BMVA News

BMVA News[1] is published every three months. Contributions on any activity related to machine vision or pattern recognition are eagerly sought. These could include reports on technical activities such as conferences, workshops or other meetings. Items of timely or topical interest are also particularly welcome; these might include details of funding initiatives, programmatic reports from ongoing projects and standards activities. Items for the next edition should reach the editor by 31st October 1994.

Contents

[1] The British Machine Vision Association and Society for Pattern Recognition is a Company limited by guarantee, No. 2543446, registered in England and Wales. Registered Office: Granta Lodge, 71 Graham Road, Malvern, WR14 2JS. The Association is a non-profit-making body and is registered as charity No. 1002307.

Editorial

It's been a slow summer and the contributions haven't exactly been flooding my mailbox, but here it is, the all-new BMVA newsletter. We have reports of the exciting BMVA Executive Committee "election" and recent conferences and technical meetings. The biggest recent event was of course ECCV in Stockholm, and I must say it was highly enjoyable. The higlight for me was a performance of Purcell's "Dido and Aeneas" in which the singer playing Aeneas appeared in one scene sporting a six-foot member to demonstrate his virility, an "interpretation" which would probably be unacceptable at Glyndebourne, assuming they ever play the old stuff there. We have a boggle-eyed first-timer's view of ECCV from Adam Baumberg, who from the balance of his report seems to have already got the right idea about how to spend ones time at a Big Conference. We also have a report on a recent workshop on Digital Mammography held at York from Jon Parker. The next Big Conference is of course our own BMVC, which in recent years has had all the foreigners queueing up to get in (at least they would queue up if they were British). Chairman Edwin Hancock has an update. Has anyone not heard of ECVnet? Neither had I, but Patrick Courtney has written an article telling us all about it.

BMVA Executive Committee

The call for nominations for places on the BMVA Executive Committee closed recently. By a remarkable feat of self-organisation, precisely the right number of nominations were received to avoid a ballot, thereby saving a tree. The lucky people are:

Adrian Clark (Essex)

Roy Davies (Royal Holloway)

John Illingworth (Surrey)

Josef Kittler (Surrey)

Phil McLauchlan (Oxford)

Geoff Sullivan (Reading)

Chris Taylor (Manchester)

Neil Thacker (Sheffield)

Tim Trew (Philips)

Margaret Varga (DRA)

BMVC'94

University of York, UK, 13-16 September 1994

At the time of writing the process of finalising the programme and assembling the proceedings is nearing completion. This years call for papers brought an unprecedented 174 submissions, presenting the programme committee with a very difficult and often painful task of selecting the 75 papers for presentation. Because of the very large number of submissions, it was necessary to augment the committee; I am particularly grateful to Maria Petrou, David Pycock and David Hogg for aggreeing to assist with the herculean reviewing task at a very busy time in the academic year.

Each submitted paper was reviewed by three members of the programme committee and was ranked on the aggregate of their decisions. On the whole there was an astonishing consistency of opinion. The relatively small number of reviewing conflicts were resolved by discussion at the Programme Committee meeeting held at UCL on 10 June. Decisions concerning whether or not a paper was to be included in the programme were based on the aggregate rank and the committee discussions. By expanding the programme from 65 to 75 papers, the fraction of accepted contributions was about 45%, i.e. only 5% lower than last year. It is also worth mentioning that about 25% of this years presentations come from outide the UK.

I believe that we have been able to assemble a high quality programme from the submissions. As usual, the conference is a single-track meeting with both oral and poster presentations. In addition to the contributed papers, there will be invited talks by Jan Koenderink and Kazuhiko Yamamoto together with a pre-conference tutorial covering statistical methods in machine vision which will be presented by Josef Kittler and Chris Taylor.

The cost of registration, including the proceedings, full board and accommodation and the social programme will be approximately GBP250. A printed copy of the Proceedings will be available to delegates at the conference, and a selection of the best papers will be published separately in a special issue of Image and Vision Computing Journal.

