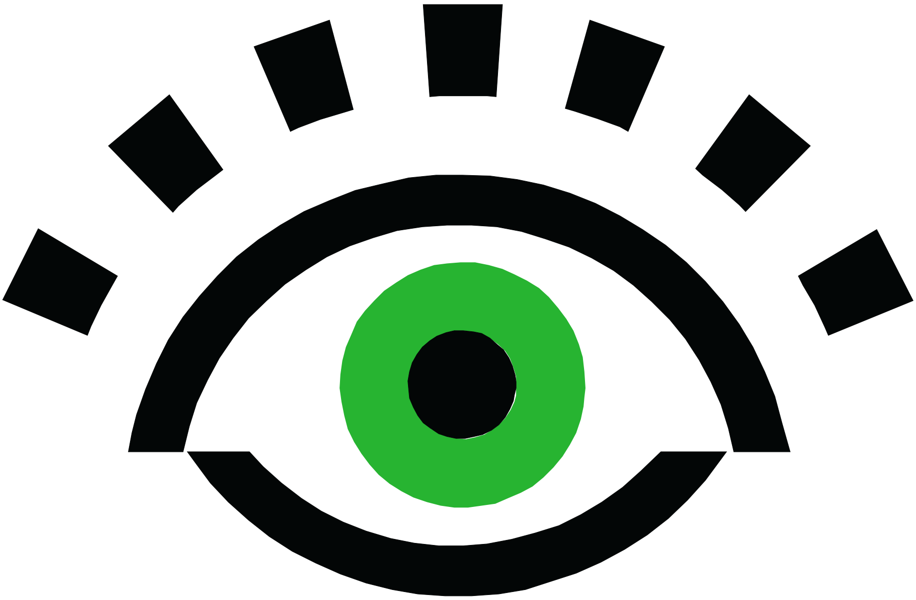
vision

Bulletin of the Applied Vision Association



GJB Travel award winner's report
Natural Images abstracts
References on Vision

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AIM OF THE AVA: TO PROMOTE AND ADVANCE THE APPLICATION OF RESEARCH WORK IN ALL AREAS RELATED TO VISION

Noticeboard

AVA on the Internet

The Applied Vision Association now has its own world wide web pages at: *http://www.dmu.ac.uk/ava/*
The pages contain details of who is on the committee, contact emails, latest details on forthcoming AVA meetings and links to other vision related pages. There are also archives of abstracts from previous AVA meetings.
There is also an AVA anonymous ftp site at: *ftp://ftp.psy.dmu.ac.uk*
This site contains:
· a hyperspectral data set of natural scenes produced by Gavin Brelstaff (see http://www.crs4.it/~gjb/ftpJOSA.html).
· David Foster's bootstrap program for estimating the accuracy of a statistical estimate derived from a set of experimental data (see http://www.op.umist.ac.uk/bootstrap.html).
If there is anything else you think this archive should contain then let us know.

AVA and OPO Subscriptions

Membership for 2001/2002 will be as follows: ordinary members £20, student members £10. It is now possible to pay by direct debit or credit card—see the renewal notices coming out in September.

Editorial

This issue of the Bulletin contains a very comprehensive report from ARVO by Julian Wallace who received a travel award from the AVA. Somewhat belatedly we publish the abstracts of last year's Natural Images Meeting. There are a number of AVA meetings coming up and we include details of these meetings. If you have any comments on the Bulletin of the AVA then do contact me: mscase@dmu.ac.uk

Deadline for copy for the next Bulletin – 5th November 2001

Geoffrey J. Burton Memorial Fund

The fund was established in 1986 with the aim of providing financial assistance to students (postgraduates studying for a higher degree or first-year postdoctoral junior scientists) based in the UK travelling to any conferences or meetings at which they will be presenting a paper or poster. Donations to the fund can be directed to the AVA secretariat and cheques etc. should be made payable to “The Geoffrey J. Burton Memorial Fund”.

The maximum award to any one individual is £400.

The AVA Committee has decided that from now on there will be a single award made once a year. The closing date for awards will be the last day in February each year and will be for conferences held from 1st March to the end of the following February (i.e. there will not be retrospective awards). Applicants do not have to be presenting at an AVA conference.

The next closing date for applications is:

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for conferences held between 1st March 2002 and 28th February 2003.

