CENTRE FOR VISION RESEARCH

York University, North York, Ontario M3J 1P3

Annual Report

July, 1994 to June, 1995

Faculty

John Amanatides	Assistant Professor of Computer Science. Research Associate, Human Performance in Space Laboratory. Interests: computer graphics.
Otmar Bock	Adjunct Professor of Psychology. Senior Scientist and Project Leader, Human Performance in Space Laboratory. Interests: visuo-motor coordination in healthy humans, neurological patients, and astronauts in weightlessness; robotics and artificial neural networks.
Doug Crawford	Assistant Professor of Psychology and Biology. Interests: three-dimensional eye and head movements, visuomotor neurophysiology.
Keith Grasse	Associate Professor of Psychology and Biology. Project Leader, Human Performance in Space Laboratory. Interests: neurophysiology of the visual system, eye movements, auditory neurophysiology, neuropharmacology.
Marc Green	Adjunct Associate Professor. Interests: visual psychophysics and computer vision.
Laurence Harris	Associate Professor of Psychology. Project Leader, Human Performance in Space Laboratory. Interests: electrophysiology of the vestibular and oculomotor systems.
Ian Howard	Distinguished Research Professor of Psychology and Biology. Director of the Centre for Vision Research. Co-Director of the Human Performance in Space Laboratory. Interests: space perception, eye movements, visual-vestibular interactions.
Michael Jenkin	Associate Professor of Computer Science. Research Associate in the Human Performance in Space Laboratory. Interests: computer vision, robotics and image understanding.
Peter K. Kaiser	Professor Emeritus of Psychology and Biology. Interests: colour vision, sensory processes, physiological optics, human factors.
Evangelos E. Milios	Associate Professor of Computer Science. Interests: computer vision, robotic hand-eye coordination, mobile robot navigation.
Hiroshi Ono	Professor of Psychology. Project Leader, Human Performance in Space Laboratory. Interests: visual perception of direction and distance; eye movements.

Jonathan Ostroff	Associate Professor of Computer Science. Research Associate, Human Performance in Space Laboratory. Interests: real-time systems, control systems.

Faculty cont'd.

David Regan	CAE/NSERC Industrial Research Professor. Distinguished Research Professor of Psychology and Biology, York University. Professor of Ophthalmology and Medicine at the University of Toronto. Co-Director, Human Performance in Space Laboratory. Killam Fellow. Interests: psychophysics of spatial vision, motion, stereopsis, colour vision; vision aviation; visually evoked magnetic and electrical brain activity; visual disorders; auditory psychophysics.
Josée Rivest	Assistant Professor of Psychology, Glendon College, York University. Interests: multiple attributes in localization of contours and perceptual learning.
Minas Spetsakis	Assistant Professor of Computer Science. Research Associate, Human Performance in Space Laboratory. Interests: computer vision and robotics.
Paul Stager	Professor of Psychology. Research Associate, Human Performance in Space Laboratory. Interests: Human factors in aerospace performance and system design.
Martin Steinbach	Professor of Psychology and Biology. Associate Director, The Eye Research Institute of Canada Adjunct Professor of Ophthalmology, University of Toronto. Senior Scientist, Dept. of Ophthalmology, Hospital for Sick Children. Director of Research, Department of Ophthalmology, University of Toronto. Interests: eye movements; visual-motor coordination; clinical disorders of the oculomotor system.

Research Grants (Annual)

Amanatides

NSERC Research Grant. Ray tracing and sampling. 22,000

NSERC Equip Grant with Jenkin, Milios and Spetsakis. High-performance graphics equipment 16,412

Bock

NSERC Operating Grant. Control principles of aimed arm movements in humans 13,000

DCIEM Contract. Purposive arm movements during G_Z centrifuge stimulation 33,000

DCIEM Contract with D'Eleuterio. New control concept for robotic manipulators 110,000

Canadian Space Agency Contract. Eye-hand coordination in microgravity 104,000

Crawford

Start up equipment fund from Faculty of Arts 42,000

For construction of laboratory in BSB Vivarium 18,000

York Faculty of Arts Research Grant 3,500

President's NSERC Fund 2,000

York Ad Hoc Travel Grant 800

Grasse

NSERC Operating Grant. 28,000

NSERC Equipment Grant 20,000

Harris

NSERC Operating Grant. The detection of conflict in visual-vestibular interactions 28,000

President's NSERC Fund. York University 2,700

PRECARN feasibility study with M. Jenkin, Aastra Aerospace and ISTS 35,000

NSERC Industrial Fellowship with M. Jenkin and Aastra Aerospace 52,000

Howard

NSERC Operating Grant. Visual pursuit and induced visual motion. 39,000

DCIEM Contract. 50,000

Ontario Centre of Excellence Grant with Grasse, Harris, Jenkin, Ono & Regan, HP Lab 439,000

Jenkin

NSERC Operating Grant. Active Stereo 22,000

NSERC Equipment Grant. A next generation stereo head with E. Milios and J. Tsotsos 26,600

Kaiser

NSERC Operating Grant. Studies in colour vision 29,000

Milios

NSERC Operating Grant 17,000

DSS contract. Numeric and Symbolic Processing for Sonar Info. Management with M. Jenkin 15,000

PRECARN Project with M. Jenkin 80,000

Ono

NSERC Operating Grant. Sensory and motor aspects of space perception 30,500

NATO Travel Grant with Wade and Swanston. Motion and orientation in spatial vision 7,803

Sabbatical Leave Fellowship 7,000

Ostroff

NSERC Operating Grant 20,000

Regan

NSERC/CAE Industrial Chair 125,586

NSERC Operating Grant 72,000

AFOSR Grant 239,533

Rivest

NSERC Operating Grant. Contribution of multiple attributes to localization of contours 13,000

Spetsakis

NSERC Operating Grant. Visual motion analysis 18,000

Stager	
Transport Canada. Human engineering in Canadian automated air traffic system	115,000
Steinbach	
NSERC Operating Grant. Human oculomotor control	31,000
MRC Operating Grant. Visual function in strabismic and monocularly enucleated children	64,000
MRC Post Doctoral Fellowship - Elizabeth Irving	45,000
Jackman Foundation. Oculomotor Lab at the Eye Research Institute of Canada	17,500
York University Summer Graduate Assistance Program	3,000
Total annual value of grants	**$2,056,934**

Publications July 1994-June 1995

Books

Howard, I.P and Rogers, B.J. *Binocular Vision and Stereopsis.* Oxford University Press. An 800-page book to appear in August, 1995.

Chapters in Books

Grasse, K.L. and Cynader, M.S. The accessory optic system of frontal-eyed animals. In A. Leventhal (Ed.), *Vision and Visual Dysfunction*, Vol. IV, Chap. 5, *The Neuronal Basis of Visual Function.* London: Macmillan, 1994, in press.

Harris, L.R. Visual motion caused by movements of the eye, head and body. In A.T. Smith, and R. Snowden (Eds.), *Detecting Visual Motion*, London: Academic Press, 1994, pp 397-436.

Wall, C., **Harris L.R.** and Lathan, C. Visuo-vestibular interactions during z-axis linear accelerations in man. In D.L. Tomko, B. Cohen and F. Guedry (Eds.), *Sensing and Controlling Motion: Vestibular and Sensorimotor Function*, 1994, in press.

J.S. Ostroff. Visual tools for verifying real-time systems. In *Theories and Experiences in Real-Time Systems, AMAST Series in Computing*, Vol. 2. Iowa City: World Scientific Press, 1995.

Regan, D. Perceptual motor skills and human motion analysis. In G. Salvendy (Ed.), *Handbook Of Human Factors And Ergonomics*, New York: Wiley, 1995.

Stager, P. Achieving the objectives of certification through validation: Methodological issues. In J.A.Wise, V.D. Hopkin and D. Garland (Eds.), *Human Factors Certification of Advanced Aviation Technologies*, Florida: Embry-Riddle Aeronautical University Press, 1993, pp 401-411.

Papers in Refereed Journals

Bock, O., Goltz, H. and Steinbach, M.J. (1995). On the role of extraretinal signals for saccade generation.*Experimental Brain Research*, 104, 349-350.

Crawford, J.D. (1994). The oculomotor neural integrator uses a behavior-related coordinate system. *The Journal of Neuroscience*, 14, 6911-6923.

Crawford, J.D. and Vilis, T. (1995). How does the brain solve the problems of rotational motion? *The Journal of Motor Behaviour*, 27, 89-99.

Dengis, C.A., Steinbach, M.J. and Kraft, S.P. (1994). Botulinum toxin chemodenervation of medial and lateral rectus muscles produces equal shifts of eye alignment for equal degrees. *Binocular Vision*, 9, 159-164.

Grasse, K.L. (1994). The effects of positional disparity on the motion selective responses of neurons in the cat accessory optic system. *Vision Research*, 34, 1673-1689.

Gray, R. and Regan, D. (1995). Cyclopean motion perception produced by oscillations of size, disparity and location. *Vision Research*, in press.

Harris, L.R. (1994). Keeping track of visual codes which move from cell to cell during eye movements. A commentary on Bridgeman, vander Heilden and Velichkovsky. *Behavioral and Brain Sciences*, 17, 265-266.