Technical sessions will cover the following areas:

- Feature extraction and texture.
- Architectures for vision.
- Object recognition and matching.
- Motion and tracking.
- Active and deformable shape models.
- Statistical methods in vision.
- Calibration and geometry.
- Symmetry.
- Illumination and colour.
- Sensor fusion.

Further information may be obtained from the Conference Chairman:

Dr Edwin Hancock
Department of Computer Science
University of York
York, Y01 5DD
Tel: +44 (0)904 43 3374
Fax: +44 (0)904 43 2767
Email: `erh@minster.york.ac.uk`

BMVA Publicity

The standard BMVA booklet, which we hand out at exhibitions and send to all potentential applicants for membership, is now getting quite old and some of the descriptions of research activities are almost certainly out of date. This material and the associated wall posters are probably the first information that people see when they find out about the BMVA and it is important that it is capable of attracting new membership.

We will be updating this information in the near future and require contact names in any research groups who would be keen to provide materials (images + text). Those interested should please email or phone me with names, email address and telephone numbers of responsible contacts to. These people will then be contacted in the near future regarding specific contribuuions.

Neil Thacker (BMVA Publicity Officer)
Silicon Vision Group,
University of Sheffield.
Tel: +44 (0)742 825177
Email: `n.thacker@sheffield.ac.uk`

Personal Identification and Verification

A BMVA technical meeting held on 11th May 1994

This meeting, chaired by Margaret Varga of the DRA, saw many of the old regulars, as well as some new faces. After a short introduction, the first speaker, Peter Hawkes of the British Technology Group Ltd., set the scene. Personal identification and verification is finding many applications in air travel, banking, social security and personnel security. It is a new industry, and a growth industry that is trying to keep up with the two other growth industries of crime and fraud. There is a need for positive identification, and so the characteristics that are to be measured must be stable over a long time. The best known system specification was set by Barclays Bank in 1992, and that suggested that there should be less than 1 in 100,000 rejections of a true user, no more than 5 percent of impersonators to be accepted, with the response coming from £150 equipment in less than 3 seconds.

The public seems quite happy to show their hand and have it measured. Well, happy as long as you do not have to jam your hand up against pegs to standardise finger positions. Whilst potential suppliers of equipment seem unwilling to say how their systems work, it is possible to sample and measure the finger and palm prints, finger and hand dimensions, and hand vein patterns. A video was shown which showed a futuristic scene of a biosphere being used to identify a traveller, but then went on to extol the INSPASS system being introduced by the US Immigration and Naturalisation Service. It is being tested at Kennedy and Newark airports, and is currently aimed at frequent travellers into the USA. Although the equipment costs £2000, the personal details fit in a 9 byte template, and so can easily be stored on 1 track of a 400 bit black stripe bank card.

The first talk then concluded with details of BTG's hand vein pattern matching system. Their trial system takes about 2 seconds to work on a 386, and the vein template fits easily into the prescribed 400 bits. Yes, a good start to the day.

The second speaker Dr Mike Carey of Ensigma Ltd., Gwent, covered speaker identification and verification. The latter in particular has many applications for verifying the owner of a credit card, or an account when home banking or shopping. Although the input device, a microphone, is ridiculously cheap, and digital signal processing chips weigh in around $10 each, there are already *millions* of such stations world wide in the international telephone network. Tell that to the fingerprinting brigade! Who of course would reply that fingerprints do not get colds, are unique, and do not suffer from the noise such as that found at three o'clock on a Saturday afternoon in a River Island store. Dr Carey cited an application, that of home arrest. Big brother rings up to see if the arrestee is at home, and able to pass a voice test. Even if the test fails for 10 percent of the cases, the human inspector is still working 10 times more efficiently than at present. Currently inspectors have to drive to each arrestee's house to make a visual check.

Ensigma's system asks users to enroll by giving samples of their voice. They are asked to supply several strings of 5 digits, and these form the templates, which occupy about one Kbyte. When in use, the user is asked to repeat a randomly chosen 5 digit number, and is expected to give that number without hesitation. Tests have shown that assertive speakers fair best, but speakers who mumble tend to be rejected, and so mumble even more.