To apply for an award you need to complete an application form which is available from:

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The 2001 award has been given to Julian Wallace from Glasgow University. Julian presented at ARVO on “The efficiency of smooth pursuit for surface motions”.

Report of ARVO 2001 Annual Meeting, Fort Lauderdale, Florida, April 29-May 4.

Julian M. Wallace, University of Glasgow

A visit to Florida, the 'sunshine state', conjures up images of Palm trees, long sandy beaches, & beautiful people basking under the sun. Expectations of good weather are particularly high then if, like me, you are subjected to the wet and cold of the Scottish climate for most of the year. Greeted by a thunderstorm, my arrival in Florida was somewhat at odds with these expectations and unfortunately, this set the meteorogical tone for the ARVO 2001 annual meeting. Despite a few brief respites, the Floridian sun took refuge behind a grey blanket for most of the week while the strong winds contorted the Palm trees lining the coast (and the occasional passer-by) into shapes usually seen on news broadcasts of hurricane reports. It was a small comfort to find that the shuttle route to the convention centre happened to lie on the hurricane evacuation route! Evening dining offered refuge from the elements, at least until Thursday when a section of roof caved in under the weight of the water seeping through our chosen Mexican diner. The manager didn't seem so worried, though he spent the rest of the evening shuffling diners from table to table to escape ominous drips. In the absence of sunshine, the emphasis of the visit was firmly on the science, and despite the split of allegiances instigated by the new Vision Sciences meeting there was plenty science to explore.

The main purpose of my visit and the basis of my being awarded the GJB TraveI Award was to present my current research, *The efficiency of smooth pursuit for surface motion*. This work followed from research with Pascal Mamassian investigating the efficiency of motion perception, specifically speed discrimination of transparent and non-transparent motion. This 'quantum' or statistical efficiency measure was pioneered in vision by Horace Barlow (e.g. Barlow 1978), and has recently been applied to the study of stereoscopic depth (Harris & Parker, 1992) and coherent motion perception (Barlow & Tripathy, 1997). One advantage of the approach is that it allows us to assess the level of information actually used in performing a visual task, this is because human performance is compared to the 'ideal observer' that uses all the available information. In the current research we extended the approach from our psychophysical research to the oculomotor domain, in collaboration with Guillame Masson and Daniel Mestre (both of the CNRS Centre for Research in Cognitive Neuroscience in Marseille). There have been a few recent studies demonstrating that smooth pursuit (the eye movement initiated in response to visual motion) is indeed sensitive to surface motions (Niemann, Ilg & Hoffmann, 1994; Heinen & Watamaniuk, 1998). However, the pursuit dynamic alone does not tell us what visual information is actually being used to drive the response. To approach this issue we computed the efficiency of smooth pursuit for transparent motion. Briefly, our task demanded that observers attempt to track the faster surface of a transparent motion display (in which two surfaces move in opposite directions), a pursuit speed discrimination task. We determined whether the pursuit response was indeed tracking the faster motion or not, giving a binary response as we would get for a psychophysical speed discrimination task. Thus we could compute sensitivities in the normal way. We ran ideal observer simulations on the same task and computed an ideal sensitivity. Because the ideal observer uses all the information in the stimulus in the optimal way, the efficiency (squared ratio of human to ideal sensitivities) will reflect the amount if information human observers use. Our main findings were that the efficiency improved as the difference in speed between the surfaces increased, which indicated increased use of information in transparent displays with larger speed differences. This pattern followed our previous perceptual results (Wallace & Mamassian, ARVO 2000) and suggested that common mechanisms underlie both tasks. We speculate that this may reflect an ability to use information from increasingly different populations of speed tuned cells. We also found that there was no increase in efficiency over time (by comparing performance between two epochs, early and late, of the eye-movement). This additionally suggested that the system does not take advantage of all the available temporal information in the stimulus (unlike the ideal observer), but rather uses only a subset of the available temporal information. The study was well received by my poster visitors, with a few particularly interesting comments suggesting further considerations.