Harris, L.R. (1994). The oculomotor response to plaids. *British Ocular Motor Group Newsletter*, 7, 3-6.

Sawin, E.P., Sokolowski, M.B., **Harris, L.R.** and Campos, A.R. (1994). Sensorimotor transformation from light reception to phototactic behaviour in drosophila larva. *Journal of Insect Physiology*, 7, 553-567.

Lathan, C.E., Wall, C. and **Harris, L.R.** (1994). The response of the otolith-ocular system to z-axis linear acceleration and optokinetic stimulation in humans: The effect of stimuli phase relationships during sinusoidal movement. *Experimental Brain Research*, 103, 256-266.

Harris, L.R. and Lott, L.A. (1995). Sensitivity to full-field visual movement compatible with head rotation: variations between axes of rotation.*Visual Neurosciences*, 12, 743-754.
Andersen, R.A., **Harris, L.R.** et al. (1995). The coding of head movement. *Journal of Vestibular Research*, in press.
Harris, L.R. and Lott, L.A. (1995). Sensitivity to full-field visual movement compatible with head rotation: variation with eye-in-head position.*Visual Neurosciences*, in press.
Howard, I.P. and Sun, L. (1994). Cycloversion and cyclovergence: the effects of the area and position of the visual display. *Experimental Brain Research*, 100, 509-514.
Howard, I.P. (1995). Depth from binocular rivalry without spatial disparity. *Perception*, 24, 67-74.

Papers in Refereed Journals cont'd.

Cheung, S.K., Money, K.E. and **Howard, I.P**. (1995). Dynamics of torsional optokinetic nystagmus under altered gravitoinertial forces. *Experimental Brain Research*, 102, 511-518.

Howard, I.P. and Howard, A. (1994). Vection: the contributions of absolute and relative visual motion. *Perception*, 23, 745-751.

Howard, I.P. and Childerson, L. (1994). The contribution of motion, the visual frame and visual polarity to sensations of body tilt. *Perception*, 23, 753-762.

Telford, L., **Howard, I.P**. and Ohmi, M. (1995). Heading judgments during active and passive self motion. *Experimental Brain Research*, in press.

Howard, I.P. (1995). Alhazen's neglected discoveries of visual phenomena. *Perception*, in press.

Jenkin, M., Milios, E. and Tsotsos, J. (1994). TRISH: A binocular robot head with torsional eye movements, special issue on mobile robots, robot heads and active vision of the *International Journal of Pattern Recognition and Artificial Intelligence*, in press.

Kaneko, H. and Howard, I.P. (1995). Relative size disparities and the perception of surface slant. *Vision Research*, in press.

Cooperstock, J. and **Milios, E**. (1993). A neural-network operated vision-guided mobile robot arm for docking and reaching. *Journal of Robotics and Autonomous Systems*, in press.

Feng, Lu and **Milios, E.** (1994)**.** Optimal Spline Fitting to Planar Shape. *Signal Processing*, Elsevier Science Publishers, 37, 129-140.

Nakamizo, S., Shimono, K., Kondo, M. and **Ono, H**. (1994). Visual directions of two stimuli in the Panum's limiting case. *Perception*, 23, 1037-1048.

Ohmi, M. and **Ono, H.** (1994). Depth between simple stimuli with motion parallax.*Vision*, 6, 1-14, (in Japanese).

O'Shea, R.P., Blackburn, S.G. and **Ono, H**. (1994). Contrast as a depth cue.*Vision Research*, 34, 1595-1604.

Tam, W.J. and **Ono, H.** (1994). Fixation disengagement and eye movement latencies. *Perception and Psychophysics*, 56, 256-260.

Ono, H. and Mapp, A. (1995).Wells-Hering's Laws of visual direction. *Perception*, 24, 237-252.

Ono, H. and Ujike, H. (1994). Apparent depth with MAE and head movement. *Perception*, 23,1241-1248.

Nakamizo S. and **Ono, H.** (1995). Writing an English article with "style". *The journal of the Insitute of Television Engineers of Japan*, in press.

Regan, D. (1995). Spatial vision in children and adults: A tribute to Russel Harter. *International Journal of Neuroscience*, 80, 153-172.

Regan, D. and Vincent, A. (1995). Visual processing of looming and time to contact throughout the visual field. *Vision Research*, 35, 1845-1857.

Regan, D., Hamstra, S.J., Kaushal, S., Vincent, A., Gray, R. and Beverley, K.I. (1995). Visual processing of an object's motion in three dimensions for a stationary or a moving observer. *Perception*, 24, 87-103.

Regan, D. and Simpson, T.L. (1995). Multiple sclerosis can cause visual processing deficits specific to texture-defined form. *Neurology*, 45, 809-815.

Regan, D. and Hong, X.H. (1995). Two models of the recognition and detection of texture-defined letters compared. *Biological Cybernetics*, 2, 389-396.

Regan, D. (1995). Spatial orientation in aviation: Visual contributions. *Journal of Vestibular Research*, in press.

Kruk, R. and **Regan, D.** (1995). Collision avoidance: A helicopter simulator study. *Aviation, Space and Environmental Medicine*, in press.

Regan, D. (1995). Orientation discrimination for texture-defined form. *Perception*, in press.

Regan, D., Gray, R. and Hamstra, S.J. (1995). Evidence for a neural mechanism that encodes angles. *Vision Research*, in press.

Portfors-Yeomans, C. V. & Regan, D. (1995) Discrimination of the direction and speed of motion in depth from binocular information alone. J. Exp. Psychol.: Hum. Percept & Perform. In press.

Simpson, T. L. (1995). Vision thresholds from psychometric analyses: alternatives to Probit analysis. *Optometry and Vision Science*, 72, 371-377.

Simpson, T. and **Regan, D.** (1995). Test-retest variability and correlations between tests of texture processing, motion processing, visual acuity and contrast sensitivity. *Optometry and Vision Science*, 72,11-16.

Regan, D. and He, P. (1995). Magnetic and electrical brain responses to chromatic contrast in human. *Vision Research*, in press.

Regan, D. and He, P. (1995). Comparison of visual responses to texture-defined form and to luminance-defined form by neuromagnetic recording. *Journal of Neurophysiology*, in press.

Papers in Refereed Journals cont'd.

Regan, D., He, P. and Regan, M. P. (1995). An audio-visual convergence area in human brain. *Experimental Brain Research*, in press.

Regan M.P. (1995). Half-wave linear rectification of a frequency modulated sinusoid. *Journal of Applied Mathematics and Computation*, in press.

Reed, M.J., Steinbach, M.J., Ono, H., Craft, S., and Gallie, B. (1995). Alignment ability of strabismic and eye enuculated subjects on the horizontal and oblique meridian. *Vision Research*, in press.

Reed, M. J., Steeves, J., Kraft, S. P., Gallie, B. L. and Steinbach, M. J. Contrast sensitivity in strabismic and monocularly enucleated children. *Vision Research*, in press.

Rivest, J., Cavanagh, P. and Lassonde, M. (1994). Interhemispheric depth judgement. *Neuropsychologia*, 32, 69-77.

Cavanagh, P., Saida, S. and **Rivest, J.** (1995). The contribution of color to motion parallax. *Vision Research*, 35, 1871-1879.

Rivest, J. and Cavanagh, P. (1995). Multiple attributes are coded together for localization of contours. *Vision Research*, in press.

Bowns, L., Kirshner, E.L. and **Steinbach, M.J.** (1994). Shear sensitivity in normal and monocularly enucleated adults. *Vision Research*, 34, 3389-3395.

Vincent, A. and Regan, D. (1995). Parallel independent processing of orientation, spatial frequency and contrast. *Perception*, 24, 491-499.

Published Proceedings

Jenkin, M.R.M. and Tsotsos, J.K. Active stereo vision and cyclotorsion. *IEEE CVPR '94*, 806-811, June, 1994.

J.S. Ostroff. A CASE tool for the design of safty-Critical Software. *IEEE /ACM Seventh International Workshop on Computer-Aided Software Engineering CASE-95*, Toronto, Ontario, Canada, July, 1995.

J.S. Ostroff. Automated modular specification and verification of real-time reactive systems. *IEEE Workshop on Industrial-Strength Formal Specification Techniques WIFT'95*, Boca Raton, Florida, April 1995.

M. Lawford, M. Wonham, and J.S. Ostroff. State event observers for labelled transition systems. *33rd IEEE CDC*, Lake Buena Vista, Florida, Dec. 1994.

Conference Presentations and Abstracts

Allison, R.S., Zacher, J.E., Howard, I.P., and Oman, C.M. The effect of field size on roll vection in a tumbling room. *Investigative Ophthalmology and visual Science*, 1995, 36, S829.

Crawford, J.D. and Guitton, D. A model for the sensorimotor transformations required for accurate 3-D saccades. *Neuroscience Abstract*, 1994, 20, 234.

Crawford, J.D. Visuomotor codes for three-dimensional saccades. *York University International Conference on Visual Coding*, York University, Toronto. June, 1995.