Dr Barry Blain of the Home Office, Police Systems Research and Development Group is a great believer in fingerprints! They are sent to a central database to identify an arrested person, and it is fingerprints,

not voice prints, that are often left behind at the scene of a crime. At present, fingerprint identification is computer assisted, but a proposed national system that could handle 2000 searches a day to identify arrested persons, and nearly 4000 searches of finger marks from scenes of crime would involve some 350,000 automatic comparisons every second over a working day! That needs a machine of 400,000 Mips, equivalent to 100 Crays or 40,000 PCs just for the UK. That's a lot of looking at whorls, loops and arches.

Professor Mike Fairhurst of the University of Kent outlined a toolkit approach for signature verification, and mentioned KAPPA, their own system. As people sign their names differently from day to day, the system must handle that variation, yet still be able to reject unauthorised signatures. The toolkit allows *plug-in* modules so that the final system can be easily tailored to suit the customer's requirements. Some users may only want (or is that afford?) a static inspection of the signature's image, whereas others may want to consider the rate of signing, or even the pressure variations whilst signing. No problem. Just plug in another module or so. The topic of handling rejected signatures came up again. It is less important on a £5 credit card transaction than on a £1000 one, but both need to be handled carefully. An absolute pass-fail decision is not enough as the shop assistant needs to know what to do in the event of an apparent failure. Professor Fairhurst commented that trial system results need to be carefully considered, as they present an artificial environment, and testers are tempted to try to *beat the system*.

Dr Ian Craw gave another of his entertaining talks on identifying faces. He has a certain sonorous, Thespian voice, and thanks to him and his colleagues, the term *eigenface* no longer raises any eyebrows. Perhaps we've all been normalised! We were advised that there would now be two talks considering the *right way* of handling such inspections, and presented with a very low resolution picture which was quickly spotted as being that of John Major. It seems incredible that faces have been encoded with between 8 to 45 pixels per face, and yet still recognised by us humans in a 100 millisecond observation. As for computers, well they find facial landmarks, and see how they vary from the British Standard Face. Using principal component analysis, faces may be encoded in terms of eigenfaces, stored in 30 bytes, and hence fit on that black stripe card. Our speaker finished with a word of advice for his computers which can be summed up as, "you can try to accommodate our human frailnesses of smiling, moving and ageing, but forget our hairstyles!" Well, how did you look

10 years ago?

The last speaker on a very interesting day, Dr Yael Moses, now at Oxford, but formerly at the Weizmann Institute, Israel outlined the work of that Institute. She considered the topic of recognising faces, when the new face is seen under different conditions from any previous observation. That change may come from variations in the illumination, the viewing direction or from facial expressions. Dr Moses finally presented the results of an empirical computational study that compared recognition sensitivity across these different conditions.

Overall, a good day, with many superb ideas, an enormous market, and a feeling that tapping into even just a small part of it would greatly advance our standing.

> *Geoff Dowling*
> *City University*
> *London EC1V OHB.*
> *Email:* `g.dowling@uk.ac.city.cs`

ECCV'94

The European Conference on Computer Vision, May 1994, Stockholm

Casting my thoughts back to Stockholm in May, one thing that sticks in my mind is the salmon – smoked salmon, poached salmon, salmon terrine, salmon mousse, salmon starters, ... Stockholmers appear to be very proud of the fact that you can catch salmon in the local rivers and lakes in and around the city centre. This is undoubtedly due to the superlative Swedish organisation and efficiency and the 3rd ECCV was likewise impeccably organised. The marketing slogan was "Stockholm – beauty on water" and in fact there was water everywhere (but not a drop to drink, unless you're prepared to fork out a fiver for a pint of beer). The social program was particularly successful including a splendid reception in the somewhat intimidating City Hall – a building which conjures up the grandeur of a German castle although mostly constructed in concrete. Apparently the "banquet room" is the setting for the annual Nobel banquet – a fact that we were reminded of on more than one occasion! The mayor honoured us with his presence and produced probably the best talk of the conference (although there were no prizes this year). He confessed to being computer illiterate but singled out several of the forthcoming talks including "A comparison between the

standard Hough transform and the Mahalanobis distance Hough transform" as sounding of particular interest and he was sure that we would undoubtedly enjoy discovering the benefits of the latter over the former (and vice versa). After an enjoyable buffet (including two types of salmon) we were given a tour around the building by our guide whose delivery could best be described as part town crier and part Shakespearian actor.