There were a few other presentations involving novel applications of ideal observers. **Jason Gold and colleagues** applied equivalent input noise techniques to investigate visual memory. This technique can be used to partition out of the contribution of internal noise to the efficiency measure. This internal noise free measure is termed ‘calculation’ efficiency (Pelli, 1990), in contrast to the model-free statistical efficiency measure. Gold et al. found a large drop in calculation efficiency between a 100ms and 2000ms ISI in a same/different discrimination task, but no change in internal noise. This indicates that the limiting factor to visual memory is that the signal strength decreases with time. However, it was questioned that a 100ms delay is perhaps too short to address visual memory, as this could result in apparent motion of the texture elements in the display which observers could use to make a response. Further data collected at intermediate ISIs (beyond the critical duration for apparent motion) should clear this up. **Steven Shimozaki and colleagues** applied the ideal observer approach to investigate attentional cueing effects. The paradigm involves a simple target detection task in which a cue indicates the target location before target presentation. The cueing effect refers to the longer reaction times for invalid cue trials compared to valid cue trials. It has been speculated that this effect reflects an attentional modulation of early perceptual processing. Shimozaki et al. described a Bayesian ideal observer for this task with a weighted likelihood based on the cue validity, a manipulation that gives a cueing effect. Then the pattern of performance can be compared between human and ideal, and if similar it could be suggested that the 'ideal' is a valid model of human performance. This is exactly what was found, and was used to argue against the early-selection account. But although this ideal observer approach does provide a competing framework for interpreting such attentional effects, the fact that an alternative model is consistent with the effect does not disprove the early-selection model. To tease apart these competing models would require a situation in which the models offered competing predictions, which could then be tested.

There was an interesting application of Transcranial Magnetic stimulation (TMS) from **Nestor Matthews and colleagues,** who argued for a double dissociation between speed and direction discrimination. TMS is a recently developed non-invasive technique can be used to manipulate cortical neural firing rates. An insulated coil is help over a region of the head and a large voltage is passed through this inducing magnetic current. When the coil is held over the head this magnetic current penetrates the skull and the cortex (but does not penetrate through to subcortical areas). For example, if the coil is held over motor cortex the induced voltage can result in involuntary movement of a single finger (Barker et al., 1985). Matthews and colleagues task was to discriminate the speed or direction of two random dot displays (presented in successive temporal intervals). TMS was applied at varying time intervals during the second stimulus presentation (the stimulus to be discriminated). Stimulation sites were described as lateral and medial regions (which would contain those areas V1 and MT, fundamental to motion processing). They claimed that TMS reduced perceived speed but did not affect perceived direction. The objective findings were a selective impairment for speed discrimination when TMS was applied medially. Combined with previous psychophysical evidence (Matthews & Qian, 1999) for a selective impairment of direction but not speed discrimination this argued for a double dissociation. This implies that velocity coding does not limit performance in speed or direction discrimination, but instead involves independent speed and direction mechanisms. Another interesting selective deficit was Stuart Anstis leg-injury (impairment for ARVO, but not VSS!). Anstis provided a recorded apology for being unable to deliver his presentation personally, though he did (unsuccessfully) attempt to give the presentation *in absentia*. Nonetheless, **Anstis and Rogers** demonstration of illusory motion (delivered by Brian Rogers) was quite impressive, at first. Spokes of a similar luminance to that of a grey-level color wheel are perceived as moving anticlockwise when the wheel is cycled clockwise. Unfortunately, there is in fact real motion in the stimulus and so the effect is not so surprising. A more lasting impression was **Jean-Michel Hupé & Nava Rubin's** demonstration that the perception of transparency is possible in a coherent plaid when viewed for an extended duration. In Hupe's demo the plaid moved in a cardinal (vertical) direction and indeed with time the coherent motion gave way to transparency. In fact, this effect was documented as long ago as 1935 by Hans Wallach. However, Hupe demonstrated that if the plaid moved in an oblique direction (which was achieved by simply asking the audience to tilt their respective heads) this effect occurred almost instantaneously. This difference is extremely striking. Hupe & Rubin have quantified this effect in the measurement of reaction time to perceive transparency for such plaids in cardinal and non-cardinal directions. They indeed found that oblique directions (of the pattern motion) caused a shorter reaction time than that to plaids in cardinal directions, but also in comparison to plaids with components of a threefold difference in speed! This is an intriguing effect, and the relevance if this 'cardinal bias' to modelling was emphasised. But what are the mechanisms underlying the switch from a non-transparent to a transparent percept over time? This switch suggests that temporal dynamics can be a significant aspect of motion segmentation and integration, and should be a feature of such models.