Dengis, C.A., Steinbach, M.J., Ono, H., Gunther, L.N. and Postiglione, S. Eye-hand coordination tasks in normal, strabismics and enucleateds. *Investigative Ophthalmology and Visual Science*, 1995, 36, S2951.

Guitton, D. and Crawford, J.D. Three-Dimensional Constraints on coordinated eye-head gaze shifts in the monkey. *Neuroscience Abstract*, 1994, 20, 1405.

Gunther, L.N., Dengis, C.A., Ono, H. and Steinbach, M.J. Apparent motion during head rotation while wearing baseout prisms. *Investigative Ophthalmology and Visual Science*, 1995, 36, S3146.

Goltz, H.C., Irving, E.L., Steinbach, M.J., Eizenman, M. (1995). Vertical eye position control in darkness: Interaction of orbital position and gravity. *Investigative Ophthalmolgy and Visual Science*, 1995, 36, S685.

Bigel, M. and **Harris, L.R.** (1994). The effects of prolonged unilateral rotation on nystagmus: vestibular responses of skaters. *Canadian Brain and Behaviour Conference*, Vancouver, Canada.

Harris, L R. Visual coding of self movement. *Conference on Neural Control of Movement*t. Hawaii, 1994.
Harris, L.R. Visual-vestibular interactions. *Conference on Neuromorphic Engineering*. Telluride, Colorado, 1994.
Harris, L.R. and Mente, P. The oculomotor response to visual and vestibular stimulation around different axes. *Neuroscience Abstracts*, 1994, in press.
Harris, L.R and Mente, P. The combination of visual and vestibular information in processing self motion, *The 3rd International Symposium on the Head/Neck system,* Vail, Colorado, 1995.
Harris, L.R. and Mente, P. Is self motion coded by labelled lines or by a system of channels? *Visual Coding Conference,* North York, June, 1995.

Conference Presentations and Abstracts cont'd.

Ho, W.A. and Howard, I.P. Stereopsis from centroid disparity. *Investigative Ophthalmology and Visual Science*, 1995, 36, S813.

Dong, J., **Howard, I.P**, and Zacher, J.E. Human torsional optokinetic nystagmus in response to central and peripheral stimulation. *Investigative Ophthalmology and visual Science*, 1995, 36, S352.

Pierce, B.J. and **Howard, I.P**. Illusory inclination and depth contrast in stereoscopic display systems. *Investigative Ophthalmology and Visual Science*, 1995, 36, S376.

Howard, I.P. Stereoscopic distortions in virtual-reality systems. *Conference on Virtual Reality*, DCIEM, Toronto, June, 1995

Howard, I.P. Understanding stereoscopic vision. Invited paper to the *Annual Conference of the Advanced Telecomunication Research Laboratories*, Kyoto, Japan. November, 1994.

Howard, I.P. Aftereffects of active and passive body rotation. Paper presented at the *International Conference on The Neurology of Human Spatial Orientation*, Ibiza. May, 1995.

Howard, I.P. Vestibular and proprioceptive factors in aftereffects of self rotation. Invited paper at *The 3rd International Symposium on the Head/Neck system*, Vail, Colorado. July, 1995.

Tsotsos, J.K, Dickinson, S., **Jenkin, M.**, **Milios, E.**, Jepson, A., Down, B., Amdur, E., Stevenson, S., Black, M., Metaxas, D., Cooperstock, J., Culhane, S., Nuflo, F., Verghese, G., Wai, W., Wilkes, D., Ye, Y. The PLAYBOT Project. *Proceeding IJCAI Workshop on AI Applications for Disabled People*, Aug 19, Montreal, 1995.

Jenkin, M., Bains, N., Bruce, J., Campbell, T., Down, B., Jasiobedzki, P., Jepson, A., Majarais, B., Milios, E., Nickerson, S.B., Service, J.R.R., Terzopoulos, D., Tsotsos, J. and Wilkes, D. ARK: autonomous mobile robot for an industrial environment. *1994 IEEE/RSJ International Conference on Intelligent Robots and Systems, (IROS)*, Munich, Germany, Sept 12-16, pp. 1301 - 1308.

Dudek, J., **Jenkin, M.**, **Milios, E.**, and Wilkes, D. Exploring graph-like worlds embedded in a metric map. *Vision Interface*, Quebec City. May, 16-19, 1995, pp. 195-202.

Kaneko, H. and Howard, I.P. Spatial organization of vertical disparity pooling. *Investigative Ophthalmology and Visual Science*, 1995, 36, S230.

Lu, F. and **Milios, E.** Robot pose estimation in unknown environments by matching 2D range scans. *IEEE Computer Vision and Pattern Recognition Conference (CVPR)*, June 1994, pp. 935-938.

Lu, F. and **Milios, E.** An Iterative Algorithm for Shape Registration. *2nd International Workshop on Visual Form*, Capri, Italy, May 30 - June 2, 1994. World Scientific, Singapore, pp. 344-353.

Tsotsos, J. and **Milios, E**. Selective Attention within a Visual Processing Pyramid. *1995 IEEE Workshop on Nonlinear Signal and Image Processing*, June 20-22, 1995, Neos Marmaras, Halk.

Lu, F. and **Milios, E.** Optimal Global Pose Estimation for Consistent Sensor Data Registration. *IEEE International Conference on Robotics and Automation*, Nagoya, Japan, 1995.

Prassler, E. and **Milios, E**. Motion planning amongst arbitrarily moving unknown obstacles. *1994 IEEE/RSJ International Conference on Intelligent Robots and Systems, (IROS)*, Munich. Sept., 1338-1346.

Prassler, E., **Milios, E**. Position estimation using equidistance lines. *IEEE International Conference on Robotics and Automation*, Nagoya, Japan, 1995.

Nickerson, S.B., Jasiobedzki, P., **Jenkin, M**., Jepson, A., **Milios, E.**, Down, B., Service, J. R., Terzopoulos, D., Tsotsos, J., Wilkes, D., Bains, N. and Campbell, T. ARK: Autonomous mobile robot in an industrial environment. *CIRFFSS '94, AIAA/NASA Conference*, Houston, TX, 1994.

Ono, H. and Susami, K. Body balance during a wall-paper illusion. *27th Korokiamu*, Kohfu, Japan, 1994.

Ujike, H. and **Ono, H**. Parallactic depth threshold as a function of head velocity. *Japan Society of Applied Physics*, 1994.

Ujike, H. and **Ono, H**. Parallactic depth with MAE and head movement. *Japan Society of Applied Physics*, 1994.

Nakamizo, S., **Ono, H.** and Ujike. H. Subjective staircase illusion and vertical horopter. *Japanese Vision Society Meeting*, 1995, Kanazawa, Japan, 1995.

Susami, K. and **Ono, H.** Absolute distance of wall paper illision and vertical disparity. *The 28th Chikaku Korokiamu*, Kanazawa, Japan, 1995.

Susami, K. and **Ono, H**. Wall paper illision and vertical disparity. *Japanese Psychonomic Society*, Tokyo, Japan, 1995.

Ichikawa, M. and **Ono, H**. Differenct velocity profiles of the head movement and depth perception from motion disparity. *Japanese Vision Society Meeting*, 1995, Tokyuo, Japan.

Wisniewski, I. and **Ono, H.** Local and global stereopsis in random-dot stereograms, with matched and unmatched elements. *Investigative Ophthalmology and Visual Science*, 1995, 36, S1719.

Gray, R. and Regan, D. Cyclopean motion perception produced by oscillations of size, disparity and location. *Investigative Ophthalmology and Visual Science*, 1995, 36, S369.

Conference Presentations and Abstracts cont'd.

Regan, D. and Gray, R. Evidence for a neural mechanism that encodes angles. *Investigative Ophthalmology and Visual Science*, 1995, 36, S465.

Portfors-Yeomans, C.V. and Regan, D. Direction discrimination and speed discrimination of motion in depth using binnocular cues only. *Investigative Ophthalmology and Visual Science*, 1995, 36, S813.

Giaschi, D.E. and **Regan, D**. Dissociated visual development in the processing of motion-defined form. *Investigative Ophthalmology and Visual Science*, 1995, 36, S443.

Regan, D. Vision in sport, driving and aviation. *Canadian Optometry Annual Meeting*, Kitchener.

Regan, D. Methods for testing visual functions that are important in aviation and driving. *DCIEM Vision in Aviation Workshop*, Toronto.

Regan, D. Psychophysical methods analysis of visual processing into parallel and sequential sub-units. *International Conference on Visual Coding*, York University, North York, June, 1995.

Regan, D. Applying psychophysical research to the design of stereo flight simulators.*TORON-NIHON Workshop on Virtual Reality*, Toronto.

Boutet, I., Intriligator, J. and **Rivest, J**. The influence of attention on visual learning. *Investigative Ophthalmology and Visual Science*, 1995, 36, S37.

Rivest, J., Boutet, I. and Intriligator, J. Perceptual learning of orientation discrimination across attributes. *Investigative Ophthalmology and Visual Science*, 1995, 36, S376.

Stager, P. Validation as means to Certification. Symposium on Human Factors Certification. *Proceedings of the Human Factors and Ergonomics Society 38th Annual Meeting*. Nashville, October, 1994, 1052-1056.