Equally enjoyable (if not more so) was the conference banquet. The conference organisers had thoughtfully arranged for a scenic boat trip on the lake to carry us to our destination but, not so thoughtfully, had left us to find our own way back. The banquet itself was excellent with plenty of good food and drink (the ubiquitous salmon making an early appearance). Any danger of long drawn-out speeches was avoided by the delegates bursting into applause at every opportunity. The journey home turned out to be a considerable walk but by this time we didn't really care.

I suppose I should mention the scientific content although I expect many will have already leafed through the proceedings. The standard was high (but not inspiring) and inevitably there were a few patchy papers that slipped through the net. More noticeable was the presentation, or lack of it, which in places was incredibly bad. We were subjected to scrawled hand-written overheads, unreadable equations, indigestible tables of numbers, unclear images, monotone voices and unprepared speakers (here's something I just knocked up on the plane coming over, being the philosophy). As this was my first conference presentation I had toiled especially hard to produce some suitable slides (and even a video) and am sure such efforts were appreciated. Of course, there were several interesting and informative presentations. Personally I enjoyed Malladi et al.'s paper on "Evolutionary Fronts for Topology Independent Shape Modeling and Recovery", Kanade talking about "A Paraperspective Factorization Method for Shape and Motion Recovery" and J.Davis talking about hand-gesture recognition, to name but a few. The conference hall was very comfortable (at times too comfortable) and the facilities were of a suitably high standard. There were a few amusing moments at the sessions, most memorably when Philip Torr wearing a "mega-death" T-shirt decided to relax and take a seat whilst delivering his talk.

Stockholm is a thriving modern city with plenty of attractions and I'm sure that most delegates will have taken an afternoon off to see the impressive "Vasa" – a preserved 17th century war vessel that unfortunately sank very soon after being launched. We also enjoyed evenings strolls around the old city looking for that perfect drinking establishment (but ended up returning to the familiarity of the Hotel bar). All in all, this was a beautiful setting for what was my first international conference.

Adam Baumberg
University of Leeds.

ECVnet

The European Computer Vision Network (ECVnet) is an association of public, private and industrial research laboratories devoted to the advancement of the science and technology of computer vision in Europe. This network has been funded for 3 years by the European Commission and held its first meeting recently in Paris

Objectives

The goal of the network is to incite development of the scientific foundation and commercial infrastructure needed to transform Computer Vision from a laboratory science to a widely used technology. Two kinds of actions are envisaged:

- Collaborative actions which can be of two sorts: initiatives to create a common infrastructure; and opportunistic actions to advance promising new approaches and applications.

- Technology transfer actions which seek to develop the industrial base necessary for the growth of a computer vision industry.

ECVnet is concerned with technologies for autonomous robotics, active vision, image analysis, computational geometry, theoretical computer vision, neuro-science and biological vision.

Structure

The network is organised as a set of primary nodes (founding members) each of which serves as a communication point for a set of associate (secondary) nodes. The network structure is open, with procedures for adding new primary and secondary nodes at an annual meeting of the network management board.

There are at present 13 primary nodes which are the University of Aalborg (Denmark), the Catholic University of Leuven (Belgium), the University of Genova (Italy), the FhG-IITB, University of Karlsruhe (Germany), INRIA at Sophia Antipolis (France), the University of Utrecht (Netherlands), the Royal Institute of Technology (Sweden), LPPA-CNRS, University of Paris VI (France), ITMI (France) and ELSAG (Italy), and the three UK nodes at the University of Sheffield, the University of Oxford and British Aerospace in Bristol.

