Newsletter of the
BRITISH MACHINE VISION ASSOCIATION
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EDITORS NOTE

The current newsletter represents the ninth edition which I have edited since my appointment in the summer of 1988. However, duties as Association Secretary now increasingly occupy my available time and therefore this edition will be my last. However I am glad to announce that a new, keen face will be taking over the position: Dr Edwin Hancock, currently of the Rutherford Appleton Laboratory but presently to be lecturer at York University. Edwin is well known in AVC circles and has experience as Secretary to the Alvey Speech Club and as a regular contributor to conference reports in BPRA, BMVA and IAPR newsletters. No doubt he will impose his own inimitable style on BMVA News and I for one look forward to seeing it appear through my letterbox. I am sure he will do an excellent job and wish him the best of luck!

Most of the current issue is dominated by the plan of BMVA meetings during 1991 and an extensive report of the recent international meetings held in Japan. In recent months the BMVA Committee has been active forging links with many Associations that hold occasional meetings of interest to BMVA members. They have arranged to co-sponsor many of these meetings. Co-sponsoring means that BMVA members can attend these meetings at the same discounted rate offered to members of these societies. This form of interaction is often valuable as it permits BMVA members to make contacts with people in other fields and gives an opportunity to view problems from a less familiar viewpoint.

BMVC90 Best Paper Prizes.

At a recent Committee meeting the BMVC90 Programme Committee chose the best paper prizes for the conference. Three prizes now exist: a Best Scientific paper prize, an Industrial prize (sponsored by Computer Recognition Systems Ltd) and a Best Poster award. The last of these prizes was initiated only this year and reflects the high value that the organisers place on the poster session as a forum for display of good work. Each of the prizes is worth £100. The best scientific prize went to:

• Porrill and Pollard, " Curve Matching and Stereo Calibration."

while the best Best Industrial Paper was judged to be:

• Blake, McGowen, Lo and Konask, "Equipolar geometry for trinocular active range sensors."

The poster prize proved a more contentious matter and it was finally decided that the prize should be shared between two contributions:

• Astley and Taylor, "Combining cues for mammographic abnormalities."

• Tock, Crow and Lishman, "A Knowledge based system for measuring faces."

Future BMVA Programme.

During the last few months the BMVA Committee has been preparing an extensive program of technical meetings for the coming year. These include the following meetings:

• 20 March 1991 *"Collaborative European Vision Projects"*

• 24 April 1991 *"Motion Analysis"*

• 22 May 1991 *"Developing vision systems for robot vehicles"*

• 19 June 1991 *"Applications of Machine Vision to Medicine, Remote Sensing and Surveillance."*

• 16 July 1991 *"Image Compression"*

• 23-26 September 1991 *BMVC91*

• 23 October 1991 *"Natural Vision"*

• 20 November 1991 *"Active Vision"*:

• 11 December 1991 *"Rigorous Neural Nets"*

The majority of meetings will be in Central London and are scheduled as one-day events. No registration fee is payable by BMVA members although a charge of £5

will be levied for non-members (unless they are members of a co-sponsoring organisation). Arranged lunches will be available on prior registration but a small fee may be payable for these. Fuller details including final programme will be mailed to members nearer the time of each meeting.

In addition to the above meetings, whose technical programme is arranged by members of the BMVA, it has agreed to co-sponsor a series of meetings arranged by the other technical societies. Among these the Institute of Electrical Engineers has arranged the following meetings:

- 8 March 1991 *"Binary image processing techniques and applications."*
- 22 April 1991 *"Parallel Architectures for image processing applications"*
- 28 May 1991 *"Adaptive interpolation in images"*

and plans future meetings on "Machine storage and recognition of faces" and "Applications of image processing in mass health screening". The Institute of Mechanical Engineers is holding a meeting on 13 June 1991 entitled "Applications of Image Processing" and the Institute of Physics is organising a half-day meeting entitled "Computer Vision" on 11 April 1991. All the above co-sponsored meetings are accessible to BMVA members at the same meeting regsitration fee as applies to members of the organising technical society. More specific details will be circulated in this and future mailshots.