Steeves, J.K.E., Reed, M.J., Gallie, B.L., Kraft, S.P. and Steinbach, M.J. (1995). Contrast letter acuity in the the remaining eye of enucleates and depressed in the non-deviating eye of strabismics subjects. *Investigative Ophthalmology and Visual Science*, 1995, 36, S645.

Irving, E.L., **Goltz, H.C**., Kraft, S.P. and **Steinbach, M.J.** (1995). Saccade dynamic and adjustable suture strabismus surgery. *Annual Department of Ophthalmology Research Day Meeting*, Univ. of Toronto

Irving, E.L., **Goltz, H.C.**, Kraft, S.P. and **Steinbach, M.J.** (1995). Adjustable suture strabismus surgery affects saccade dynamics. *Investigative Ophthalmolgy and Visual Science*, 1995, 36, S956.

Vincent, A. and Regan, D. Parallel processing of spatial frequency, temporal frequency, orientation and contrast. *Investigative Ophthalmology and Visual Science*, 1995, 36, S438.

Zacher, J.E., Allison, R.S., and Howard, I.P. The effect of active movement on postrotatory nystagmus and illusory body rotation. *Investigative Ophthalmology and Visual Science*, 1995, 36, S685.

Colloquia

Laurence Harris
Dept. Psychology, Royal Holloway College, University of London, May, 1995

Ian Howard
Four seminars to the Advanced Telecommunication Research Laboratories, Kyoto, Japan, Nov. 1994.
Institute of Technology, Tokyo. Nov. 1994.
Deparment of Psychology, University of Dunedin, New Zealand, October 1994.
Department of Psychology, University of Auckland, New Zealand, October 1994.
Senior Scholars Lecture, York University, March, 1995.

Evangelos Milios
University of Patras, Department of Computer Science, June 19, 1994.
Technical University of Athens, Department of Computer Science, June 24 and 26, 1994.

Hiroshi Ono
Smith Kettlewell Eye Insititute, October 1995
ATR Human Information Processing Research Laboratories, Kyoto, Japan, Nov. 1994
NTT Basic Research Laboratories, Kanagawa, Japan, Feb. 1995
Tokyo Institute of Technology, Tokyo, Japan, March, 1995.

Martin Steinbach
Eye Research Institute of Canada (1995)
Hospital for Sick Children, Toronto - Ophthalmology Rounds (1995)

York Conference on Visual Coding

An International Conference on Visual Coding was held at York University on June 20-24th, 1995. There were 18 invited speakers, 26 posters and 117 registrants. The conference was sponsored by the The Institute for Space and Terrestrial Science, The Centre for Vision Research, and The Department of Psychology.

Collaborative Research

Otmar Bock
Visuo-motor performance during parabolic flight (with CSA and NASA)
Miniaturized device for visuo-motor testing (with CSA)
Study of human motor skills aboard the Neurolab Space Shuttle flight (with CSA and NASA)
Visual localization in Strabismic patients (with Dr. Steinbach)

Doug Crawford
Dr. Douglas Tweed, Dept. Physiology, U. Western Ont., Dept. Neurology, U. Tubingen, Three dimensional geometry of eye movements.
Dr. Tutis Vilis (Dept. Physiology, U. Western Ont, on Neurophysiology of eye movements.
Dr. Daniel Guitton, Montreal Neurological Institute, on Eye-head coordination during gaze shifts.

Keith Grasse
Dr. Colin Blakemore, Dept. of Physiology, University of Oxford, Oxford, England
Dr. Franklin Sengpiel, Dept of Physiology, University of Oxford, Oxford, England
Dr. Julie Mendelson, Division of Life Sciences, University of Toronto, Scarborough, Ontario
Dr. Alison Sekuler, Dept. of Psychology, University of Toronto, Toronto, Ontario
Dr. Pat Bennett, Dept. of Psychology, University of Toronto, Toronto, Ontario
Dr. Ed Gruberg, Dept. of Biology, Temple University, Philadelphia, U.S.A.
Dr. Rob Douglas, Dept. of Ophthalmology, University of British Columbia, Vancouver, B.C.

Laurence Harris
NASA Ames (California, US). Project on intra-vestibular interactions.
MIT/Massachusetts Eye and Ear Infirmary (Mass, US). project on visual-vestibular interactions.
Co-author of a planned book on "Seeing During Motion" with Dr. Graham Barnes (London, UK).

Ian P. Howard
Co-author with Dr. Brian Rogers of Oxford University, book on Binocular Vision and Stereopsis.
Collaboration with Dr. Ron Kruk of CAE on visual factors in flight simulators.
Coinvestigator with C. Oman of MIT on the space shuttle Neurolab mission.

Evangelos Milios
With G. Dudek, Dept.of Computer Science, McGill University.
With D. Wilkes, Ontario Hydro Technologies, on Swarm robotics.
With E. Prassler, FAW, University of Ulm, Germany, on Dynamic Mobile robot navigation using distributed representations
With J. Tsotsos, Dept. of Computer Science, Univ. of Toronto, on Architectures for Auditory attention.

Hiroshi Ono
With Drs. Nicholas Wade and Michael Swanston at University of Dundee on visual motion and orientation.
Visiting Scientist, ATR Human Information Processing Research Laboratories, Kyoto, Japan, 1994.

David Regan
With Dr. R. Kruk (CAE) on visual factors in aviation and flight simulator design.
With Dr. L. Reid (Institute of Aerospace Science and Engineering, Univ. of Toronto) on flight simulators.

Josée Rivest
Collaboration with James Intriligator at Harvard University on perceptual learning experiments.

Martin Steinbach
Collaboration with Professor Iain Donaldson, University of Edinburgh, planned for early 1996.

Visiting Scientists during 1994-95

Dr. Byron Pierce	USAF Exchange Scientist, Human Factors Division
Dr. Andrew King	University of London
Dr. Nicholas Wade	Dundee University, Scotland

Dr. Michael Swanston University of Abertay, Scotland

Visiting Scientists during 1995-96

Dr. A. Smith	University of London, UK
Dr. G. Barnes	Institute of Neurology, University of London, UK
Dr. Kenzo Sakurai	Tohoku Gakuin University, Japan
Dr. Michael Swanston	Dundee University, Scotland
Dr. Nicholas Wade	Dundee University, Scotland
Dr. Terunori Mori	Tamavagwa University, Japan
Dr. Mitsuho Yamada	NHK Laboratory
Dr. Kenji Susami	ATR Human Information Processing Research Laboratories

Research Associates

Dr. Karin Arnold	Working with O. Bock
Dr. Rubin Gellman	Working with M. Steinbach
Dr. Esther Gonzalez	Working with M. Steinbach
Dr. Xiang-Hua Hong	Working with D. Regan
Mrs. Antonie Howard	Working with I. Howard
Dr. John Lipitkas	Working with O. Bock
Dr. Maureen Reed	Working with M. Steinbach
Dr. Marian Regan, Sr. Res. Assoc.	Working with D. Regan
Dr. Alex Vincent	Working with D. Regan
Mr. Jim Zacher	Working with I.P. Howard

Post Doctoral Fellows

Alan Ho	Working with I.P. Howard
Elizabeth Irving	Working with M. Steinbach
Hirohiko Kaneko	Working with I.P. Howard
Piotr Jasiobedzki	Working with E. Milios at U. of T.
Hiroyasu Ujike	Working with H. Ono

Graduate students (supervisors)

Robert Allison (Howard)	2nd year Ph.D.
Carol Dengis (Steinbach)	5th year Ph.D.
Tim Field (Ostroff)	3rd year M.Sc.
Roger Gray (Regan)	2nd year Ph.D.
Herb Goltz (Steinbach)	4th year Ph.D
Carl Gruden (Ostroff)	3rd year M.Sc.
Lorraine Gunther (Ono)	4th year M.A.
Ghee Ho (Stager)	4th year Ph.D.
Bernard Majaris (Jenkin)	2nd year M.Sc.
Peter Mente (Harris)	3rdyear M.Sc.
Ng Siu-Ming (Spetsakis)	3rd year M.Sc.
Randy Penfield (Grasse)	2nd year M.A.
Jennifer Steeves (Steinbach)	2ndyear M.A.
Ling Yao (Amanatides)	2nd year M.Sc.
Christine Yeomans (Regan)	2nd year Ph.D.
Jay Ying (Milios)	3rd year M.Sc.
Sun Zuening (Spetsakis)	2nd year M.Sc.

Welcome to New Members of the Centre For Vision Research

Research Associates and Post Doctoral Fellows

Dr. Feng Lu	Working with Milios
Dr. Makoto Ichikawa	Working with H. Ono
Mr. R. Norel	Working with E. Milios
Dr. Shoji Sunaga	Working with P. Kaiser
Dr. Mashiro Ishii	Working with I.P. Howard

Graduate Students

Jyoti Baid (Milios)	1st year M.Sc.
Isabelle Boutet (Rivest)	1st year M.A.
Andrea Downie (Grasse)	1st year M.A.
Kazuhiko Enomoto (Ono)	Visiting Student from Japan
Xuapeig Fang (Howard)	1st year M.Sc.
Phillip Grove (Ono)	1st year M.A.
Denise Henriques (Crawford)	1st year M.A.
Eliana Klier (Crawford)	1st year M.Sc.
Michael Smith (Crawford)	lst year M.A.
Grant Wainman (Ono)	1st year M.A.

