Scottish Vision Group Meeting 2002

Timetable

Tuesday 30th July

5.30 A sixteenth century stereoscope unearthed in St Andrews? Nick Wade

7.00 Dinner

Wednesday 31st July

10.00 Change blindness from a psychophysical perspective, Harry Orbach
10.25 The moon illusion in drawings: illusion and reality, Helen Ross
10.50 Why is attention limited? Implications from neural coding, Mike Oram

11.15-11.45 Refreshments

11.45 Discriminating direction of motion in depth, Martin Lages & Erich Graf
12.10 The contribution of eye movement to the detection of motion-in-depth, Andrew Welchman & Julie Harris
12.35 Vertical disparity pooling across spatially segregated surfaces Lisa O'Kane & Paul Hibbard

1pm lunch

3.30 Applications of computer vision in face animation, Bernard Tiddeman
3.55 Correlates of symmetry and male facial attractiveness, Ben Jones
4.20 Narcissism and judgements of facial attractiveness, Tony Little

4.45 Refreshments
5.15 A reduced field of view does not cause objects to be seen as closer, Andrea Loftus, Isla McKenna, Susannah Murphy & Mark Mon-Williams
6.00 Mark Mon-Williams, Title to be confirmed

7.00 Dinner

Thursday 1st August

10.00 Integration and segmentation in motion perception, Paul Hibbard
10.25 Modelling interactions between chromatic and achromatic stereopsis mechanisms,
David Simmons & Frederick Kingdom
10.50 Centre-surround contrast interactions of textures are tuned to image statistics, Scott McDonald & Yoav Tadmor.
11.15 Measuring sensitivity to spatial orientation in scene recognition using an ideal observer, Maxine McCotter & Philippe Schyns

Abstracts

A sixteenth century stereoscope unearthed in St Andrews?

Nick Wade
Department of Psychology, University of Dundee, Dundee DD1 4HN
n.j.wade@dundee.ac.uk

In February 1860, James Forbes, the newly appointed Principal of St. Andrews University, received a letter from a young medical student, Alexander Crum Brown. Brown described two sketches he had seen in the Musée Wicar, Lille; they were by Jacopo Chimenti (ca. 1551-1640), an artist from Empoli, and depicted a young man holding a compass and a plumb line. When Crum Brown combined them by overconvergence he observed stereoscopic depth. Brown's informal observation was conveyed to David Brewster, who suggested that the drawings were produced for a stereoscope, possibly made by Giovanni Battista della Porta (1535-1615). There followed a bitter debate about the supposed stereoscopic effects that could be seen when the pictures combined. Brewster's claims were finally dispelled when precise measurements were made of the drawings: some parts were stereoscopic and others were pseudoscopic. Brewster's attempts to wrest the invention of the stereoscope from Wheatstone were unsuccessful.

The Psychophysics of Change Blindness

Harry Orbach
Department of Vision Sciences, Glasgow Caledonian University, Glasgow G4 0BA
h.orbach@gcal.ac.uk

Change blindness, a striking inability to detect changes which occur during interruptions to visual input, has typically been studied using complex naturalistic scenes. Our laboratory has studied this phenomenon quantitatively, using simple abstract patterns. Our results call into question common explanations based on abstract visual representations, spatial attention and memory. If time permits, a signal detection theory analysis of physiological evidence for implicit change detection during change blindness will be presented.

The Moon Illusion in Perspective Drawings

Helen E. Ross, William H. Robertson, Robin N.Campbell
Department of Psychology, University of Stirling, FK9 4LA
h.e.ross@stir.ac.uk

The moon illusion is the apparent enlargement of the low moon or sun compared to higher in the sky. This illusion appears in works of art, which often contain abnormally large celestial bodies even at high elevations. Most pictures are fanciful, or follow conventions other than linear perspective. If perspective is broadly maintained, pictures can provide a measure of the illusion. Examples will be shown of known scenes, where the artist's representation is compared with a photograph. The sketch by Gillies of the village of Temple shows the February sun at an elevation of 18 deg, and enlarged by a factor of two compared to the midground - the same enlargement as other background objects. The painting by Eardley of 'Catterline in Winter' shows the afternoon sun enlarged by a factor of 2-3 compared to background objects. These estimates are within the range of other experimental measures of the illusion. Drawings of moons added by children to photocopies of a real scene showed a large illusion in young children, reducing to the adult level by about age 9 years. Ross, H.E. & Plug, C.(2002) The mystery of the moon illusion: Exploring size perception. Oxford:OUP.

