SOCIETY FOR INFORMATION DISPLAY
UK & IRELAND CHAPTER

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Chairman's Report

John Raines

AGM and Technical Meeting

This year's AGM and the associated Technical Meeting were held in two 15th Century tithe barns, which form the Knebworth House Conference Centre. Situated near Stevenage in Hertfordshire with direct access from the A1(M) the location proved to be a refreshing change from the usual modern conference room, normally used by the Chapter for such meetings.

The AGM consists essentially of a report back to members of the Chapter's activities over the past year and the election of officers. Chris Williams, the director for the past year resigned from the post and from the committee, due to his growing business commitments. We are fortunate in that Dr Alan Mosley agreed to his name going forward to the SID appointments' committee as the new director. Dr Sally Day, who has been of immense help to me over the past year, resigned as vice-chair due to pressure of work. She recognised that it would be difficult to find sufficient time to devote to the job of chair once the time came to take on the job. I am pleased to report that she will continue to be a member of the committee. Dr Ian Sage, a long-standing member of the committee agreed to be nominated for the post of vice-chair, and was duly elected. I as chair, along with other officers, were re-elected to our posts. I would, however like to pay tribute at this point to all the committee for the considerable amount of work they undertake, on an entirely voluntary basis, for SID and its members.

A change in one of the chapter's by-laws was approved. It essentially allows the chairman to stay in office for a period of up to three years rather than the current two. The committee put this forward as there was a general feeling that just as the chairman had "learnt the ropes" he then had to relinquish the post.

Chris Williams gave an update on an initiative he has played a major part in, the Masters Degree Course (see Page 4) and we then moved on to the technical meeting entitled, 'Display Technologies Update'. This is reported on Page 2 of this Newsletter, but I would like to express my sincere thanks to all the speakers who contributed to an excellent technical session.

The one or two day technical meetings are one of the major commitments taken on by the UK and Ireland Chapter. Our objective is to organise at least four or more technical meetings each year, in order to give members a chance to catch up on major technological advances in all areas of display technologies and applications, together with market trends Together with EID the arrangement of these meetings forms a core activity for the committee.

We are to a large extent totally dependent on SID members working in the various fields of display technologies to form the mainstay of speakers at these events. Sadly the organisation of these meetings is becoming ever increasingly onerous. This is primarily due to the modern day pressures of work, with the consequent reluctance of companies to release key people to either speak at, or just attend such meetings. A recent example is our AGM, which required work over a period of three months to put the programme in place.

The work involved can however be very rewarding, as dogged perseverance combined with much arm-twisting can result in an excellent range of speakers and topics.

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Display Technologies Update

Report on the one-day meeting held at Knebworth House Stevenage on Wednesday 16 May 2001

Sally Day

The meeting was held in the barn at Knebworth House Stevenage, which provided a very pleasant setting for an interesting meeting. Glorious sunshine was thought-fully provided, presaging a delightful barbecue for lunch, more of that later…. The morning's talks followed the Annual General Meeting of the UK chapter and a short talk about the history of Knebworth House and the barns that, after having been moved a short distance, were now used as the conference facilities.

Microdisplays were the topic for the first session and two talks were given, the first on **Three Five System's current LCOS technology**, by Paul Chambers of Three Five Systems Ltd and the second on **Next generation microdisplays and applications** by Tim Wilkinson from the University of Cambridge Engineering Department.

Technical Session in the Tithe Barn

Paul gave an overview of the market areas for microdisplays and the way in which Three Five Systems were approaching developing this. The benefits of Liquid Crystal on Silicon (LCOS) were given as being low cost in terms of pixels/dollar, the inherently high aperture ratio, 90%, achievable by putting planarising layers and mirrors over the silicon and the integration of the driver electronics into the backplane. The main market areas were near to eye applications, mobile, internet applications, multimedia projectors and digital TV and larger-format monitors, requiring up to 1.3-5.0 M pixels.