Research Grants (Annual)

Amanatides

NSERC Research Grant. Ray tracing and sampling. 22,000

NSERC Equip Grant with Jenkin, Milios and Spetsakis. High-performance graphics equipment 16,412

Bock

NSERC Operating Grant. Control principles of aimed arm movements in humans 13,000

DCIEM Contract. Purposive arm movements during G_Z centrifuge stimulation 33,000

DCIEM Contract with D'Eleuterio. New control concept for robotic manipulators 110,000

Canadian Space Agency Contract. Eye-hand coordination in microgravity 104,000

Crawford

Start up equipment fund from Faculty of Arts 42,000

For construction of laboratory in BSB Vivarium 18,000

York Faculty of Arts Research Grant 3,500

President's NSERC Fund 2,000

York Ad Hoc Travel Grant 800

Grasse

NSERC Operating Grant. 28,000

NSERC Equipment Grant 20,000

Harris

NSERC Operating Grant. The detection of conflict in visual-vestibular interactions 28,000

President's NSERC Fund. York University 2,700

PRECARN feasibility study with M. Jenkin, Aastra Aerospace and ISTS 35,000

NSERC Industrial Fellowship with M. Jenkin and Aastra Aerospace 52,000

Howard

NSERC Operating Grant. Visual pursuit and induced visual motion. 39,000

DCIEM Contract. 50,000

Ontario Centre of Excellence Grant with Grasse, Harris, Jenkin, Ono & Regan, HP Lab 439,000

Jenkin

NSERC Operating Grant. Active Stereo 22,000

NSERC Equipment Grant. A next generation stereo head with E. Milios and J. Tsotsos 26,600

Kaiser

NSERC Operating Grant. Studies in colour vision 29,000

Milios

NSERC Operating Grant 17,000

DSS contract. Numeric and Symbolic Processing for Sonar Info. Management with M. Jenkin 15,000

PRECARN Project with M. Jenkin 80,000

Ono

NSERC Operating Grant. Sensory and motor aspects of space perception 30,500

NATO Travel Grant with Wade and Swanston. Motion and orientation in spatial vision 7,803

Sabbatical Leave Fellowship 7,000

Ostroff

NSERC Operating Grant 20,000

Regan

NSERC/CAE Industrial Chair 125,586

NSERC Operating Grant 72,000

AFOSR Grant 239,533

Rivest

NSERC Operating Grant. Contribution of multiple attributes to localization of contours 13,000

Spetsakis

NSERC Operating Grant. Visual motion analysis 18,000

Stager	
Transport Canada. Human engineering in Canadian automated air traffic system	115,000
Steinbach	
NSERC Operating Grant. Human oculomotor control	31,000
MRC Operating Grant. Visual function in strabismic and monocularly enucleated children	64,000
MRC Post Doctoral Fellowship - Elizabeth Irving	45,000
Jackman Foundation. Oculomotor Lab at the Eye Research Institute of Canada	17,500
York University Summer Graduate Assistance Program	3,000
Total annual value of grants	**$2,056,934**

Publications July 1994-June 1995

Books

Howard, I.P and Rogers, B.J. *Binocular Vision and Stereopsis.* Oxford University Press. An 800-page book to appear in August, 1995.

Chapters in Books

Grasse, K.L. and Cynader, M.S. The accessory optic system of frontal-eyed animals. In A. Leventhal (Ed.), *Vision and Visual Dysfunction*, Vol. IV, Chap. 5, *The Neuronal Basis of Visual Function.* London: Macmillan, 1994, in press.

Harris, L.R. Visual motion caused by movements of the eye, head and body. In A.T. Smith, and R. Snowden (Eds.), *Detecting Visual Motion*, London: Academic Press, 1994, pp 397-436.

Wall, C., **Harris L.R.** and Lathan, C. Visuo-vestibular interactions during z-axis linear accelerations in man. In D.L. Tomko, B. Cohen and F. Guedry (Eds.), *Sensing and Controlling Motion: Vestibular and Sensorimotor Function*, 1994, in press.

J.S. Ostroff. Visual tools for verifying real-time systems. In *Theories and Experiences in Real-Time Systems, AMAST Series in Computing*, Vol. 2. Iowa City: World Scientific Press, 1995.

Regan, D. Perceptual motor skills and human motion analysis. In G. Salvendy (Ed.), *Handbook Of Human Factors And Ergonomics*, New York: Wiley, 1995.

Stager, P. Achieving the objectives of certification through validation: Methodological issues. In J.A.Wise, V.D. Hopkin and D. Garland (Eds.), *Human Factors Certification of Advanced Aviation Technologies,* Florida: Embry-Riddle Aeronautical University Press, 1993, pp 401-411.

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Bock, O., Goltz, H. and Steinbach, M.J. (1995). On the role of extraretinal signals for saccade generation.*Experimental Brain Research*, 104, 349-350.

Crawford, J.D. (1994). The oculomotor neural integrator uses a behavior-related coordinate system. *The Journal of Neuroscience*, 14, 6911-6923.

Crawford, J.D. and Vilis, T. (1995). How does the brain solve the problems of rotational motion? *The Journal of Motor Behaviour,* 27, 89-99.

Dengis, C.A., Steinbach, M.J. and Kraft, S.P. (1994). Botulinum toxin chemodenervation of medial and lateral rectus muscles produces equal shifts of eye alignment for equal degrees. *Binocular Vision*, 9, 159-164.

Grasse, K.L. (1994). The effects of positional disparity on the motion selective responses of neurons in the cat accessory optic system. *Vision Research,* 34, 1673-1689.

Gray, R. and Regan, D. (1995). Cyclopean motion perception produced by oscillations of size, disparity and location. *Vision Research*, in press.

Harris, L.R. (1994). Keeping track of visual codes which move from cell to cell during eye movements. A commentary on Bridgeman, vander Heilden and Velichkovsky. *Behavioral and Brain Sciences*, 17, 265-266.

Harris, L.R. (1994). The oculomotor response to plaids. *British Ocular Motor Group Newsletter,* 7, 3-6.

Sawin, E.P., Sokolowski, M.B., **Harris, L.R.** and Campos, A.R. (1994). Sensorimotor transformation from light reception to phototactic behaviour in drosophila larva. *Journal of Insect Physiology*, 7, 553-567.

Lathan, C.E., Wall, C. and **Harris, L.R.** (1994). The response of the otolith-ocular system to z-axis linear acceleration and optokinetic stimulation in humans: The effect of stimuli phase relationships during sinusoidal movement. *Experimental Brain Research,* 103, 256-266.

Harris, L.R. and Lott, L.A. (1995). Sensitivity to full-field visual movement compatible with head rotation: variations between axes of rotation.*Visual Neurosciences*, 12, 743-754.
Andersen, R.A., **Harris, L.R.** et al. (1995). The coding of head movement. *Journal of Vestibular Research*, in press.
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Howard, I.P. and Sun, L. (1994). Cycloversion and cyclovergence: the effects of the area and position of the visual display. *Experimental Brain Research*, 100, 509-514.
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Cheung, S.K., Money, K.E. and **Howard, I.P**. (1995). Dynamics of torsional optokinetic nystagmus under altered gravitoinertial forces. *Experimental Brain Research*, 102, 511-518.

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Telford, L., **Howard, I.P**. and Ohmi, M. (1995). Heading judgments during active and passive self motion. *Experimental Brain Research*, in press.

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Cooperstock, J. and **Milios, E**. (1993). A neural-network operated vision-guided mobile robot arm for docking and reaching. *Journal of Robotics and Autonomous Systems*, in press.

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Regan, D. (1995). Spatial vision in children and adults: A tribute to Russel Harter. *International Journal of Neuroscience*, 80, 153-172.

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Regan, D., Hamstra, S.J., Kaushal, S., Vincent, A., Gray, R. and Beverley, K.I. (1995). Visual processing of an object's motion in three dimensions for a stationary or a moving observer. *Perception*, 24, 87-103.

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Regan, D., Gray, R. and Hamstra, S.J. (1995). Evidence for a neural mechanism that encodes angles. *Vision Research*, in press.

Portfors-Yeomans, C. V. & Regan, D. (1995) Discrimination of the direction and speed of motion in depth from binocular information alone. J. Exp. Psychol.: Hum. Percept & Perform. In press.

Simpson, T. L. (1995). Vision thresholds from psychometric analyses: alternatives to Probit analysis. *Optometry and Vision Science*, 72, 371-377.

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Regan, D. and He, P. (1995). Magnetic and electrical brain responses to chromatic contrast in human. *Vision Research*, in press.

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Regan, D., He, P. and Regan, M. P. (1995). An audio-visual convergence area in human brain. *Experimental Brain Research*, in press.

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Reed, M.J., Steinbach, M.J., Ono, H., Craft, S., and Gallie, B. (1995). Alignment ability of strabismic and eye enuculated subjects on the horizontal and oblique meridian. *Vision Research*, in press.