Activities

Network activities will be supervised and coordinated by a number of standing committees. Each standing committee will receive and review proposals for activities from network nodes or associates. The standing committee make recommendations to the steering committee for funding and budget.

The following standing committees are proposed for the first year of operation:

Infrastructure (Chair: Prof. Giulio Sandini) to support the collaborative aspect of the network the primary nodes will establish servers which will be accessed via mosaic/WorldWideWeb. The first such server is already operational at DIST in Genoa (the URL is: HTTP://afrodite.lira.dist.unige.it).

Educational (Chair: Prof. Hans-Helmut Nagel) to support the development of human resources and the transfer of knowledge, teaching resources will be developed and made available.

Software Environments Specifications (Chair: Prof. Olivier Faugeras) to investiagate the use of standard software environments to facilitate the development and transfer of methods.

Plans are currently being drawn up for activities in the additional areas of **scientific activities** (chair: Prof. Erik Granum), **industrial activities** (chair: Dr. Philip Greenway) and **benchmarking activities** (chair: Dr. Patrick Stelmaszyk) are still being defined.

Actions within these activity areas will be performed by special interest groups drawn from the network nodes and associates which will form and meet in an opportunistic manner under sponsorship of the network. They will organise workshops and meetings to harmonise terminology, define subdisciplines and to compare preliminary results from research in progress.

The network does have small reserves with which to fund such meetings and to facilitate deserving activities. It cannot, however, fund research work.

Relation with BMVC

The ECVnet plans to establish working relationship with existing national scientific groupings such as the BMVC. The goal will be to help promote the activities of the national societies in other countries of the EU, and to encourage joint activities between these national societies.

Patrick Courtney
ITMI
France

If your laboratory is interested in joining and contributing to the network or simply finding out more, please contact one of the UK nodes or the coordinator at the address below:

Prof. James L. Crowley
Coordinator, ECVnet
LIFIA - IMAG
46 Ave Felix Viallet
38031 Grenoble, France
Email: `jlc@lifia.imag.fr`
Tel: +33 76 57 46 55
Fax: +33 76 57 46 02
Sec: +33 76 57 48 06

IPA'95

The fifth international conference on Image Processing and its Applications will be held at Heriot-Watt University, Edinburgh on 3rd-6th July 1995. It is planned to hold a day of tutorials on 3rd July followed by the three day conference. Categories of paper that may be submitted include, but are not restricted to, the following:

Image Communication Coding and compression, image perception and fidelity, multimedia, virtual reality, standards.

Image Interpretation Labelling and classification, neural networks, motion, stereo and 3D, shape.

Image Analysis Image models, filtering, transforms, morphology, texture, segmentation, enhancement, colour.

Architecture Acquisition, hardware, VLSI, real-time issues, storage, display.

Applications TV and video, robotics, medical, forensic, security and surveillance, remote sensing, transport, industrial inspection.

The deadline for reception of 1000 word abstracts is 28th October. The Conference is being organised by the Electronics Division of the IEE, in association with the BCS, the BMVA, the IEEE (UKRI Section), the Institute of Physics, the Royal Television Society, the UK IVA and the IEE Scottish Centre. For information about the conference, contact

> *IPA95 Secretariat*
> *IEE Conference Services*
> *Savoy Place*
> *London WC2R OBL*
> *Tel: + 44 (0)71 344 5478/5477*
> *Telex: 261176 IEE LDN G*
> *Fax: + 44 (0)71 497 3633*
> *Email:* `conference@iee.org.uk`

Mammography Meeting

The Second International Workshop on Digital Mammography (10-12 July 1994, York, UK) was organised following a successful special session of SPIE Bio- Medical Image Processing in San Jose Feb. 1993, which drew together groups applying image analysis techniques to digitised mammograms (breast X-ray images). This second conference was organised in association with the BMVA and AVA (Applied Vision Association) and was well attended reflecting the growth of interest in this field, particularly in North America and Europe. Most of the sessions focussed on methods for computer interpretation of mammograms with others investigating improvements to the imaging technique and performance measurement of the human observer (radiologist). Mammograms are notoriously difficult images to interpret by human observer or computer and provide some interesting and unique machine vision problems.