On the perception and action front, **David Burr & colleagues** had an interesting application of their finding of a compression of visual space during saccades (Ross, Morrone and Burr, 1997). A bar was presented during a horizontal saccade at various positions. Subjects indicated the position verbally or by pointing (on a touch-screen monitor). Verbal reports resulted in errors, which demonstrated the previously found compression of visual space. In contrast, pointing was accurate, but only without visual feedback. With visual feedback the compression errors were again evident. This result is consistent with Milner & Goodale's (1995) arguments for different pathways in perception and action. It has been speculated that the visual compression is an outcome of saccadic suppression of motion perception. In contradiction, **Eric Castet and colleagues** provided evidence that motion perception is possible during saccaddes. In a similar task a grating of variable duration was flashed during a horizontal saccade. If gratings are flashed before the saccade offset, motion against the saccade direction is perceived. However, if the grating is still present beyond the saccade offset it is perceived as static. They propose that this is due to backward masking and accounts for the fact that we do not usually perceive the world as moving when making saccades. If indeed motion perception of static images does occur during saccades, this gives an alternative interpretation of Burr et al's results. The perceived location of the static bar should no longer be veridical if subject to visual motion, and so we should expect that the reported location would be distorted in some way. It will be interesting to see how this dispute develops.

Further stimulating research came from **Paul Azzopardi & Alan Cowey** who questioned the Crick & Koch (1995) hypothesis with fMRI evidence that the frontal cortical regions are activated by guessing. In a similar fashion, **Steve Dakin & Pete Bex** attacked Usher & Donnelly's (1998) evidence for binding based on synchrony (with control for visible persistence and eye movements they find evidence for contour integration mechanisms rather than asynchrony *per se)*. **Edward Hubbard (**with **Vilayanur Ramachandran)** delivered an entertaining talk on syneasethesia which provided good evidence for a sensory basis to the disorder (and a tentative neurological explanation in terms of neural cross-wiring of number processing and color (V4) regions, which happen to lie adjacent to each other). There was of course far too much going on to do justice to in this report, I was bombarded with such a volume of new information! Although I found this battery of the senses stimulating, it was occasionally bewildering. This was particularly the case with **Seyranian & D'Zmura,** who claimed that we could learn to navigate in the "fourth dimension". The illuminating description of this dimension was that it is lies in the co-ordinates of 'nim' and 'bor'.

Although ARVO 2001 was a scientific success perhaps the bad turn of weather was a sign for vision scientists to move on, I hear the weather over at Vision Sciences was glorious.

I would like to thank the AVA for the GJB 2001 award, which facilitated this stimulating and enjoyable visit.

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Here is the abstract of Julian's ARVO presentation:

The efficiency of smooth pursuit for surface motion. J.M. Wallace[1], G.S. Masson[2], D.R. Mestre[2], P. Mamassian[1]. Psychology, University of Glasgow, Glasgow, Scotland[1], Centre de Recherche en Neurosciences Cognitives, CNRS, Marseille, France.[2].

Purpose: Previously we computed the statistical efficiency for perceptual speed discrimination of transparent motions in opposite directions (Wallace & Mamassian, ARVO 2000). Here we apply the ideal observer approach to smooth pursuit of similar motion stimuli to compute the efficiency of this oculomotor system. This method will permit direct comparisons of performance between perceptual and visuomotor discrimination tasks. **Methods:** We back-projected random-dot kinematograms (12x12deg) of two simultaneous, correlated dot motions in opposite (horizontal) directions. These stimuli were perceived as two transparent surfaces. In a method of constant stimuli we varied the difference in speeds of the opposite motions (speed ratios: 1-4, standard speed: 4deg/s; stimulus duration 450ms). Performance was limited by the addition of uncorrelated noise dots (10 values: 1-99%) to the stimuli. Observers (2 authors & 1 naive) were instructed to track the faster surface. Responses were recorded with the scleral search coil technique. We analysed the pursuit responses within early [110-170ms] and late [290-350ms] time windows. We established the direction of the response in each time window by a velocity criterion. From this we obtained 'oculometric' functions, the equivalent of a psychometric function for the oculomotor system, from which we extract a threshold. **Results:** Thresholds were higher within the early time window than within the late time window. Efficiencies improved as the difference in speeds increased between the transparent motions, for both time windows. **Conclusions:** When presented with large transparent surface motions observers are able to selectively track one such motion. Our method unveils the slow build-up dynamics of this mechanism, in which accuracy improves over time. We discuss the implications of the efficiency measure for the mechanisms underlying perceptual and oculomotor processing.
CR: None
Support: EPSRC