The talk then concentrated on the work being done to develop the large format monitors. Three Five Systems are working with others to provide the light engine for the large-volume applications. Below 31" the CRT still dominates, but above this, tiling is required and projection systems based on microdisplays are a very good alternative. In the market for large screen TVs, the technology is competing with Plasma screens, but at half of the price. Three Five are collaborating with Thompsons in the USA, where the market is expected to be big, to match the houses, which require the very large TVs! Other applications for micro displays are in digital cameras, although these must be low cost and do not require high resolution, so this is not such an attractive market. The near-to-eye display market is still in development and probably requires good wireless access to be in place. Paul concluded by saying that the ability of silicon to integrate functionality would strengthen the position of LCOS displays over time and that it is the right technology at the right time, at the right price with the right resolution – of course as always, time will tell.

The next talk from Tim Wilkinson covered different types of pixel that have been and will be used in LCOS devices, these started with 'thick' (i.e. intellectually challenged) pixels, going onto smart pixels and then intelligent pixels. The first type used row and column address, in the same way as conventional a-Si TFT displays, but were formed on a silicon wafer; the aluminium mirrors had poor optical quality. The smart pixels incorporate some circuitry and a photodetector at the pixel, however the extra circuitry restricted the fill factor to 30% and the mirrors were still poor. The extra circuitry at the pixel allowed some processing of the displayed image, such as edge enhancement.

The next stage has come about because of the new CMOS processing at 0.25µm, which now allows A-D converters, registers and digital arithmetic at the pixel. Planarisation methods now allow optical quality mirrors to be used and silicon posts are used for spacers in the liquid-crystal layer and all of these can be assembled at the foundry. The row and column addressing is still used at present, but may be removed using intelligent image processing MPEG methods. However, the use of the higher resolution in the circuits means that the voltages available to switch the liquid crystal are very low, and generally for the liquid crystal, low pixel voltages lead to low switching speeds. So work is needed to improve the materials specifically for this type of display.

Tim then went on to describe how the 'intelligent' pixels could be used. Firstly, high-resolution displays are one application, 10k × 10k, perhaps projecting onto Optically Addressed Spatial Light Modulators to increase the size. Another is a mobile multimedia communicator, or a 'Dick Tracey' watch, which combines a camera and display. Wavelet compression can be used to reduce the data rates for transmitting images. The wavelet compression can be done in the Si backplane, giving 8-32 kbit/sec, for voice and data. Tim went on to describe the architecture of the pixel

that is being designed and tested at the moment, including a part of the circuit for wavelet transforms. Finally at breakneck speed due to the imminent barbecue Tim described the use of the intelligent, and otherwise pixels in telecommunications for optical interconnects and channel equalisers.

Lunch followed, and in true British tradition was a barbecue in the pouring rain, luckily Knebworth House had moved a second barn to be close to the first, so there was somewhere dry to eat and continue discussions about the meeting and the AGM.

The afternoon session started with a talk from Tony Lowe entitled **Managing data-bandwidth requirements of high-resolution displays.** He started by pointing out some things that could be learnt from user behaviour, in particular that many people still print out material in order to look at it. This is because the resolution and ease of use of paper is not matched by displays yet. Examples of why people still use paper are the position of view, the use of multiple pages and the overall visual quality, as well as being able to mark or write directly on the paper. He discussed this further by showing graphs of the resolution achieved by printing, and by different display technologies and devices. For some of these, depending on the size of the display the limit of visual acuity is being reached. This is, at the moment, still expensive and generally achieved using tiling. He then went on to discuss the specific implementation for some types of systems and the progress being made.