The main aim of current work in this field is automated detection of abnormality to make breast cancer screening more effective. Two signs of disease, calcifications and stellate lesions, received most of the attention. Calcifications are small inorganic salts which can be deposited in tumours. They appear on the mammogram as small specks and are an important indicator of disease. Stellate lesions are tumours with a star-like appearance and are likely to be malignant disease.

Many methods were reported for the detection of calcifications including matched Fourier filter, difference of gaussian filters and image restoration. Most of these methods can achieve good detection rates but at the expense of many false positives. These can be partially eliminated using feature analysis with neural networks or other more traditional classifiers. Detectors for stellate lesions typically employ line and edge detectors and need to be quite sophisticated to cope with the structured background of the mammogram.

The difficulties of image analysis of mammograms are mostly due to the highly variable appearance, both in size and shape, of each breast and abnormality. It is very difficult to model the breast and in practice it may only be possible to loosely define "normal" appearance. To get around the problem of variation of shape with size, some groups are applying novel multiscale approaches involving wavelets and fuzzy pyramid linking. To acquire ad-hoc information about "normal" mammographic appearance images of left and right breasts or images of the same breast taken at different times can be registered to detect small changes due to disease. The registration problem is highly complex due to natural anatomical variation and lack of reliable marker points from which to calculate a transformation or warping.

Computer techniques are also being investigated for the differential diagnosis of breast lesions. The shape of calcifications and tumours may indicate what type of lesion is present and therefore whether a lesion is benign or malignant. More subtle classification problems are also being investigated such as whether the texture of normal mammographic images can indicate the risk for development of cancer at a later date. The use of neural networks of various architectures abound in this area along with more standard techniques such as nearest-neighbour rule.

Although progress has undoubtedly been made on these problems, it is difficult to assess the significance of results due to the lack of a common database available to all groups. That situation is now changing. In the U.K. the Mammographic Image Analysis Society (MIAS) released last year a database of over 300 digitised images. Twenty-seven copies of the database have been bought by groups around the world and several papers at the conference were based on it. In the United States there is now a four year programme to create a larger and more comprehensive database. The use of these databases should allow intercomparison of techniques developed by different groups.

The imaging technology which has become stan-

dard now for breast screening could undoubtedly be improved. Perhaps the main problem with the use of film is the response curve which introduces non-linearity of contrast and noise into the image. Digital capture systems have been shown to be almost linear in response and, although expensive, now look likely to come into use for mammography. A little more speculative was the suggestion to replace the standard X-ray generating tube with a narrow beam of monochromatic X-rays from a synchrotron, radically changing the imaging process.

Although there may be resistance and scepticism in the medical community about the use of computers to assist with the interpretation of mammograms, the speed, sophistication and accuracy of algorithms is contnually improving and the use of digital capture and display of images is likely in the near future. Such is the interest in the USA in computer methods that a working party, "The National Digital Mammography Development Group" has been set up, involving several of the main groups. Their aim is to develop an "intelligent workstation" for the use of the radiologist in a clinical setting.

Of course, all this would not be necessary if the performance of the radiologist was consistently very high. In the U.K. results from the NHS breast screening programme show that to reduce mortality from breast cancer we need to improve detection of early symptoms and that the radiologist does miss and/or misclassify some of the important mammographic signs. If computer vision can be shown to improve, or make more consistent, the performance of the average radiologist, there must surely be a place for it in the breast clinic.

A third conference on digital mammography is planned for early 1996 to be held in Chicago, USA.

Jon Parker
Joint Department of Physics
Institute of Cancer Research
& Royal Marsden Hospital

Journal of Real-Time Imaging

Real-Time Imaging is the title of a new journal from Academic Press which will be published from January 1995. There will be six issues in the first year. The Journal will have a wide-ranging remit, covering the areas of image compression, target acquisition and tracking, remote control and sensing, image enhancement and filtering, networking for real-time imaging, advanced computer architectures,

computer vision, optical measurement and inspection, and simulation. There will be a cross- disciplinary emphasis. An important feature of the new journal will be the speed of review (expected to be 4-5 weeks) and of subsequent publication.

