designs need to tolerate pixel and array alignment. (No mask-alignment enables large display sizes). Direct-write distortion compensation enables high registration accuracy.
- **Ink selection:** Deposition of uniform layers by printing requires good understanding of the drying dynamics. Orthogonal inks must be chosen for multiple layer deposition.
- **Materials stability:** Materials need to be electrically and mechanically stable during processing and operation.
- **Disruptive manufacturing:** Careful equipment selection is required to meet the unique criteria of the industry. Also needed is a simple process flow to minimise capital expenditure, adaptable tooling to maximise versatility, and costs need to be appropriate to application

Ramsdale argued that the challenges in technology and manufacturing of flexible displays can be addressed, using standard equipment. Plastic Logic believes that printing will achieve the lowest cost – even without roll to roll. This simple fact creates a massive opportunity for product innovation.

Materials for printed displays: current challenges
Robin Pitson, **Gwent Electronic Materials,** Pontypool, England

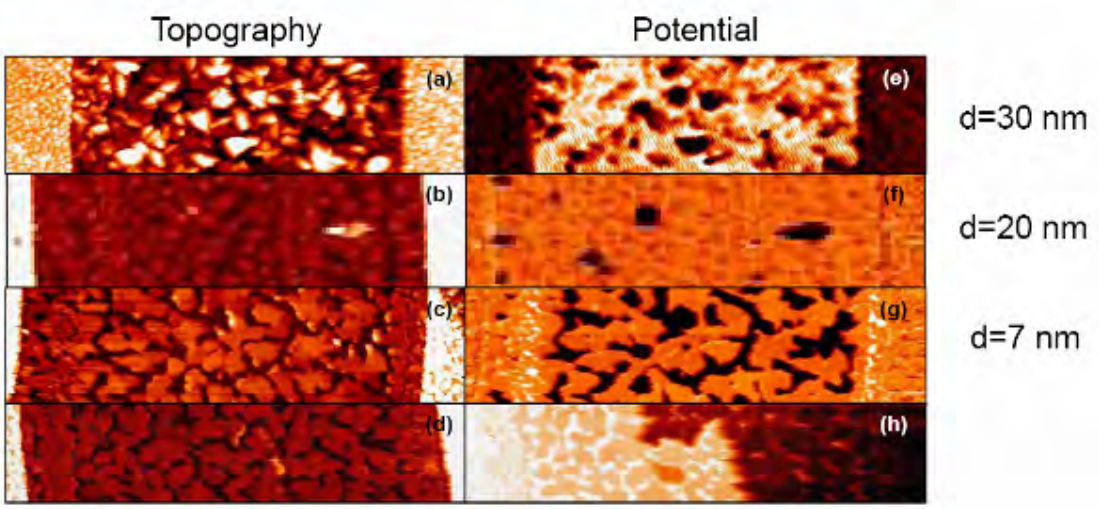
Robin Pitson from GEM talked about the challenges facing the materials market for printed displays. He highlighted several current areas of work:

- **Circuit design and resistivity.** Scientists work with conductivity and resistivity; engineers work in sheet resistance; and customers want unrealistic physical properties. In consideration of these factors, it's essential to understand the materials and their use in specific applications.
- **Dense and non-dense compounded systems.** No application method will give the bulk resistivity of the pure metal. As the bulk metal resistivity is approached the physical properties of the films are degraded. As such, the current-carrying ability is the key parameter.
- **Application methods and resistivity.** Application methods that give thin films approaching one micron give lower resistivities then bulk film methods; flexible films produce higher resistivities then less flexible films; and highly conductive metal based films will work-harden
- **Polymer materials.** The Impossible dream in the materials world is that bulk metal resistivities and can existing on flexible films with no metal hardening. The reality is that a variety of resistivities and physical properties to match application-specific requirements must compromise to achieve physical properties.

Pitson noted that the fundamental properties of metals are not going to be changed by formulation, the design of application-specific metal based systems can solve complex problems, and that new formulations will result in higher intensity devices with better colours.