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Rivest, J., Cavanagh, P. and Lassonde, M. (1994). Interhemispheric depth judgement. *Neuropsychologia*, 32, 69-77.

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Rivest, J. and Cavanagh, P. (1995). Multiple attributes are coded together for localization of contours. *Vision Research*, in press.

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J.S. Ostroff. Automated modular specification and verification of real-time reactive systems. *IEEE Workshop on Industrial-Strength Formal Specification Techniques WIFT'95*, Boca Raton, Florida, April 1995.

M. Lawford, M. Wonham, and J.S. Ostroff. State event observers for labelled transition systems. *33rd IEEE CDC*, Lake Buena Vista, Florida, Dec. 1994.

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Dengis, C.A., Steinbach, M.J., Ono, H., Gunther, L.N. and Postiglione, S. Eye-hand coordination tasks in normal, strabismics and enucleateds. *Investigative Ophthalmology and Visual Science*, 1995, 36, S2951.

Guitton, D. and Crawford, J.D. Three-Dimensional Constraints on coordinated eye-head gaze shifts in the monkey. *Neuroscience Abstract*, 1994, 20, 1405.

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Goltz, H.C., Irving, E.L., Steinbach, M.J., Eizenman, M. (1995). Vertical eye position control in darkness: Interaction of orbital position and gravity. *Investigative Ophthalmolgy and Visual Science*, 1995, 36, S685.

Bigel, M. and **Harris, L.R.** (1994). The effects of prolonged unilateral rotation on nystagmus: vestibular responses of skaters. *Canadian Brain and Behaviour Conference*, Vancouver, Canada.

Harris, L R. Visual coding of self movement. *Conference on Neural Control of Movement*t. Hawaii, 1994.
Harris, L.R. Visual-vestibular interactions. *Conference on Neuromorphic Engineering*. Telluride, Colorado, 1994.
Harris, L.R. and Mente, P. The oculomotor response to visual and vestibular stimulation around different axes. *Neuroscience Abstracts*, 1994, in press.
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Harris, L.R. and Mente, P. Is self motion coded by labelled lines or by a system of channels? *Visual Coding Conference,* North York, June, 1995.

Conference Presentations and Abstracts cont'd.

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Dong, J., **Howard, I.P**, and Zacher, J.E. Human torsional optokinetic nystagmus in response to central and peripheral stimulation. *Investigative Ophthalmology and visual Science*, 1995, 36, S352.

Pierce, B.J. and **Howard, I.P**. Illusory inclination and depth contrast in stereoscopic display systems. *Investigative Ophthalmology and Visual Science*, 1995, 36, S376.

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Kaneko, H. and Howard, I.P. Spatial organization of vertical disparity pooling. *Investigative Ophthalmology and Visual Science*, 1995, 36, S230.

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Prassler, E. and **Milios, E**. Motion planning amongst arbitrarily moving unknown obstacles. *1994 IEEE/RSJ International Conference on Intelligent Robots and Systems, (IROS)*, Munich. Sept., 1338-1346.

Prassler, E., **Milios, E**. Position estimation using equidistance lines. *IEEE International Conference on Robotics and Automation*, Nagoya, Japan, 1995.

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Irving, E.L., **Goltz, H.C.**, Kraft, S.P. and **Steinbach, M.J.** (1995). Adjustable suture strabismus surgery affects saccade dynamics. *Investigative Ophthalmolgy and Visual Science*, 1995, 36, S956.

Vincent, A. and Regan, D. Parallel processing of spatial frequency, temporal frequency, orientation and contrast. *Investigative Ophthalmology and Visual Science*, 1995, 36, S438.

Zacher, J.E., Allison, R.S., and Howard, I.P. The effect of active movement on postrotatory nystagmus and illusory body rotation. *Investigative Ophthalmology and Visual Science*, 1995, 36, S685.

Colloquia

Laurence Harris
Dept. Psychology, Royal Holloway College, University of London, May, 1995

Ian Howard
Four seminars to the Advanced Telecommunication Research Laboratories, Kyoto, Japan, Nov. 1994.
Institute of Technology, Tokyo. Nov. 1994.
Deparment of Psychology, University of Dunedin, New Zealand, October 1994.
Department of Psychology, University of Auckland, New Zealand, October 1994.
Senior Scholars Lecture, York University, March, 1995.

Evangelos Milios
University of Patras, Department of Computer Science, June 19, 1994.
Technical University of Athens, Department of Computer Science, June 24 and 26, 1994.

Hiroshi Ono
Smith Kettlewell Eye Insititute, October 1995
ATR Human Information Processing Research Laboratories, Kyoto, Japan, Nov. 1994
NTT Basic Research Laboratories, Kanagawa, Japan, Feb. 1995
Tokyo Institute of Technology, Tokyo, Japan, March, 1995.

Martin Steinbach
Eye Research Institute of Canada (1995)
Hospital for Sick Children, Toronto - Ophthalmology Rounds (1995)

York Conference on Visual Coding

An International Conference on Visual Coding was held at York University on June 20-24th, 1995. There were 18 invited speakers, 26 posters and 117 registrants. The conference was sponsored by the The Institute for Space and Terrestrial Science, The Centre for Vision Research, and The Department of Psychology.

Collaborative Research

Otmar Bock
Visuo-motor performance during parabolic flight (with CSA and NASA)
Miniaturized device for visuo-motor testing (with CSA)
Study of human motor skills aboard the Neurolab Space Shuttle flight (with CSA and NASA)
Visual localization in Strabismic patients (with Dr. Steinbach)

Doug Crawford
Dr. Douglas Tweed, Dept. Physiology, U. Western Ont., Dept. Neurology, U. Tubingen, Three dimensional geometry of eye movements.
Dr. Tutis Vilis (Dept. Physiology, U. Western Ont, on Neurophysiology of eye movements.
Dr. Daniel Guitton, Montreal Neurological Institute, on Eye-head coordination during gaze shifts.

Keith Grasse
Dr. Colin Blakemore, Dept. of Physiology, University of Oxford, Oxford, England
Dr. Franklin Sengpiel, Dept of Physiology, University of Oxford, Oxford, England
Dr. Julie Mendelson, Division of Life Sciences, University of Toronto, Scarborough, Ontario
Dr. Alison Sekuler, Dept. of Psychology, University of Toronto, Toronto, Ontario
Dr. Pat Bennett, Dept. of Psychology, University of Toronto, Toronto, Ontario
Dr. Ed Gruberg, Dept. of Biology, Temple University, Philadelphia, U.S.A.
Dr. Rob Douglas, Dept. of Ophthalmology, University of British Columbia, Vancouver, B.C.

Laurence Harris
NASA Ames (California, US). Project on intra-vestibular interactions.
MIT/Massachusetts Eye and Ear Infirmary (Mass, US). project on visual-vestibular interactions.
Co-author of a planned book on "Seeing During Motion" with Dr. Graham Barnes (London, UK).

Ian P. Howard
Co-author with Dr. Brian Rogers of Oxford University, book on Binocular Vision and Stereopsis.
Collaboration with Dr. Ron Kruk of CAE on visual factors in flight simulators.
Coinvestigator with C. Oman of MIT on the space shuttle Neurolab mission.

Evangelos Milios
With G. Dudek, Dept.of Computer Science, McGill University.
With D. Wilkes, Ontario Hydro Technologies, on Swarm robotics.
With E. Prassler, FAW, University of Ulm, Germany, on Dynamic Mobile robot navigation using distributed representations
With J. Tsotsos, Dept. of Computer Science, Univ. of Toronto, on Architectures for Auditory attention.

Hiroshi Ono
With Drs. Nicholas Wade and Michael Swanston at University of Dundee on visual motion and orientation.
Visiting Scientist, ATR Human Information Processing Research Laboratories, Kyoto, Japan, 1994.

David Regan
With Dr. R. Kruk (CAE) on visual factors in aviation and flight simulator design.
With Dr. L. Reid (Institute of Aerospace Science and Engineering, Univ. of Toronto) on flight simulators.

Josée Rivest
Collaboration with James Intriligator at Harvard University on perceptual learning experiments.

Martin Steinbach
Collaboration with Professor Iain Donaldson, University of Edinburgh, planned for early 1996.

Awards and Honours

Doug Crawford
Winner of the Polanyi Prize for 1995 in Physiology/Medicine

Evangelos Milios
Member of the Program Committee of "Sensor Fusion VII", SPIE OE/Symposium, Boston, Nov., 1994.
Member of the Scientific Committee of the 2nd International Workshop on Visual Form, Capri, June, 1994.

David Regan
Editorial Board: Spatial Vision
Editorial Board: Ophthalmic and Physiological Optics

Paul Stager
Member of the Panel on Human Factors in Air Traffic Control Automation, operating under the auspices of the US National Research Council's Committee on Human Factors and the US National Academy of Sciences.

Martin Steinbach
Expert Witness for and Consultant to the Ontario Human Rights Commission

E. Lynn Kirshner Memorial Scholarship for 1994
Awarded to Dr. Stan Hamstra for a paper he coauthored with Dr. D. Regan entitled "Orientation Discrimination in Cyclopean Vision" published in Vision Research, 35, 365-374. Stan graduated in 1994 and is now working in the Department of Physiology, University of Toronto.