Natural Images III - Bristol, 15 Sept 2000
Abstracts

Colour constancy and the natural image

Anya Hurlbert, University of Newcastle upon Tyne

Colour constancy is a fundamental mechanism that compensates for spectral and spatial changes in the illumination and thereby keeps object colours constant - more or less perfectly. Recent experimental tests of colour constancy suggest that it might be more perfect in the natural world than in artificial images. But much of what we understand about the operation of colour constancy has been gleaned from artificial images made from collections of flat, matte surfaces, each with uniform colour and brightness - so-called “Mondrians.” Natural images look very different from Mondrians, and contain features such as specular highlights, mutual reflections, transparency, and shadows, as well as matte surfaces with intrinsic non-uniformities of colour and brightness. Some models of colour constancy exploit these features to improve performance; others fail in their presence. I will briefly describe these different models and compare them with experimental tests of colour constancy in artificial and natural images.

Measurement of illumination in natural scenes

Daniel Osorio, School of Biological Sciences, University of Sussex Brighton. BN1 9QG.

Variation in illumination intensity and spectral composition affects the evolution, design and performance of visual mechanisms, especially where recovery of surface properties (e.g. object colour) is required. Measurement of spatio-temporal variation in illumination requires a short exposure time, rendering some hyperspectral imaging methods unworkable. Instead we have found that for forest lights measurements in the 400nm to 700nm range can be made using a conventional 8-bit digital video (DV) camera. First we characterised 238 forest illuminant spectra by PCA. The first two components explain 97 % of the total variance. Compared to illumination under open skies described by Judd, the loci of forest illuminants are displaced toward to the green region in chromaticity plots, and unlike open sky illumination cannot be approximated directly by correlated colour temperature. Illuminant spectra from DV images are accurately recover, by a linear least-squares-fit estimation technique. Application of DV data to spectral analysis can greatly facilitate studies of the spatial and temporal variation of illumination in natural scenes, and more generally to measurement of reflectance spectra and the understanding of colour vision in natural environments.

Chiao CC, Osorio D , Vorobyev M , Cronin TW (2000) Characterization of natural illuminants in forests and the use of digital video data to reconstruct illuminant spectra. J. Opt. Soc. Am. A. in press

Perception of Ultraviolet by Birds

Emma Smith and Verity Greenwood, School of Biological Sciences, Bristol University, Woodland Road, Bristol. BS8 1UG.

Bird vision is significantly different from that of humans. Humans have three classes of single cone receptor, whereas birds have at least four. Poultry have long, medium and short wavelength cones plus a violet sensitive cone that has some sensitivity to ultraviolet wavelengths. Songbirds also have long, medium and short wavelength cones plus a cone that is maximally sensitive to ultraviolet. Previous research suggests that songbirds, birds of prey and poultry can detect ultraviolet. Few studies have investigated whether the violet/ultraviolet cone is used purely for luminance detection, or whether the birds can see ultraviolet as a separate hue. Hue is the sensation we typically think of as ‘colour’, for example the sensation of blueness or redness of a stimulus. We are currently using psychophysical techniques based around associative learning with poultry (Japanese quail) and songbirds (starlings) to see if they perceive ultraviolet, and if so, whether they can perceive it as a hue. So far we have established that both quail and starlings can detect ultraviolet, and it appears that starlings see ultraviolet as a separate hue. We are currently testing the quail to see if possession of a violet cone receptor enables ultraviolet hue perception.

Can image statistics explain the distribution of retinal receptor cells?