The second part of Tony Lowe's talk was about the requirement for the data link between the computer and the display. The attach distance to the display is increasing as the use of computing increases. Examples were given, such as retail banking, supermarkets, trading rooms. The user then interacts with the display and data must be sent in both directions, albeit not necessarily at the same speed. For flat panel displays, the addressing is a serial digital RGB signal and for high resolution the clock rates can reach 2.5 Gbits/sec. Computer displays are generally shipped with 1.8 m or 3 m data cables, any longer and the cables do no meet the signal radiation standards. The solution is to use specialized cables, in particular optical transmission is attractive because the problem of radiation is non-existent. He finished by detailing the QUXGAW standard, which would be 3480 x 2400, requiring 18 Gbits/sec, which gives print quality images. The displays for this are in development; the optical fibre connection to the display is cheaper than copper for more than 20 m; differential update will help data transfer, however the protocols will need to be set up to enable this.

The next two talks were on the use of light emitting organic materials for displays. The first on **Matching materials to OLED technologies**, was given by Jonathan Pillow from Opsys Ltd. He started by describing the start-up company and that they were entering pilot manufacturing for passive matrix displays and backlights. He then went on to describe the OLED structure and the advantages of OLED, which are the wide operating temperature range, the speed and the Lambertian emission, as well as the colour range potential. The different applications require different operating properties, for example backlights require high brightness, passive matrix require fast switching and very bright emission for the time that they are switched on. For active matrix displays the efficiency is important and finally for large area, cheap manufacture is required, ideally roll – roll manufacturing.

He then went on to talk about the different material systems that are being considered. He started with small fluorescent materials, which can be manufactured by evaporation and this is being done commercially; these give high brightness but limited efficiency. Polymers are available, but more difficult to process – more of this technology from the next talk. He then talked about phosphorescent materials, the organolanthanides, including in a dendrimer structure. These are showing very interesting potential, but are in the development stage. The materials emit from the central metal ion and so the emission is sharp spectrally. A group at Oxford University are investigating the different dendrimer structures and he went through the detail of how controlling the structure e.g. the branching can affect the conductivity. The surface groups can also be varied, thereby altering the properties. A table comparing all of the different approaches and their use in different types of display was shown, with the dendrimers showing the most promise.

The next talk on **light-emitting polymers for colour-display applications** was given by Karl Heeks from CDT. He started by saying there are, at the moment two competing technologies for displays, the thermally evaporated small-molecule technology and the solution processable light-emitting polymers. He went through the companies that were at present developing organic light-emitting polymer displays and then described the progress that CDT as a company were making. The key features of the materials for displays are the high efficiency and high brightness, the fast video-rate switching and the low-cost processability, such as the use of ink-jet printing methods.

Karl then went on to describe some of the technical details such as the work-function requirements of the cathode and anode, low and high respectively to assist electron injection and hole injection, the high mobility to reduce power consumption. Fewer than 5V are required to operate the display. The polyanaline systems were described in terms of the performance that has been achieved; the brightness, the efficiency, the voltage requirements and the lifetimes are all metrics that are of importance. It was clear from this that the blue is not as well developed, the turn on voltage of 2.6V is slightly higher then the others and the lifetimes are getting longer.

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Seamlessly Integrated Training and Education for the Displays Community in the UK

Chris Williams

Through the pages of the SID UK Newsletter, we have often spoken about the need for a training programme to be implemented in the UK that was targeted at our Displays Community. The wider Photonics community has both undergraduate and postgraduate courses in place, yet within Displays, neither undergraduate or postgraduate courses have been available. This lack of training resource has left UK companies and universities poorly equipped to cope with the revolution that has taken place in the displays industry over the last decade. The emerging technologies now coming into mass production globally will further add to this dearth of knowledge.

Societies like SID and BLCS have tried valiantly to offer limited access to training resource, and we can be proud of the quality of material presented at the SID UK seminars, but this activity alone does not fill the gap in knowledge and training. Voluntary societies lack the resources to offer the type of comprehensive training programme that is needed to address the full breadth and depth of the Displays Industry. Such a programme could only be implemented with the assistance and financial support of the DTI.