Reliability of organic field-effect transistors
Henning Sirringhaus, **Cambridge Integrated Knowledge Centre,** Cambridge, England

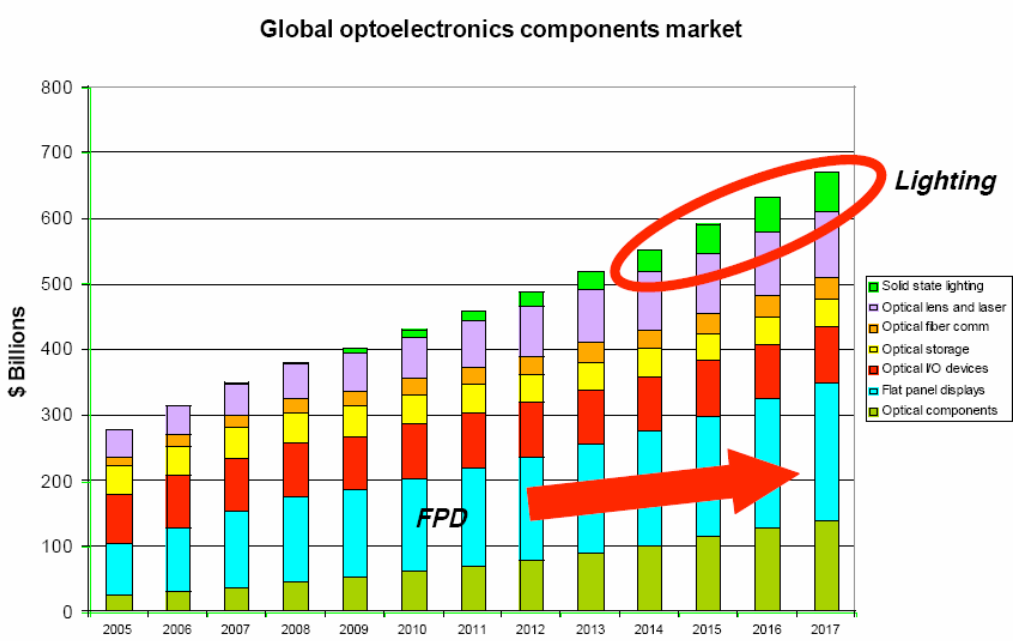
Henning Sirringhaus from the CIKC talked about the reliability of organic TFTs. He reviewed the organic/printable electronics program at the CIKC, noting that the focus is on furthering the manufacturing infrastructure for printing polymer transistors and solar cells in support of commercial efforts from the likes of Plastic Logic and DuPont Teijin Films. The CIKC also serves as an advanced photovoltaics research accelerator for interests supported by the Carbon Trust, TTP, and DuPont Teijin Films. Work related to the reliability of organic TFTS is supported by Hitachi. Sirringhaus advised that operational bias-stress induced degradation and threshold voltage shifts in organic TFTs depends on a number of factors (including the semiconductor/gate dielectric materials, the morphology of the semiconductor, the device architecture, contacts, and the environment). Although several mechanisms for bias-stress degradation in organic FETS have been identified, scientific understanding of degradation mechanisms remains poor. Such understanding is imperative in order to help develop stable devices.



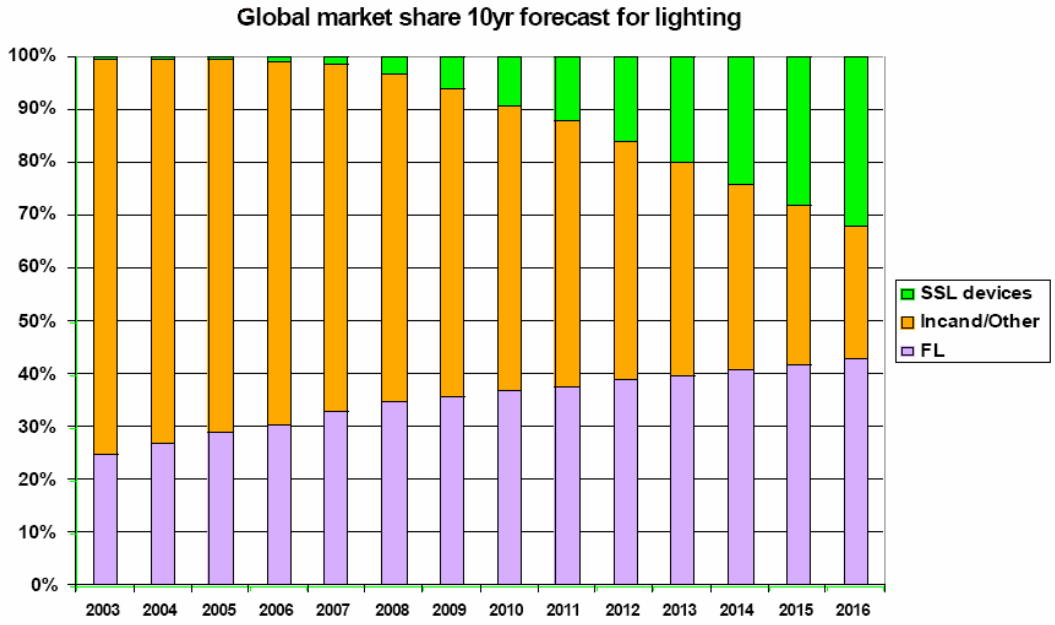
Sirringhaus showed the charge trapping at grain boundaries in pentacene as an example of what the CIKC is doing to better define device reliability factors.