David Young, University of Sussex

Human cone cells have a spatial distribution on the retina such that their density, as a function of eccentricity, is closely approximated by a power law. The factors that have determined this distribution presumably include the capabilities of the eye movement system, the information transmission properties of the retina and optic nerve, the nature of the visual information needed for survival, and the statistical structure of retinal images. I argue that the last of these might provide the key to understanding retinal layout, since the cone density function is what would be expected if scale-free statistics determine the optimal distribution. This suggests that it might be possible to find a general theory of spatially-variant image sampling which would depend more on the statistical structure of the input than on the details of subsequent processing strategies or the tasks to be performed. Such a theory would be applicable to active computer vision systems, once the technology allows a more flexible approach to the design of the sensor arrays used in cameras. This talk discusses the question of whether it might be possible to link retinal design to image statistics, and the central difficulty of how to incorporate the temporal dimension, which is needed to take account of eye or camera movements, into such a theory.

Can a linear model explain a simple cell's responses to natural images?

David Tolhurst, University of Cambridge

A first approximation model of V1 simple cells is that they show linear spatio-temporal summation. However, even with simplistic “laboratory” stimuli, it can be shown that there are nonlinearities in simple-cell behaviour. We are interested in how simple cells respond to natural scenes, and we have used digitised monochrome photographs of natural scenes as stimuli for studying ferret visual cortex. We are interested in whether nonlinear behaviour, such as proposed “contextual influences” from outside the “classical receptive field” may play some special role in the coding of information in natural scenes. Might these nonlinear processes make simple-cell responses sparser, perhaps? However, our first analyses of the responses of ferret simple cells seem to suggest that a linear model of spatial summation will explain most of a simple cell’s responses.

Natural Image Statistics and Human Vision

Tom Troscianko[1], David Tolhurst[2], Alej Parraga[1], Mazviita Chirimuuta[1], Iain Gilchrist[1]
1: Dept Eperimental Psychology, University of Bristol, 2: Physiological Laboratory, University of Cambridge

It seems clear that human vision is adapted to the scenes that we look at; but how can we show this experimentally? In particular, what is the information to which we are optimised? We begin by considering the second-order (Fourier) statistics of natural scenes, in which amplitude falls off inversely with spatial frequency. The slope of this fall-off (known as the spectral slope) can be manipulated to render the images progressively less natural. We measure discrimination thresholds for subtly morphed objects. The results suggest that performance is indeed optimal when spectral slopes are normal. A model of local contrast discrimination predicts the thresholds well, suggesting that performance is mediated by units early in the visual pathway.

However, second-order statistics do not explain some other characteristics of natural images, particularly their perceived contrast. By performing contrast-matching experiments, we show that perceived contrast is mediated, at least in part, by higher-order statistics. These statistics may determine the ability of the visual system to segment the scene into regions of illumination. Finally, it may be important to consider the task for which aspects of vision may have evolved. For the red-green colour opponent system, there is good evidence that the system is optimised for detecting fruit amongst foliage. By analysing the Fourier properties of such scenes in luminance and colour space, we suggest that the contrast sensitivity functions as measured psychophysically are particularly efficient at detecting exactly such scenes.

The sources of contrast masking in natural images

J. S. Lauritzen & D. J. Tolhurst Dept of Physiology, University of Cambridge, Downing Street, CB2 3EG Cambridge

Contrast masking, the elevation in detection threshold for a test stimulus in the presence of another stimulus over the threshold for the test stimulus alone, is well documented for simple masking stimuli like sine-wave gratings. However, masking by compound stimuli such as plaids is more difficult to interpret, and truly complex stimuli like natural images have so far eluded attempts to quantify their masking properties.

We studied masking by natural images psychophysically by embedding a Gabor patch test stimulus into a set of natural images. The natural images were filtered both in the frequency and space domains to restrict the overlap with the structure of the test Gabor.

Each scene was filtered using band-pass and notch filters of two different bandwidths for the same spatial frequency and orientation as the test stimulus, as well as filters that selectively only affected either orientation or spatial frequency. In the space domain images were multiplied by Gaussians of the same size as the test Gabor to create image patches and images with the area missing in which the Gabor is displayed.

We found that a significant proportion of the masking in natural scenes is contributed by components outside the frequency and orientation bands of the test stimulus, though there seems to be no clear indication of a dominance of orientation or frequency. In the space domain, regions beyond the extent of the test stimulus contributed significantly to masking.