Three years ago, trial Masters Degree modules were run by Cambridge, Dundee and Nottingham Trent Universities. These courses, funded by EPSRC, were to assess the need for a full Displays oriented Masters programme within industry. The courses were successful, and it was clear that a full programme could be justified. Follow up meetings amongst the participating Universities confirmed the need and plans were put in place to create a complete degree proposal. The final implementation is unique and may prove a 'role model' for other high technology degrees to be held around the UK in future.

No single University can cover the full range of Displays technology in its research activities. It was determined at an early stage that the Degree Course should be inter-university, with partners chosen because of their skills in particular areas of display technology. This has resulted in the creation of the 'Displaymasters' partnership, with Dundee University awarding the Master of Science Degree in partnership with the Universities of Abertay-Dundee, Cambridge, Edinburgh, Napier, Oxford and Nottingham Trent.

It has taken three years to create this programme, called the Masters Training Programme in 'Display Technology, Systems and Applications'. The programme received formal funding from EPSRC in January this year, and will admit its first students in September this year. This Masters Degree comprises nine taught modules, delivered by six Universities in five cities around the UK. The Masters degree can be studied full-time over 12 months, or part-time over 2-3 years. To offer greater flexibility, the individual modules are also available as 'stand alone' training modules, so engineers and scientists who wish to attend a particular module or modules can do so.

Full information about the Masters Degree and the Course Content is available on the website www.displaymasters.ac.uk. Bookings can be made NOW for the full degree and for individual modules.

The Master of Science Degree is critical to the objective of creating a pool of well trained display technologists in the UK, not only for local SME and OEM company benefit but also for potential Display Technology Inward Investors. However, this is just part of the story. In addition to the need to train 'Display Technologists' there is a great need for awareness and basic technical training for a much wider range of staff in all areas of commerce and industry.

As more product designs become display centric, so more staff in design, production, shipping, QA, sales purchasing and administration will become exposed to different types of displays. They may not need the high level training of the Masters course, but giving these members of staff specific training will improve efficiency, product awareness and help improve costs.

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Microdisplay Conference in Edinburgh

13 – 14 September 2001, Newhaven Lecture Theatre, ERI Building, 15 College Street, Edinburgh, EH8 9AA, Scotland

International speakers on the past, present and future of the Microdisplay Industry. Contact details for enquiries and bookings at: www.cupid.ed.ac.uk

Combined **U**niversity **P**artnership with **I**ndustry and **D**isplays

Alfred Woodhead Best Paper Award

The Alfred Woodhead Best Paper Award for the meeting on Transport Display Trends, which took place last September at Brooklands in Weybridge, was awarded to Ray Bridgwater of SEOS Displays for a paper on Displays for driving simulators. The award was presented at the AGM meeting by John Raines, Chapter Chairman.

Previous winners have received a cheque. However, at a recent meeting, the Chapter Committee thought that it was high time that the award was updated. After discussing the various possibilities it was decided that it would be more appropriate to present the winner with a framed certificate to act as a permanent memento.

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The AGM was a good example of this - a combination of excellent speakers presenting a wide range of interesting topics in a pleasant informal atmosphere proved to be a winner, and we had the largest turnout for an AGM in recent years.

None of this is achieved without considerable financial risk for the Chapter, since such locations demand up-front payment for an indeterminate number of delegates. The feedback received during the meeting was that the majority of those attending had enjoyed the day and could we please do it again.

As for EID, Trident Exhibitions have announced that they are co-locating it with other exhibitions they organise at the NEC in Birmingham. This means there will be no EID this year. The current plan is that it will be held on 13 and 14 Feb. 2002 alongside exhibitions encompassing Image Processing, Optical Technology, Sensors, and Machine Vision.

As always, your views on Chapter activities are always welcome, send me your thoughts by e-mail. Or contact any committee member.

John Raines.
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He also mentioned that a white light emitting polymer is under development.