Photonics is jazzing consumer products
Michael Lebby, **OIDA,** Washington, DC

Michael Lebby from the Optoelectronics Industry Development Association gave an information-packed talk about a huge range of opportunities in the world of displays and lighting. He reviewed consumer market trends, photonics trends, technology trends and manufacturing challenges, asserting that "Once we anticipate future lifestyle needs, we then have to see if future technology and products can support those needs"… He predicted several drivers to the future of the photonics market: Video will be the killer app to drive bandwidth; displays will be a driver for next generation communicators, projection will allow novel form-fit-function designs; 3D will improve and perhaps become popular; new lighting technologies will explode and electronic fashion will emerge.



Global photonics components market is expected to grow from $315 billion in 2006 to $675 billion in 2017. Flat Panel Displays are the big driver, with Solid State Lighting growing to $60 billion in 2017.



Lebby predicts that Solid State Lighting will grow to 32% of the entire lighting market by 2016.

Technology Strategy Board
A discussion with Iain Gray

by Mark Fihn, Veritas et Visus

In February, along with members of the UKDL staff, I had the opportunity to meet with Iain Gray, head of the Technology Strategy Board, the UK government organization responsible for encouraging the growth of technology and innovation in the UK. Displays and Lighting is seen as a major opportunity for UK industry, and so it was with fascination that we listened to Mr. Gray explain some of his perceptions about the Technology Strategy Board's strategies related to UK government/industry cooperation.

The Technology Strategy Board is an executive non-departmental public body (NDPB), established by the Government in 2007 and sponsored by the Department for Innovation, Universities and Skills (DIUS). Its activities are jointly supported and funded by DIUS and other Government Departments, the Devolved Administrations, Regional Development Agencies and Research Councils.

Iain Gray recently moved from an executive position at Airbus to take over the helm of the Technology Strategy Board. He advised that although shifting from aerospace to high-technology is a challenge, his post at Airbus prepared him well for his new position in that he learned to work with both big and small companies, government agencies, research centres, academic partners in a variety of projects and collaborative efforts.

He described the state of innovation in the UK as being a "fantastic arena for growth". He noted that in the past, several industries, including aerospace, created a significant amount of manufacturing in the UK, but has been displaced by Asian production. "Plastic electronics can help to rebuild the manufacturing base in the UK". As such, the Technology Strategy Board is supportive in ways that position industry in technology terms and will seek to facilitate investments in technology and to encourage innovation. As well as investing in programmes and projects, much of the organisation's work is in spreading knowledge, understanding policy, spotting opportunities and bringing people together to solve problems or make new advances.

Gray advised that the UK is "notoriously good at science, but needs to better recognize the needs of business". This focus is an area that the Technology Strategy Board will support. "We're much more than just a funding agency, we advise the government about industry needs, we work with the regions, and we help identify the barriers against technology development". The Technology Strategy Board works closely with other organisations who are involved in innovation, research and technology, combining and focusing resources. Programmes and activities are often jointly funded with Research Councils, Government Departments, Regional Development Agencies and the devolved administrations of Scotland, Wales and Northern Ireland. Of course, funding is also of major importance – the most recent call for collaborative research and development directed £10 million to support Displays and Lighting from a total of £100 million. The Government's Comprehensive Spending Review in Autumn 2007 increased the funding available for the Technology Strategy Board. Working with the Regional Development Agencies and the Research Councils, over £1 billion will be invested into technology in the next three years.

Iain Gray, head of the Technology Strategy Board, sees technology innovation as a primary opportunity by which the UK can regain advantage in the world of technology.

Since the Technology Strategy Board is a non-departmental government entity, there is sometimes concern that party politics may impact on its work. , but Gray clearly advised that the organisation has broad cross-party support. "The innovation space is supported across all parties. In fact the general feeling is that not enough is being done to promote technological innovation – across regions; across technologies". Gray continued, "No party is opposed to these activities – the attitude is to increase funding and support.

Gray was similarly unambiguous when discussing the future role of networking in the KTN structure – networks are encouraged to engage with other KTNs, particularly to help create a business value. A KTN is a national network in a specific field of technology or business application, which brings together people from businesses, universities, research, finance, and technology organisations in order to stimulate innovation through knowledge transfer and sharing of ideas.