The Editors-in-Chief are Phillip A. Laplante of Fairleigh Dickinson University, and Alexander D. Stoyenko of New Jersey Institute of Technology. Roy Davies of Royal Holloway University of London has been appointed European Co-ordinating Editor: European authors can submit papers direct to him for refereeing.

Roy Davies will be pleased to offer advice about the scope of the Journal and related matters.

Professor E.R. Davies
European Co-ordinating Editor, Real-Time Imaging
Machine Vision Group, Department of Physics
Royal Holloway, University of London
Egham Hill, Egham
Surrey TW20 0EX UK

Tel: +44 (0)784-443497
Fax: +44 (0)784-472794
Email: `e.r.davies@rhbnc.ac.uk`

Tracking and Data Fusion

A BMVA technical meeting held on 8th June 1994

In the Computer Vision Group at Napier University we have an increasing requirement for information on the behaviour of individual vehicles and pedestrians to support our department's work on the control of transportation systems. This means extending current work based on statistical measures of image activity to the tracking of individual vehicle movements. The BMVA meeting on "Tracking and Data Fusion" at the British Institute of Radiology on 8th June therefore seemed a good opportunity to get up to date on suitable techniques. Unfortunately, having travelled down from Edinburgh on the morning of the meeting, the first two talks were missed however the rest of the day's presentations made the trip well worthwhile. Generally, the meeting was semi-formal in style and criticism was of a helpfully constructive nature.

Adam Baumberg of the University of Leeds gave a talk on "Tracking a walking person using an automatically acquired model". By assuming a static

background images were binarised and used to extract the boundary of a pedestrian's silhouette. Principal component analysis was then used to analyse the modes of variation of the boundaries and a set of 18 modes found which covered 90modes were then used as a basis set for characterising pedestrian movement. A video was shown demonstrating the method in action and dealing with partial occlusion as two pedestrians crossed paths. He concluded with some results on inferring pedestrian trajectory from the shape of their silhouette. When questioned about problems caused by shadows distorting the shape of the pedestrian outline he pointed out that it is valid to extract the shape information under relatively ideal conditions - a training stage, and then to apply the models so produced in real situations.

The next two papers presented results on multiple model Kalman filters. Tony Lacey of the University of Sheffield discussed object tracking of corners in artificial test sequences with additive gaussian noise and some corners removed. Results were given for a Kalman filter incorporating models for constant position and constant velocity although the possibility of other models such as constant acceleration and simple harmonic motion was suggested. The filters based on each of the chosen models are run in parallel and the problem becomes the selection of the best predictive model at any given time. To provide a basis for this selection a statistical comparison of the predictions and measurements is used. The best results were achieved using the Bhattacharyya integral to make these comparisons. At the end of the talk he indicated that there are problems with bootstrapping the various models. Jonathan Roberts of Southampton applied multiple model adaptive estimation to time-to-collision estimation and segmentation in road traffic situations. In this case the outputs from the models were used in weighted combination rather than just as switchable alternatives. Work at Southhampton is now looking at replacement of the Kalman filters with fuzzy estimators.

Kevin Bradshaw of Oxford University talked on trajectory filtering and modelling to aid active pursuit. He used the assumption that object motion was constrained to the ground plane to recover the homography relating the image plane to the ground plane in the scene. This correspondence is recoverable if at least 4 points of correspondence between ground and image plane are known. Once this relation had been determined it was used to simplify motion estimation by projecting features tracked in the image plane into the scene's ground plane before applying motion models.