Why is attention limited? Implications from neural coding

Mike Oram
School of Psychology, University of St Andrews, St Andrews, KY16 9JU
mwo@st-andrews.ac.uk

Neurophysiological recordings from visual system suggest that the evidence for a role for precisely timed spikes relative to other spike times (~1-10ms resolution) is inconclusive, including when visual stimuli are attended or not. This suggests that the visual system does not carry a signal that identifies whether the responses were elicited when the stimulus was attended or not. Simulations show that the absence of such a signal reduces but does not eliminate the increased discrimination between stimuli that are attended compared to when the stimuli are unattended. The increased accuracy asymptotes with increased gain-control, however, suggesting limited benefit from increasing attention. Paradoxically, the absence of a signal identifying the attentional state under which stimuli were viewed can produce the greatest discrimination between attended and unattended stimuli. Furthermore, the greatest reduction in discrimination errors occurs for a limited range of gain-control. These coding issues suggest attention maximises the discrimination of attended from unattended stimuli that is "target detection" and that as such, the effects of attention should be limited.

Discriminating direction of motion in depth

Martin Lages & Erich Graf
Department of Psychology, University of Glasgow, Glasgow, G12 8QB
m.lages@psy.gla.ac.uk

A variant of the Pulfrich illusion was used to investigate first and second-order motion in depth. Independent control over spatial and temporal frequency revealed different spatiotemporal tuning for the two stimulus types. Stimuli were presented to the left and right eye on a calibrated CRT display with a refresh rate of 120 Hz in a split-screen Wheatstone configuration. Stimuli were luminance- or contrast-modulated sine-wave gratings moving behind a Gaussian envelope. On each trial subjects verged on a fixation cross flanked by nonius lines as the gratings oscillated sinusoidally for 2 s. After each presentation subjects had to indicate whether direction of motion in depth was clockwise or counterclockwise when viewed from above. Interocular phase differences between left an right gratings were randomised over trials to determine a discrimination threshold. Phase thresholds for the discrimination of luminance-defined motion in depth showed band-pass temporal frequency tuning whereas thresholds for contrast-defined motion in depth were elevated and showed broad-band tuning. These characteristics suggest that second-order motion in depth is due to pooling of residual first-order activation.

The contribution of eye movement to the detection of motion-in-depth.

Andrew E. Welchman & Julie M.Harris
Department of Psychology, University of Newcastle-upon-Tyne, Newcastle, NE1
7RUA.E.Welchman@ncl.ac.uk

Extra-retinal information about eye position is theoretically highly useful for scaling disparities and interpreting 3D motions. Yet, the oft-cited paper by Regan et al. (1986, IOVS 27, 584) suggests that changes in ocular convergence alone are not an adequate stimulus for perceiving motion-in-depth. We consider this further by investigating the role that eye movements play in detecting motion towards or away from an observer. Motion detection was examined under a 2IFC, constant stimuli protocol for conditions with or without tracking eye movements. Observers detected small displacements in depth (dmin) under three conditions: absolute motion (no reference marks visible); relative motion - fixation (observers fixate a cross); relative motion - tracking (observers track the moving dot). Speed of motion was varied from 0.25-2 arcmin/s to

alter the rate of change of vergence demand. Detection thresholds for absolute motion were higher than for relative motion, although differences were attenuated at higher speeds. 'Relative motion - tracking' thresholds were higher than in fixation conditions. Observers are able to detect motion defined only by changes of absolute disparity. However, the addition of eye movements to relative motion has a detrimental influence on detection performance. This is surprising because the retinal motions in each 'relative motion' condition should be identical.