Gray noted that there are currently 23 KTNs, which evolved from several origins, covering a broad range of activities. He pointed to the valuable role of KTNs not only in fostering innovation but in advising the Technology Strategy Board on business needs and technology trends. Some of the KTNs have received enormously positive feedback (including Displays and Lighting), but not all get top marks. Gray advised that the Technology Strategy Board will be monitoring and reviewing KTN activities closely. The business community has also identified that it wants coherence and consistency in the way the KTNs function. He noted that because the various networks are at different levels of maturity, it's difficult to apply meaningful metrics by which to effectively evaluate the performance of each KTN.

Gray acknowledged that the technology sector faces an interesting challenge – to inspire small companies to become system manufacturers – and not simply suppliers to big companies. He emphasized that the Technology Strategy Board helps promote innovation from the university/start-up level through to commercial enterprise. Small companies are currently a focus with a goal of providing a leg up to help stimulate manufacturing. He further advised, however, that there are several emerging technologies that may be still at the invention stage, which is not an area of primary focus for the TSB. "The need is to get beyond the proof-of-concept stage, but to instead look at component and process-level development".

Gray expressed particular support, even excitement, for the Knowledge Transfer Partnerships. A KTP is the placement of a high calibre, recently-qualified individual into a business to work on innovation projects. Increasing business interaction with the university 'knowledge base,' it provides company-based training for graduates at the same time as delivering real benefits for the business. "KTPs have been very successful, and we have been tasked to double their number, and to develop more flexible forms of Knowledge Transfer Partnerships. We also need to reduce paperwork and bureaucracy in the KTP process."

When asked to distinguish the focus of the Technology Strategy Board with regard to business interests versus university interests, Gray advised that "the organizational structure is not as important as how innovation works. We work closely with DIUS, for example - the meat of what we have now is a proximity between the skills agenda and the innovation agenda, which is a powerful synergy. The precise structure is not so important".

When asked if the Technology Strategy Board would serve as a champion for cross-governmental policy mismatches, for example, technological development versus health and safety, Gray explained that the organisation is focused on the creation of wealth in the UK and not primarily on things like health and safety, (although these are by no means mutually exclusive concerns). If regulation is a hindrance to innovation, then the Technology Strategy Board will certainly help to drive innovation. "But it is not the role of the TSB to police other agencies – our job at the end of the day is to help UK business" Gray added, "No technology is an end game, so its our intent to continuously support increasingly better technology solutions.

Iain Gray is Chief Executive of the Technology Strategy Board. Iain is a Chartered Engineer, a Fellow of the Royal Aeronautical Society, Chairman of the Business and Industry Panel of The Engineering and Technology Board (ETB), a Governor of the University of the West of England and a Board Member of SEMTA and the Energy Technologies Institute. Iain completed his early education in Aberdeen, culminating in an Engineering Science honours degree at Aberdeen University. He also holds a Masters of Philosophy from Southampton University and has Honorary Doctorates in Engineering and Science from Bath, Bristol and Aberdeen Universities. Iain joined British Aerospace (now Airbus UK) in 1989 and over time held roles including Director of Strategy and External Affairs and Engineering Director, becoming Airbus UK's Managing Director and General Manager in January 2004. He joined the Technology Strategy Board as Chief Executive in November 2007.

Governance of the UK Displays and Lighting KTN

ADVISORY BOARD

Chairman	Robert Simpson	
Board Members	Stuart Evans, David Monk, Paul May, Gareth Jones	

STEERING COMMITTEE

Chairman	Robert Simpson	
Members	Chris Williams	Director UKDL
	Mike Biddle	Technology Strategy Board
	Ian Williams	BERR
	Keith Rollins	(DuPont Teijin) representing FLEXYNET
	Chris Rider	(Kodak) representing ET
	Chris Winscom	(Kodak) representing LABL
	Ken Vassie	(NPL) representing SPURSS
Tim Claypole	University of Swansea	
Bill Milne	University of Cambridge	

FLEXYNET (Plastic Electronics) Sub group Industrial Committee

Chairman	Keith Rollins	DuPont Teijin Films
Committee Members:	Plastic Logic, Kodak, CDT, MDS, Dow Corning, Merck, DSTL, Xaar, Oerlikon, WCPC, Qinetiq, CENAMPS, CPI, PRL, M-solv	

LABL (Lighting & Backlighting) Sub group Industrial Committee

Chairman	Chris Winscom	Kodak
Committee Members:	Vossloh-Schwabe, Elumin8, LEDs Magazine, Polymer Optics, Enfis, WOF, NPL, University of Durham, University of Cambridge, University of Sheffield, Thorn Lighting, Ceravision, WCPC, Sharp Labs, MARL International, Pilkington Group, PRL, Tridonic Atco, M-solv	