A final comment on the technical program is that the Committee is keen to organise a wide spectrum of technical meetings and very much welcomes suggestions from individual BMVA members. So if your pet topic is not being addressed by the Association or if you wish to arrange a technical program for a meeting please contact the Association Secretary who can advise you on facilities and funds which are available.

Conference Report

Prologue

Just before Christmas, two international meetings were held adjacent to each other in Japan. This gave a great number of researchers from the West the opportunity to visit the other side of the world. In addition, Japanese researchers themselves offered their hospitality and many of us who attended the conferences were able to visit a number of the leading laboratories during their stay. The most famous institutions, such as NTT and ETL's research laboratories were the most popular sites for individual visits, but approximately 100 participants at the ICCV were privileged to be able to join a technical tour to ATR International, the Advanced Telecommunications Research Institute International, established at Kansai Science City near Kyoto in March 1986. The Institute, which is jointly sponsored by the Japan Key Technology Centre and over 130 Japanese companies, is probably best regarded as a kind of Japanese SRI International. Amongst other things, it carries out research on machine vision, speech processing, neural networks, image processing, computer generated imagery and human computer interface in its four research laboratories, one of which specialises in auditory and visual perception research.

The visit to ATR took place on the Saturday immediately after the ICCV and was combined with a visit to Nara, the ancient capital which, in Nara Park, boasts some of the most breathtaking temples and most beautiful gardens in Japan. Todaiji Temple, despite being reduced to two thirds of the size of the original 752 AD structure when rebuilt for the second time in 1692, is still the world's largest wooden structure and houses the world's largest bronze Buddha.

The following Monday, the computer vision groups at the University of Osaka held an "open house" for participants to the ICCV, and just before I left Japan, I was able to squeeze in brief visits to Professors Tsuji, Inokuchi and Yachida's groups in the Departments of Control Engineering and of Information and Computer Sciences. During my stay in Japan, I was also fortunate enough to visit Mazda Research at Yokohama and Mitsubishi Electric at Osaka. From this brief, but enjoyable, exposure to Japanese work and the many papers presented by Japanese researchers at the two conferences, it appears that Japanese machine vision research is, for the most part, carefully targeted to meeting the requirements of specific applications (particularly so at Mitsubishi), places a strong emphasis on practical experiments and testing, usually involves the construction of in-house special purpose hardware (at the industrial research centres) and frequently involves some aspect of a futuristic human computer interface (especially at ATR). In contrast, in the UK and Europe, as in the USA, we tend to place a greater emphasis on developing more sophisticated algorithms and techniques.

3rd Int. Conf. on Computer Vision
Osaka, Japan, December 4-7, 1990

This emphasis on sophisticated algorithms and techniques was, as might be expected, particularly noticeable at the ICCV where one of the highlights was the Marr prize winning paper on "Shape from Interreflections" by Nayar, Ikeuchi and Kanade from the Robotics Institute at CMU. Not only was this work well worthy of its prize winning status, it should also be noted for perhaps setting the scientific tone (and standard) that the more academic International Conference on Computer Vision is striving for. In fact, it has been known for a long time that, whenever mutual illumination effects are important (which, in scenes of interest, is almost always), the use of photometric techniques requires the solution of a Fredholm integral equation. The surprise is not only that no-one bothered to do it until now, but that the results, for example, obtained from shape from photometric stereo methods are improved and errors reduced by solving the integral equation. In this respect, it is perhaps a classic scientific lesson for us all, but the UK at least can take comfort from the work of Forsyth and Zisserman at the AVC'89 and CVPR 1989 on the effect of interreflections on edge features which preceded

the US work. However, it should not be forgotten that quantitative scientific work of this sort requires the kind of expertise and infrastructure established over several years at the CMU quantitative vision laboratory.

Other highlights and papers which I found particularly thought-provoking at the ICCV were: coarse to fine tracking for motion estimation (Burt et al) and adaptive scale space tracking (Whitten) - used, amongst other things, again for motion estimation; attempts to perform statistical inference on the unit sphere (Collins and Weiss) and to take proper account of projective geometry when testing 3D hypotheses (Kanatani); the use of locally adaptive windows for signal matching (Okutami and Kanade); a windowed Fourier phase image matching technique (Weng); steerable filters for early vision, image analysis and wavelet decomposition (Freeman and Adelson); scale detection and region extraction from a scale-space primal sketch (Lindeberg and Eklundh), active multiscale surface reconstruction (two papers by Ahuja et al); terrain matching by analysis of aerial images (Rodriguez and Aggarwal); and the analysis of facial images using physical and anatomical models (Terzopoulos and Waters).