He went on to discuss the goals for the technology, with a flexible display as the ultimate aim. The technological challenges were given as the lifetime and efficiency of the blue emitting polymer, a common cathode for RGB and the use of ink-jet printing for the polymer. The commercial challenges were to obtain a viable material and equipment supply and finally, acceptance by the community. He described how CDT is addressing these issues and finished by showing a picture of a low temperature poly-Si active-matrix display with light-emitting polymers. A number of questions then came from the audience regarding the use of plastic substrates, encapsulation and the scaling up of ink-jet printing for production.

The final talk on **Display-enhancement films**, was presented by Rob Bennet of 3M. He described the way in which enhancement films had been developed specifically for the mobile-phone market in Japan. Colour displays are becoming more widespread in the mobile-phone market in Japan, as a consequence the light efficiency is also of even more importance. Front-light illumination was being considered in preference to backlighting. Firstly, the ways of improving the illumination for front lighting were looked at. Prismatic front elements were considered, which had some advantages, but they resulted in low contrast for the display, Moiré fringes can occur and the brightness was uneven. Finally, the cost was increased because of yield problems; defects could be seen more easily if the film was on the front and so this was not necessarily an economic solution. An alternative was then considered, which was to use transflective devices and also to improve the backlight. This fitted better with previous work that had been done on enhancement films for laptop computer displays. 3M had previously developed BEF and DBEF, a recycling polarising film for laptops, which had added 60% to the brightness of laptops. Could the same be done for mobile phone displays? In the mobile system a very thin layer is required. The DBEF film was used together with the Enhanced Specular Reflector (ESR) film, which reflects 98% of the light and is depolarising. A convincing demonstration of the reflectivity was made by Rob using a cone of the ESR film and one of a conventional reflecting film. The resulting stack of films, including light guides designed for use with prism films showed significant improvement and mean that either fewer LEDs needed to be used to illuminate or that TFT displays can be used

successfully. The importance of this market was brought home when Rob said that 4 million mobile phones are manufactured in Japan each month.

The meeting finished on time, in spite of the enormous amount of information that had been imparted during the sessions and the interest and questions generated by the talks.

The day finished with tea and toasted tea cakes and a view of the house in the sun!

Sally Day
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Training and Education continued from Page 4

Totally separate from the Masters programme, the Universities of Southampton, Cambridge, Oxford, Hull, Bristol, Exeter, Manchester and Nottingham Trent have successfully bid for DTI and EPSRC funding for a Faraday proposal called COMIT, which is centred on creating the infrastructure to further the development of next-generation telecommunication switching devices based around optical components. This Photonics based bid has also recognised the desperate need for basic skills training programmes in the UK and I am pleased to say that funding has been included in the bid to allow us to create a complementary range of training programmes in Displays for SME and OEM companies.

These programmes will comprise a series of talks, demonstrations and lectures that can be delivered at company premises or at local University sites. The contents of the talks can be chosen to suit the type of person attending and the topics that they will need to be trained in. There will literally be a 'shopping list' of options for companies to select the training topics they need. The talks will also be available to 'other' audiences, such as schools, colleges, business institutions (Chambers of Commerce, Business Link, etc) and to major users of displays (financial services, local government, etc). This comprehensive and ambitious Training and Education programme will not only involve some of the staff who are working on the Masters Degree programme, it will be able to recycle information created for the Masters Degree and represent it in a 'simpler' form at the lower levels.

The combination of these two separate but fully complementary programmes not only offers the ability to create a 'Seamlessly Integrated Training and Education Programme', it also allows better use of EPSRC and DTI funding to get 'more programmes per pound invested'.

The direct benefit to SID members is obvious. The Masters programme offers unique, intensive training for individuals, and the T&E programme offers the ability to improve the product awareness of large numbers of staff.

The Masters programme is in place and starts in September. The T&E programme is under development and will follow shortly. Enrol on the Masters course NOW!

For full information, please look at www.displaymasters.ac.uk. There is a link from the SID UK website. To discuss matters personally, please phone or e-mail me directly.

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