Vertical disparity pooling of spatially segregated surfaces.
Lisa O'Kane and Paul B Hibbard
School of Psychology, University of St Andrews, St Andrews, KY16 9JU
pbh2@st-andrews.ac.uk

Vertical disparities are observed to contribute to scaling of size and distance only when the field of view is sufficiently large, suggesting their use for small images is limited (Bradshaw et al (1995) Vision Research, 36,9,1255-1264). This could be addressed if vertical disparity information could be pooled over wide three-dimensional space (Adams et al (1996) Perception, 25, 165-176). We investigated whether vertical disparities could be pooled across surfaces, separated both in depth and within the image, in the perception of object shape and size. Observers adjusted the size and shape of a virtual, binocularly defined ellipsoid to match those of a real, hand-held tennis ball. The virtual ball was presented at 4 different distances (30,40,50 and 60cm) in four conditions. (i) alone. (ii) surrounded by a frontoparallel frame of reference dots, at a distance of 46cm; (iii) manipulated vertical disparities in the frame simulated a distance of 66cm. (iv) manipulated vertical disparities in the frame simulated a distance of 26cm. In all conditions, both perceived size and depth decreased with increasing distance. Settings were not influenced by the addition of a reference frame, providing vertical disparities over a large field of view. However, manipulation of the vertical disparities in the surround to simulate a closer viewing distance influenced the perceived shape (but not size) of the ball, consistent with the use of a smaller estimate of distance to scale disparities. Vertical disparity pooling thus allows for the scaling of the shape of objects subtending small retinal images, even when those objects are clearly segregated both in the image plane and in depth.

Applications of computer vision in face animation
Bernard Tiddeman
School of Computer Science, University of St Andrews, St Andrews, KY16 9SS
bpt@dcs.st-andrews.ac.uk

The study of facial perception has made use of computer vision and computer graphics to assist with the construction of experimental face stimuli. These techniques include methods for prototyping and transforming facial images along dimensions such as age, sex or race. In this talk a review of the existing methods is presented, along with recent developments for improved skin texture prototyping and transformation and extension of the transformation techniques to moving images.

Correlates of symmetry and male facial attractiveness
Ben Jones
School of Psychology, University of St Andrews, St Andrews, KY16 9JU

Narcissism and judgements of facial attractiveness
Tony Little
School of Psychology, University of St Andrews, St Andrews, KY16 9JU

A reduced field of view does not cause objects to be seen as closer

Andrea Loftus , Isla McKenna, Susannah Murphy & Mark Mon-Williams
School of Psychology, University of St Andrews, St Andrews, KY16 9JU
aml1@st-andrews.ac.uk

Watt et al (2000) suggested that reduced field of views (fov) cause objects to appear closer than their physical distance. Watt et al's suggestion is based on observing that individuals terminated prehension prematurely when pretending to grasp a paper rectangle (lights extinguished when movement commenced). We tested Watt et al's suggestion in an open-loop pointing task. Participants (n=20) pointed at targets in three locations (20cm, 30cm and 40cm) in three viewing conditions (full, 16^{o} and 4^{o} fov). Participants were accurate in the pointing task but we found no difference in mean response between conditions. We found that the smaller fov caused increased response variability. In experiment two, we asked participants to reach-and-grasp a real object under the same three conditions. The reduced fov caused no changes in grasp but we observed alterations in the transport component. The velocity profile showed a rightward skew with reduced peak velocity and increased movement time. These changes are consistent with increased variability in the perceptual estimate of target location. Notably there were no changes in the spatial path (expected if the participants had programmed a movement to a closer location). In experiment three, we repeated Watt et al's design but removed vision and forced participants to rely on a memory representation. In the 'memory' condition we found the same undershoots as described by Watt et al. We conclude that reduced fov does not cause objects to be seen as closer and suggest that Watt et al's findings are an artefact of their experimental design.