ET (Emerging Technologies) Sub group Committee

Chairman	Chris Rider	Kodak
Committee Members:	Pelikon, Sharp Labs, HP Labs, Dow Corning, CAPE, University of Swansea, University of Manchester, CDT	

SPURSS (Systems, Professional Users, Regulations, Safety, Standards) Sub Group Committee

Chairman	Ken Vassie	NPL
Committee Members:	CAA, Ginsbury Electronics, DSTL, POPAI/IQ Group, Philips Lighting, iSuppli, Commonwealth Broadcasting Association, PACSnet, RNIB, HSE, Health Protection Agency, U o Middlesex, DeMontfort University, CIE	

Contacting UKDL

Most of the information you will need about the UK Displays & Lighting KTN and its events and activities are found on the website: http://www.ukdisplaylighting.net. General queries can be sent to info@ukdisplaylighting.net, but if you would like to have direct contact with us, please feel free to do so:

In Scotland: Our Scottish office is located in Dundee, and is manned by Robbie Sharpe, who is also responsible for our national activities in the LABL Sub group. Robbie@ukdisplaylighting.net.

In Wales: Dr. Eifion Jewell, who is located at the University of Wales, Swansea, is seconded to UKDL, and is responsible for part of our FLEXYNET and ET activities, particularly with skills training in printing of functional inks. eifion@ukdisplaylighting.net.

In England: Dr. Ric Allott, Deputy Network Director, has responsibility for organization and delivery of all domestic events and activities, and is specifically responsible for FLEXYNET and ET. ric@ukdisplaylighting.net.

All marketing and promotion of UKDL activities is handled by Nick Kirkwood, who is also responsible for SPURSS. Contact Nick at nick@ukdisplaylighting.net.

All event planning, including location booking around the UK and overseas, is handled by Louisa Chanter Louisa@ukdisplaylighting.net.

Administration is handled by Kay Davenport. Kay is based at our Bletchley Park Headquarters, and is the friendly voice that enquirers will first meet if phoning through to us. Kay can be contacted at Kay@ukdisplaylighting.net.

Finance and accounts matters are handled by Cathy Williams, cathy@ukdisplaylighting.net.

Overall responsibility for the KTN, and specific responsibility for UKDL's overseas activities lies with the Director, Chris Williams. He can be contacted at chris@ukdisplaylighting.net.

If you prefer to contact us by phone, the general number is +44 (0)1908 276665. This number is manned during normal UK office hours, and reverts to voicemail at all other times.

UKDL Events

The UKDL is hosting/sponsoring numerous events in the coming months throughout the UK. Dates highlighted in **red** are still tentative. For the latest updates and registration information, go to the UKDL website: http://www.ukdisplay.net

May 2008			
6-7	Introduction to Print for Electronic Manufacture	Welsh Centre for Printing & Coating, Swansea	2-Day Residential Workshop
8-9	JEMI S2K Conference: Plastic Electronics Workshop	City Hall, Cardiff	Joint Event Workshop
14	LEDS for Lighting	Cambridge University	Tutorial
June 2008			
TBC	Characterising Thin Films	Bletchley Park	Tutorial
17	Environmental Testing	Bletchley Park	Tutorial
24	Solid State Lighting; Challenges for Architects and Lighting Designers	London, venue **TBC**	UKDL Meeting

July 2008			
2	Strategy, Roadmapping and Value Chain Analysis	Penta Hotel, Reading	Workshop
September 2008			
TBC	Transport for London	**TBC**	Workshop
10	Display Measurement	NPL Teddington	Tutorial
16-17	Future Lighting Debate	Newcastle, venue **TBC**	Workshop
25	Barrier Layer Workshop	Institute of Physics	Workshop
October 2008			
8	Touchscreen Technology	Reading	Seminar
15	Medical Displays	**TBC**	Seminar
November 2008			
4	Challenges in Organic Photovoltaics	Daresbury Laboratory	Workshop

From left to right: Louisa Chanter (Events & Exhibitions), Nick Kirkwood (Marketing Manager), Cathy Williams (Managing Director of UKDN Ltd, the administration company that runs UKDL), Ric Allott (Deputy Network Director), Chris Williams (Network Director), Robbie Sharpe (Knowledge Transfer Coordinator), Eifion Jewell (UKDL Embedded Research Fellow Swansea University), and Kay Davenport (Bletchley Park Administrator),

UK Displays & Lighting

Knowledge Transfer Network