The final talk of the day was presented by Rob Deeves who kindly filled in for Phil Greenway at short notice (the day before, I believe). He described work being carried out by British Aerospace at Sowerby Research Centre in Bristol. The talk described work involving fusion of data (the only one of the day) from a variety of sensor sources including visual, infra-red and ultrasound, to yield a modular surveillance system. Modularity was a goal of the research so that a graceful degradation of performance could be achieved in the event of incomplete or missing data from one or more of the sensors employed. Each module of the system comprised a sensor linked via some pre-processing to a transputer which performed local tracking. Further transputers provided a communication network to the global tracking part of the system which again was implemented using transputers. The global tracker employed the local tracker modules in a distributed Kalman filtering operation, to yield pedestrian and toy car trajectories. In a video shown to the audience the positional accuracy of the system was seen to improve as more modules were employed (graceful improvement!). Future work is to concentrate on developing network topologies to allow efficient communication between modules and global tracker.

Ivan Reading
Brian Stewart
Napier University

[The editor (and chair of the meeting) adds...]

To complete Ivan and Brian's report I should add something about the first two talks that they missed, by Ian Reid of Oxford University and Jim Ivins of Sheffield University.

Ian Reid's talk concerned tracking a moving object with a robot head/eye platform. The problem addressed was that of choosing a fixation point on the object within a cluster of tracked features, which will allow the camera to track the object *smoothly* using motion of the chosen fixation point as visual feedback to the head. Fixating on a single feature is unsuitable because individual features tend to disappear and reappear at irregular intervals, necessitating undesirably rapid switching between features. Using the centroid of the features also fails because features falling into and out of the image will cause the fixation point to drift uncontrollably over the object. The solution is to contruct a 3D affine frame within the object, which requires matching at least four non-coplanar points between each set of three consecutive images. A point chosen in the affine coordinate frame can thence be transferred to new images and defines a fixation point which does not drift

over the object and is not tied to any particular feature.

Jim Ivins presented work on tracking closed contours using "statistical" snakes, whose dynamics are not defined purely in terms of the contour itself, but in terms of the whole region surrounded by the snake. It is remarkable that despite this the snake can still be implemented by looking at local boundary changes. The "pressure" force pushing the snake is a function of statistics of the image data. For instance, to find a region with homogeneous grey-level, the snake expands from a "seed" region so long as the statistics of the region within the snake lie within similar limits to the seed region. Self-intersection of the snake is avoided by adding a "repulsion" force between different parts of the snake. Another example presented on video was segmentation of differently coloured regions.

BMVA Videotape

There are still a few copies of the BMVA videotape available for purchase. This in a compilation of current work in machine vision and pattern recognition, showing the state of the art in the field. The tape consists of short presentations on the topics listed below, each of which has a brief introduction to the background of the work before describing the techniques used and demonstrating results. This is ideal for exposing students to a variety of aspects of the discipline.

The tape includes items on:

- The use of affine stereo geometry to allow a robot to grasp objects.

- Model-based coding for low bit-rate image transmission.

- Real time image analysis of turbine blades, suspension bridge motion, and traffic.

- 3-D model matching using range data.

- Saccade and pursuit, acquiring and tracking an object of interest with a robot head.

- Compact representations for low bit-rate transmission of images of mouths.

- Pattern recognition for VLSI implementation.

- Autonomous guided vehicles.

- Face location to improve videophones.

The tape, which lasts 50 minutes, costs £8.50 + £1.00 postage and packing. Please send a cheque, payable to the "British Machine Vision Association", with your name and address to:

> *Tim Trew*
> *Philips Research Laboratories*
> *Cross Oak Lane*
> *Redhill RH1 5HA.*

BMVA Technical Activities

The following meetings are currently scheduled to take place later in 1994; they will be held at the Association's usual venue which is the British Institute of Radiology at 36 Portland Place, London.

- 19th Oct. 94 *Natural and Machine Vision.*

- 16th Nov. 94 *More of Adaway's Unsolved Problems.*

For further information about the BMVA meetings programme contact

> *Tim Ellis*
> *Centre for Information Engineering*
> *City University*
> *Northampton Square*
> *London EC1V OHB*
> *Email:* `t.j.ellis@uk.ac.city`