Identifying the orientation of 3D shapes from 2D views

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The purpose of the research was to test observers’ understanding of the relationships of 2D views to 3D shape. The task investigated was “object understanding” rather than “object recognition”. In the training phase, a location on the surface of a simple 3D object was marked with a red strip, and observers had memorise its position. In the test phase, 2D views of the object were presented in a tachistoscope, and with the red strip removed, the task was to indicate whether the memorised location was visible or invisible. The difficulty lay in the discrimination of the (left) side view of the object from its mirror-image (right) side view. A strong effect of “upright” versus “inverted” views was found on reaction times and errors, likewise for "front" and "back" views. Thus, although observers could turn the object freely during training they consistently imposed a standard orientation. Most observers exploited end views (where both the target side and its opposite were occluded). Block and cylinder variants of the same shape gave differing patterns of response RT reflecting the different aspect graphs of block and cylinder objects. Classic mental rotation effects were not obtained. It is concluded (a) observers can discriminate views of an object in terms of which surfaces are visible (b) this is based on representations of prototypical views (c) error rates and reaction times (as a function of view) show consistencies which are determined by object shape.

4D Swathing to Automatically Inject Character into Animations
Neill Campbell, Colin Dalton and Henk Muller, Department of Computer Science, University of Bristol

Animation packages are good at making physically realistic animations. However, they lack the ability to automatically inject cartoon-style effects such as extreme deformations of limbs. We present a technique for automatically introducing deformations into the animation of rigid objects. We animate models, including that of a stick-man, so that the model deforms flexibly, adding character. It is arguable that the deformed model, though not physically realistic, appears more natural than the original.

Forthcoming AVA meetings:

AVA/Colour Group Postgraduate Meeting
University of Newcastle
2 November 2001

Invited speaker: Professor Roger Watt

Registration for the meeting will be free. This will be a half-day meeting starting at approximately 13:30.

Overnight accommodation will be available at approximately £30. There will be a £100 prize for the best presentation.

The meeting is open for all (staff and postgraduates) to attend but the presentations will be given by postgraduates.

For more information contact:
Dr Andrew Welchman
A.E.Welchman@ncl.ac.uk

AVA Christmas Meeting
Aston University
17 December 2001 (provisional date)

For more details contact:
Dr Tim Meese
t.s.meese@aston.ac.uk

AVA books for sale

The AVA still has a number of new books for sale from conferences that it has organised over the years.

Payment can be by credit cards ***(yes we can now accept them!)*** cheque or postal order in UK pounds to "Applied Vision Association". Send your payment with the order to:

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Applied Vision Association,
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Books available:

The cost for each book is £15 (including postage in the UK) for AVA members or £20 for non-AVA members. If you are outside the UK then add £5 per book to each of the prices above.

Gale, A.S., Astley, S.M., Dance, D.R. and Cairns, A.Y. (1994) **Digital Mammography**. Elsevier (424 pages).

Gale, A.S., Brown, I.D., Haslegrave, C.M., Kruysse, H.W. and Taylor, S.P. (1993) **Vision in Vehicles IV**. North Holland (355 pages).

Brogan, D., Gale, A. and Carr, K. (1993) **Visual Search 2**. Taylor and Francis (477 pages).

The cost of the Dalton conference book is £43 (including postage in the UK) for AVA members or £48 for non-AVA members. If you are outside the UK then add £5 per book.

Dickinson, C., Murray, I. and Carden, D. (1996) **John Dalton's Colour Vision Legacy**. Taylor and Francis (784 pages).

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References supplied (as usual!) by:

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Meetings Calendar

2001

August 26-30	ECVP, Kusadasi, Turkey http://www.ecvp.org
September 7-11	24th Pupil Colloquium, USA Contact: P.A.Howarth@lboro.ac.uk http://www.mailbase.ac.uk/lists-p-t/pupil/files/
November 2	AVA/Colour Group Postgrad Meeting, Newcastle Contact: A.E.Welchman@ncl.ac.uk
December 17 (provisional)	AVA Christmas Meeting, Aston University Contact: t.s.meese@aston.ac.uk

2002

March 20	AVA Annual Meeting and AGM College of Optometrists London
May 5-10	ARVO, Ft Lauderdale, FL. http://www.arvo.org
August 25-29	ECVP, Glasgow, Scotland http://www.ecvp.org
September 11-12	Optical Performance of the Eye, UMIST http://www.umist.ac.uk/optometry/conference.htm