Integration and segmentation in motion perception

Paul B. Hibbard
School of Psychology, University of St Andrews, St Andrews, KY16 9JU
pbh2@st-andrews.ac.uk

When confronted with an image containing more than one direction of motion, the visual system must decide whether these different directions should be integrated (as in the perception of global motion coherence) or segmented (as in the perception of motion transparency). Treue et al (2000, Nature Neuroscience, 3, 270-276) suggested that the perception of transparency was determined by the width of the population response profile of directionally selective neurons in MT. Here, it is shown that transparent and non-transparent stimuli may be discriminated despite being matched for the width of their population response in Treue et al's model. As an alternative explanation, it is proposed that limitations on the perception of transparency may arise from the interpretation as well as the encoding of motion. This idea is supported by the fact that additional segmentation cues (here, contrast polarity) facilitate the perception of motion transparency, but not global motion coherence.

Modelling interactions between chromatic and achromatic stereopsis mechanisms.

David R. Simmons and Frederick .A.A. Kingdom
Department of Psychology, University of Glasgow, Glasgow, G12 8QB
d.r.simmons@psy.gla.ac.uk

Despite a number of demonstrations to the contrary, there is still debate over the existence of a chromatic-contrast-sensitive stereopsis mechanism. Whilst recent studies have focused on the presence or absence of luminance artifacts at nominal isoluminance (e.g. Champion & Simmons, ECVP 2001) there is still the question of whether or not such a mechanism is necessary in order to adequately explain performance away from isoluminance. Simmons & Kingdom (2002) presented stereoacuity data obtained with 0.5 cpd Gabor stimuli which possessed different relative amounts of (red-green) chromatic and luminance contrast. These stimulus components

could be correlated or anticorrelated between the eyes. We have since found that an adequate explanation of these data requires the evocation of three independent stereopsis mechanisms: first-order luminance, first-order chromatic and second-order luminance. These mechanisms interact via probability summation of depth sign information before the extraction of stereoscopic depth. The formalism developed to model these data, based as it is on a four-parameter fit to contrast dependence data obtained with each component contrast separately, has interesting implications for modelling other aspects of the contrast dependence of stereoscopic judgements with complex stimuli.

Centre-surround contrast interactions of textures are tuned to image statistics

Scott McDonald & Yoav Tadmor.
Department of Psychology, University of Newcastle-upon-Tyne, Newcastle, NE1 7RU
j.s.mcdonald@ncl.ac.uk

The perceived contrast of a small random dot patch is known to depend on the physical contrast of a surrounding random dot pattern. Unlike random dot patterns, whose spectra are flat, natural images have a characteristic second-order statistics; their amplitude spectra fall off with spatial frequency (f) roughly as 1/f. Here, we synthesised 1/f texture-probes and inserted them into natural images in order to determine whether their perceived contrast is affected by the statistics of the surrounding images.
Probes (1x1 deg.) were centred on natural images (4x4 deg.) whose statistics we have manipulated systematically. At each image-statistics, the contrast of a surrounding natural image was modulated sinusoidally in time (0-100% contrast, 0.5 Hz). Subjects had to adjust the contrast modulation of the probe in order to null the induced changes in its perceived contrast.
We have found that the perceived contrast of a probe is strongly affected by the particular statistics of the surrounding natural image. Suppression is maximal around the characteristic second-order statistics of natural images. This result supports the suggestion that neurones in our visual system are "tuned" to the statistical structure of the real world.

Measuring sensitivity to spatial orientation in scene recognition using an ideal observer.

Maxine McCotter & Philippe Schyns
Department of Psychology, University of Glasgow, Glasgow, G12 8QB
maxine@psy.gla.ac.uk

Scene categories have a typical spatial organisation of their major components, which provides sufficient information for fast recognition. The present study investigated the structure of this visual information using the energy spectrum of the image, which provides the dominant structural patterns in the scene. We examined the role of spatial scale and orientation in scene structure using a technique which randomised the phase angle of image pixels. An ideal observer (template matching) simulation was implemented to estimate the spatial scale and orientation information available for scene categorisation. Images were assigned to 4 super-ordinate (e.g., indoor, outdoor) and 8 basic level categories (e.g., bedroom, forest) across 57,000 trials. The density of phase-noise pixels was adjusted according to performance accuracy. Computational analysis produced diagnostic energy spectrums for each category. Scene categories were biased towards vertical and horizontal orientations at coarse and fine spatial scales.