Research Grants (Annual)

Amanatides

NSERC Research Grant. Ray tracing and sampling. 22,000

NSERC Equip Grant with Jenkin, Milios and Spetsakis. High-performance graphics equipment 16,412

Bock

NSERC Operating Grant. Control principles of aimed arm movements in humans 13,000

DCIEM Contract. Purposive arm movements during G_Z centrifuge stimulation 33,000

DCIEM Contract with D'Eleuterio. New control concept for robotic manipulators 110,000

Canadian Space Agency Contract. Eye-hand coordination in microgravity 104,000

Crawford

Start up equipment fund from Faculty of Arts 42,000

For construction of laboratory in BSB Vivarium 18,000

York Faculty of Arts Research Grant 3,500

President's NSERC Fund 2,000

York Ad Hoc Travel Grant 800

Grasse

NSERC Operating Grant. 28,000

NSERC Equipment Grant 20,000

Harris

NSERC Operating Grant. The detection of conflict in visual-vestibular interactions 28,000

President's NSERC Fund. York University 2,700

PRECARN feasibility study with M. Jenkin, Aastra Aerospace and ISTS 35,000

NSERC Industrial Fellowship with M. Jenkin and Aastra Aerospace 52,000

Howard

NSERC Operating Grant. Visual pursuit and induced visual motion. 39,000

DCIEM Contract. 50,000

Ontario Centre of Excellence Grant with Grasse, Harris, Jenkin, Ono & Regan, HP Lab 439,000

Jenkin

NSERC Operating Grant. Active Stereo 22,000

NSERC Equipment Grant. A next generation stereo head with E. Milios and J. Tsotsos 26,600

Kaiser

NSERC Operating Grant. Studies in colour vision 29,000

Milios

NSERC Operating Grant 17,000

DSS contract. Numeric and Symbolic Processing for Sonar Info. Management with M. Jenkin 15,000

PRECARN Project with M. Jenkin 80,000

Ono

NSERC Operating Grant. Sensory and motor aspects of space perception 30,500

NATO Travel Grant with Wade and Swanston. Motion and orientation in spatial vision 7,803

Sabbatical Leave Fellowship 7,000

Ostroff

NSERC Operating Grant 20,000

Regan

NSERC/CAE Industrial Chair 125,586

NSERC Operating Grant 72,000

AFOSR Grant 239,533

Rivest

NSERC Operating Grant. Contribution of multiple attributes to localization of contours 13,000

Spetsakis

NSERC Operating Grant. Visual motion analysis 18,000

Stager	
Transport Canada. Human engineering in Canadian automated air traffic system	115,000
Steinbach	
NSERC Operating Grant. Human oculomotor control	31,000
MRC Operating Grant. Visual function in strabismic and monocularly enucleated children	64,000
MRC Post Doctoral Fellowship - Elizabeth Irving	45,000
Jackman Foundation. Oculomotor Lab at the Eye Research Institute of Canada	17,500
York University Summer Graduate Assistance Program	3,000
Total annual value of grants	**$2,056,934**

Publications July 1994-June 1995

Books

Howard, I.P and Rogers, B.J. *Binocular Vision and Stereopsis.* Oxford University Press. An 800-page book to appear in August, 1995.

Chapters in Books

Grasse, K.L. and Cynader, M.S. The accessory optic system of frontal-eyed animals. In A. Leventhal (Ed.), *Vision and Visual Dysfunction*, Vol. IV, Chap. 5, *The Neuronal Basis of Visual Function.* London: Macmillan, 1994, in press.

Harris, L.R. Visual motion caused by movements of the eye, head and body. In A.T. Smith, and R. Snowden (Eds.), *Detecting Visual Motion*, London: Academic Press, 1994, pp 397-436.

Wall, C., **Harris L.R.** and Lathan, C. Visuo-vestibular interactions during z-axis linear accelerations in man. In D.L. Tomko, B. Cohen and F. Guedry (Eds.), *Sensing and Controlling Motion: Vestibular and Sensorimotor Function*, 1994, in press.

J.S. Ostroff. Visual tools for verifying real-time systems. In *Theories and Experiences in Real-Time Systems, AMAST Series in Computing*, Vol. 2. Iowa City: World Scientific Press, 1995.

Regan, D. Perceptual motor skills and human motion analysis. In G. Salvendy (Ed.), *Handbook Of Human Factors And Ergonomics*, New York: Wiley, 1995.

Stager, P. Achieving the objectives of certification through validation: Methodological issues. In J.A.Wise, V.D. Hopkin and D. Garland (Eds.), *Human Factors Certification of Advanced Aviation Technologies*, Florida: Embry-Riddle Aeronautical University Press, 1993, pp 401-411.

Papers in Refereed Journals

Bock, O., Goltz, H. and Steinbach, M.J. (1995). On the role of extraretinal signals for saccade generation.*Experimental Brain Research*, 104, 349-350.

Crawford, J.D. (1994). The oculomotor neural integrator uses a behavior-related coordinate system. *The Journal of Neuroscience*, 14, 6911-6923.

Crawford, J.D. and Vilis, T. (1995). How does the brain solve the problems of rotational motion? *The Journal of Motor Behaviour*, 27, 89-99.

Dengis, C.A., Steinbach, M.J. and Kraft, S.P. (1994). Botulinum toxin chemodenervation of medial and lateral rectus muscles produces equal shifts of eye alignment for equal degrees. *Binocular Vision*, 9, 159-164.

Grasse, K.L. (1994). The effects of positional disparity on the motion selective responses of neurons in the cat accessory optic system. *Vision Research*, 34, 1673-1689.

Gray, R. and Regan, D. (1995). Cyclopean motion perception produced by oscillations of size, disparity and location. *Vision Research*, in press.

Harris, L.R. (1994). Keeping track of visual codes which move from cell to cell during eye movements. A commentary on Bridgeman, vander Heilden and Velichkovsky. *Behavioral and Brain Sciences*, 17, 265-266.

Harris, L.R. (1994). The oculomotor response to plaids. *British Ocular Motor Group Newsletter*, 7, 3-6.

Sawin, E.P., Sokolowski, M.B., **Harris, L.R.** and Campos, A.R. (1994). Sensorimotor transformation from light reception to phototactic behaviour in drosophila larva. *Journal of Insect Physiology*, 7, 553-567.

Lathan, C.E., Wall, C. and **Harris, L.R.** (1994). The response of the otolith-ocular system to z-axis linear acceleration and optokinetic stimulation in humans: The effect of stimuli phase relationships during sinusoidal movement. *Experimental Brain Research*, 103, 256-266.

Harris, L.R. and Lott, L.A. (1995). Sensitivity to full-field visual movement compatible with head rotation: variations between axes of rotation.*Visual Neurosciences*, 12, 743-754.
Andersen, R.A., **Harris, L.R.** et al. (1995). The coding of head movement. *Journal of Vestibular Research*, in press.
Harris, L.R. and Lott, L.A. (1995). Sensitivity to full-field visual movement compatible with head rotation: variation with eye-in-head position.*Visual Neurosciences*, in press.
Howard, I.P. and Sun, L. (1994). Cycloversion and cyclovergence: the effects of the area and position of the visual display. *Experimental Brain Research*, 100, 509-514.
Howard, I.P. (1995). Depth from binocular rivalry without spatial disparity. *Perception*, 24, 67-74.

Papers in Refereed Journals cont'd.

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Howard, I.P. and Howard, A. (1994). Vection: the contributions of absolute and relative visual motion. *Perception*, 23, 745-751.

Howard, I.P. and Childerson, L. (1994). The contribution of motion, the visual frame and visual polarity to sensations of body tilt. *Perception*, 23, 753-762.

Telford, L., **Howard, I.P**. and Ohmi, M. (1995). Heading judgments during active and passive self motion. *Experimental Brain Research*, in press.

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Jenkin, M., Milios, E. and Tsotsos, J. (1994). TRISH: A binocular robot head with torsional eye movements, special issue on mobile robots, robot heads and active vision of the *International Journal of Pattern Recognition and Artificial Intelligence*, in press.

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Cooperstock, J. and **Milios, E**. (1993). A neural-network operated vision-guided mobile robot arm for docking and reaching. *Journal of Robotics and Autonomous Systems*, in press.

Feng, Lu and **Milios, E.** (1994)**.** Optimal Spline Fitting to Planar Shape. *Signal Processing*, Elsevier Science Publishers, 37, 129-140.

Nakamizo, S., Shimono, K., Kondo, M. and **Ono, H**. (1994). Visual directions of two stimuli in the Panum's limiting case. *Perception*, 23, 1037-1048.

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O'Shea, R.P., Blackburn, S.G. and **Ono, H**. (1994). Contrast as a depth cue.*Vision Research*, 34, 1595-1604.

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Ono, H. and Ujike, H. (1994). Apparent depth with MAE and head movement. *Perception*, 23,1241-1248.

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Regan, D. (1995). Spatial vision in children and adults: A tribute to Russel Harter. *International Journal of Neuroscience*, 80, 153-172.