Whilst this list is obviously personal and somewhat idiosyncratic, I would defend it by pointing out that all these papers raised important issues and that many of them share the common (and fundamental) theme of adaptive, multiscale matching. In addition, Terzopolous and Waters' paper near the end of the meeting was a piece of superlative theatre, featuring their animated film, "The Bureaucrat", which contains several minutes of simulations of a wide variety of human facial expressions and movement. It was, I thought, particularly appropriate for this film to be shown at an international meeting in Japan, where so much emphasis is placed on HCI, computer generated imagery and facial modelling.

Machine Vision Applications
Tokyo, Japan. November 28-30, 1990

Japanese work on HCI and facial modelling was, perhaps surprisingly, much in evidence at the Machine Vision Applications meeting which preceded the ICCV. The emphasis at this meeting, co-sponsored by three IAPR Technical Committees on special purpose architecture, applications in industry and graphics recognition was much more on engineering rather than science, although the occasional disappointing paper on the interpretation of visual motion did slip through the engineering net. However, in keeping with its title, many engineering, implementation and applications details came to the fore in this meeting.

In addition to the three invited talks which each gave comprehensive surveys on:

- Recent progress in industrial machine vision (Mohtadi and Sanz, IBM);

- Techniques for line drawing interpretation (Kasturi, Siva and O'Gorman, Penn. State and AT&T Bell Laboratories);

- Architectures for multidimensional low and intermediate level image processing (Jonker et al, Delft);

Papers which caught my eye included: interpretation of industrial scenes by semantic networks (Niemann et al, Erlangen); improving the performance of a multilayer perceptron through an empirical maximum likelihood learning rule (Semnani and Holt); a method for the synchronised acquisition of cylindrical range and colour data (Suenaga and Watanabe, NTT); the generation of 3-D models based on image fusion of range date (Sakaguchi et al, part of which I later saw in action at the University of Osaka); the knowledge-based interpretation of road maps based on symmetrical skeletons (Ilg and Ogniewicz, ETH); the randomised Hough transform (Kultanen et al) and a fast incremental Hough transform (Koshimizu and Numada); recognition of roads in an urban map by using the topological road network (Hayakawa et al); face recognition without features (based on the SVD and principal components analysis by Turk and Pentland); a multiresolution dynamical architecture for real-time motion analysis (Burt - also featured in the ICCV); single chip high speed computation of optical flow (Danielsson et al, Linköping); several papers on navigation and robot vision using model-based vision and visual servoing (including one of the two papers from Blaise Pascal University, the recognition of parameterised models from 3D data (Reid), the generation of environment models for indoor mobile robots (Roth-Tadak and Weymouth), and estimating the pose and motion of a known object for real-time robotic tracking (Silvén Oulu)); camera calibration by computational projective geometry (Kanatani, again!), video-rate image processing system for an autonomous personal vehicle system (Ohzora et al, Fujitsu) and an advanced vision processor with an overall image processing unit and multiple local image processing modules (Kubota et al, Toshiba).

This list is perhaps less unified than my chosen highlights from the ICCV. However, I would particularly draw attention to five papers. First, the paper from ETH on the knowledge based interpretation of road maps for the careful choice of their application (the interpretation of a single thematic layer of a road map containing only high quality road lines) and the rigour with which the symmetrised skeletons were utilised. Second, Pentland's featureless face recognition system for its effectiveness and similarity to the recent work of Scott and Longuet-Higgins (BMVC'90). Third, the linear processor array VIP chip being developed at Linköping that turns out to be ideally suited to the computation of optic flow. It was notable also that linear processor arrays were the most favoured machine architecture in Jonker's invited talk. Fourth, the real-time robot tracking work of Silvén which paid particular attention to the effect of image processing delays on the tracking. Fifth, the interpretation of industrial scenes by semantic networks by the Erlangen group, which featured a very well-developed model based image system implemented as a semantic network. This system had been developed in collaboration with Siemens AG.

My original list above, these five papers and the titles of the three invited talks should convey that this meeting was very different to the ICCV. In addition, I should add that document image processing was a theme of the meeting. A separate session was devoted to the topic, and many other papers (to a total of 17) in addition to the invited talk addressed problems in the machine interpretation of document images. It would appear, from this conference at least, that there are still many problems to be solved in this area and that solutions are urgently needed as maps, plans and engineering drawings placed in store many years ago continue to deteriorate. Another point worthy of note was the use by Japanese authors of portable video players to considerably enhance the quality of the posters at this meeting.

Epilogue

Finally, I would like to close by returning to the ICCV. One notable feature of this conference was the IEEE PAMI meeting to discuss arrangements for the next ICCV. Although this was potentially a contentious issue with the possibility of three major machine vision conferences being held in Europe in 1992, it was speedily resolved by the determination of the newly founded European Vision Society to remain independent with the second ECCV to be held in Genoa in May 1992, by the skillful chairmanship of Tom Huang (Chairman of the IEEE PAMI Committee), and the irresistible lure of Hans-Helmut Nagel's offer to organise the next ICCV in Berlin in the Spring of 1993.

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Book Review

"A digital design methodology for optical computing" by Miles Murdocca. Published by MIT Press 1990. 156 pages, ISBN 0-262-13251-6, price £26-95.

This book is based on part of the authors PhD thesis which was completed at Rudgers University in the USA. The general topic of the book is a subject of growing interest to many people. There are relatively few texts on optical computing especially at the systems level and therefore I feel that this book has an important and useful place in the literature of the subject.

The first chapter addresses the question of why study optical computing and overviews the history of the subject. It includes a discussion of the speed and device characteristics of optical technology and highlights the parallel nature of optics. Chapter two is devoted to the specifics of several devices which are used in optical computing applications; etalons (optical resonators) and self electro-optic devices (SEEDs). Arrays of these elements are now marketed by several US companies such as AT&T. Optical interconnects are discussed in this chapter and both free space and holographic techniques are considered. There are a number of approaches to the design of an optical computer and many of them are reviewed in chapter three. The discussion is by no means complete but is more than sufficient to give the reader enough knowledge to follow the subsequent chapters. The various approaches are based on both guided wave and free space interconnects and all optical (digital and analogue) and hybrid electronic/optical digital circuits. The tools to enable digital circuits to be designed are dealt with in chapter four. The techniques used involve arrays of optical logic gates connected by free space interconnects. They use AND-OR logic in modules which have predetermined connection patterns and only those connections which are not required are removed. Chapter five deals with applications of the methodology. Included are discussion of a parallel sorting network using optical programmeable logic arrays, a large optical computer design and the design of a content addresseable memory. The final chapter reviews the subject and discusses its future prospects. Whilst there are no real applications for such systems at present there are many which are awaiting some technological advance to enable them to become either viable or economic. In conclusion, I feel the book gives a good overview of a subject which is rapidly advancing. With 127 references it provides a useful introduction to the subject and is particularly strong in emphasising system aspects.
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Conference Proceedings

A limited number of copies of conference proceedings from the Alvey Vision Conferences of 1988 and 1989 and the British Machine Vision Conference of 1990 are still available for sale at the bargain prices of £25 plus package and posting. They can be obtained on request from Dr J Illingworth, Department of Electronics, University of Surrey, Guildford GU2 5XH.

DIARY

8 March 1991 IEE Colloquium on "Binary image processing techniques and applications.", London.
20 March 1991 BMVA Meeting on "Collaborative European Vision Projects.", London
11 April 1991 IOP Meeting on "Computer Vision.", London
22 April 1991 IEE Colloquium on "Parallel Architectures for image processing applications.", London
24 April 1991 BMVA Meeting on "Motion Analysis", London
22 May 1991 BMVA Meeting on "Developing vision systems for robot vehicles.", London
27-30 May 1991 International Conference on Visual Form, Capri, Italy.
28 May 1991 IEE Colloquim on "Adaptive interpolation in images.", London.
3-6 June 1991 Int Conf on Computer Vision and Pattern Recognition, Hawaii
19 June 1991 BMVA Meeting on "Applications of machine vision to medicine, remote sensing and surveillance.", London.