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Regan, D., Hamstra, S.J., Kaushal, S., Vincent, A., Gray, R. and Beverley, K.I. (1995). Visual processing of an object's motion in three dimensions for a stationary or a moving observer. *Perception*, 24, 87-103.

Regan, D. and Simpson, T.L. (1995). Multiple sclerosis can cause visual processing deficits specific to texture-defined form. *Neurology*, 45, 809-815.

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Regan, D., Gray, R. and Hamstra, S.J. (1995). Evidence for a neural mechanism that encodes angles. *Vision Research*, in press.

Portfors-Yeomans, C. V. & Regan, D. (1995) Discrimination of the direction and speed of motion in depth from binocular information alone. J. Exp. Psychol.: Hum. Percept & Perform. In press.

Simpson, T. L. (1995). Vision thresholds from psychometric analyses: alternatives to Probit analysis. *Optometry and Vision Science*, 72, 371-377.

Simpson, T. and **Regan, D.** (1995). Test-retest variability and correlations between tests of texture processing, motion processing, visual acuity and contrast sensitivity. *Optometry and Vision Science*, 72,11-16.

Regan, D. and He, P. (1995). Magnetic and electrical brain responses to chromatic contrast in human. *Vision Research*, in press.

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Regan M.P. (1995). Half-wave linear rectification of a frequency modulated sinusoid. *Journal of Applied Mathematics and Computation*, in press.

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Rivest, J., Cavanagh, P. and Lassonde, M. (1994). Interhemispheric depth judgement. *Neuropsychologia*, 32, 69-77.

Cavanagh, P., Saida, S. and **Rivest, J.** (1995). The contribution of color to motion parallax. *Vision Research*, 35, 1871-1879.

Rivest, J. and Cavanagh, P. (1995). Multiple attributes are coded together for localization of contours. *Vision Research*, in press.

Bowns, L., Kirshner, E.L. and **Steinbach, M.J.** (1994). Shear sensitivity in normal and monocularly enucleated adults. *Vision Research*, 34, 3389-3395.

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J.S. Ostroff. Automated modular specification and verification of real-time reactive systems. *IEEE Workshop on Industrial-Strength Formal Specification Techniques WIFT'95*, Boca Raton, Florida, April 1995.

M. Lawford, M. Wonham, and J.S. Ostroff. State event observers for labelled transition systems. *33rd IEEE CDC*, Lake Buena Vista, Florida, Dec. 1994.

Conference Presentations and Abstracts

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Bigel, M. and **Harris, L.R.** (1994). The effects of prolonged unilateral rotation on nystagmus: vestibular responses of skaters. *Canadian Brain and Behaviour Conference*, Vancouver, Canada.

Harris, L R. Visual coding of self movement. *Conference on Neural Control of Movement*t. Hawaii, 1994.
Harris, L.R. Visual-vestibular interactions. *Conference on Neuromorphic Engineering*. Telluride, Colorado, 1994.
Harris, L.R. and Mente, P. The oculomotor response to visual and vestibular stimulation around different axes. *Neuroscience Abstracts*, 1994, in press.
Harris, L.R and Mente, P. The combination of visual and vestibular information in processing self motion, *The 3rd International Symposium on the Head/Neck system,* Vail, Colorado, 1995.
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Dong, J., **Howard, I.P**, and Zacher, J.E. Human torsional optokinetic nystagmus in response to central and peripheral stimulation. *Investigative Ophthalmology and visual Science*, 1995, 36, S352.

Pierce, B.J. and **Howard, I.P**. Illusory inclination and depth contrast in stereoscopic display systems. *Investigative Ophthalmology and Visual Science*, 1995, 36, S376.

Howard, I.P. Stereoscopic distortions in virtual-reality systems. *Conference on Virtual Reality*, DCIEM, Toronto, June, 1995

Howard, I.P. Understanding stereoscopic vision. Invited paper to the *Annual Conference of the Advanced Telecomunication Research Laboratories*, Kyoto, Japan. November, 1994.

Howard, I.P. Aftereffects of active and passive body rotation. Paper presented at the *International Conference on The Neurology of Human Spatial Orientation*, Ibiza. May, 1995.

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Dudek, J., **Jenkin, M.**, **Milios, E.**, and Wilkes, D. Exploring graph-like worlds embedded in a metric map. *Vision Interface*, Quebec City. May, 16-19, 1995, pp. 195-202.

Kaneko, H. and Howard, I.P. Spatial organization of vertical disparity pooling. *Investigative Ophthalmology and Visual Science*, 1995, 36, S230.

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Prassler, E. and **Milios, E**. Motion planning amongst arbitrarily moving unknown obstacles. *1994 IEEE/RSJ International Conference on Intelligent Robots and Systems, (IROS)*, Munich. Sept., 1338-1346.

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Regan, D. Applying psychophysical research to the design of stereo flight simulators.*TORON-NIHON Workshop on Virtual Reality*, Toronto.

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Rivest, J., Boutet, I. and Intriligator, J. Perceptual learning of orientation discrimination across attributes. *Investigative Ophthalmology and Visual Science*, 1995, 36, S376.

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Steeves, J.K.E., Reed, M.J., Gallie, B.L., Kraft, S.P. and Steinbach, M.J. (1995). Contrast letter acuity in the the remaining eye of enucleates and depressed in the non-deviating eye of strabismics subjects. *Investigative Ophthalmology and Visual Science*, 1995, 36, S645.

Irving, E.L., **Goltz, H.C**., Kraft, S.P. and **Steinbach, M.J.** (1995). Saccade dynamic and adjustable suture strabismus surgery. *Annual Department of Ophthalmology Research Day Meeting*, Univ. of Toronto

Irving, E.L., **Goltz, H.C.**, Kraft, S.P. and **Steinbach, M.J.** (1995). Adjustable suture strabismus surgery affects saccade dynamics. *Investigative Ophthalmolgy and Visual Science*, 1995, 36, S956.

Vincent, A. and Regan, D. Parallel processing of spatial frequency, temporal frequency, orientation and contrast. *Investigative Ophthalmology and Visual Science*, 1995, 36, S438.

Zacher, J.E., Allison, R.S., and Howard, I.P. The effect of active movement on postrotatory nystagmus and illusory body rotation. *Investigative Ophthalmology and Visual Science*, 1995, 36, S685.

Colloquia

Laurence Harris
Dept. Psychology, Royal Holloway College, University of London, May, 1995

Ian Howard
Four seminars to the Advanced Telecommunication Research Laboratories, Kyoto, Japan, Nov. 1994.
Institute of Technology, Tokyo. Nov. 1994.
Deparment of Psychology, University of Dunedin, New Zealand, October 1994.
Department of Psychology, University of Auckland, New Zealand, October 1994.
Senior Scholars Lecture, York University, March, 1995.

Evangelos Milios
University of Patras, Department of Computer Science, June 19, 1994.
Technical University of Athens, Department of Computer Science, June 24 and 26, 1994.

Hiroshi Ono
Smith Kettlewell Eye Insititute, October 1995
ATR Human Information Processing Research Laboratories, Kyoto, Japan, Nov. 1994
NTT Basic Research Laboratories, Kanagawa, Japan, Feb. 1995
Tokyo Institute of Technology, Tokyo, Japan, March, 1995.

Martin Steinbach
Eye Research Institute of Canada (1995)
Hospital for Sick Children, Toronto - Ophthalmology Rounds (1995)

York Conference on Visual Coding

An International Conference on Visual Coding was held at York University on June 20-24th, 1995. There were 18 invited speakers, 26 posters and 117 registrants. The conference was sponsored by the The Institute for Space and Terrestrial Science, The Centre for Vision Research, and The Department of Psychology.

Collaborative Research

Otmar Bock
Visuo-motor performance during parabolic flight (with CSA and NASA)
Miniaturized device for visuo-motor testing (with CSA)
Study of human motor skills aboard the Neurolab Space Shuttle flight (with CSA and NASA)
Visual localization in Strabismic patients (with Dr. Steinbach)

Doug Crawford
Dr. Douglas Tweed, Dept. Physiology, U. Western Ont., Dept. Neurology, U. Tubingen, Three dimensional geometry of eye movements.
Dr. Tutis Vilis (Dept. Physiology, U. Western Ont, on Neurophysiology of eye movements.
Dr. Daniel Guitton, Montreal Neurological Institute, on Eye-head coordination during gaze shifts.

Keith Grasse
Dr. Colin Blakemore, Dept. of Physiology, University of Oxford, Oxford, England
Dr. Franklin Sengpiel, Dept of Physiology, University of Oxford, Oxford, England
Dr. Julie Mendelson, Division of Life Sciences, University of Toronto, Scarborough, Ontario
Dr. Alison Sekuler, Dept. of Psychology, University of Toronto, Toronto, Ontario
Dr. Pat Bennett, Dept. of Psychology, University of Toronto, Toronto, Ontario
Dr. Ed Gruberg, Dept. of Biology, Temple University, Philadelphia, U.S.A.
Dr. Rob Douglas, Dept. of Ophthalmology, University of British Columbia, Vancouver, B.C.

Laurence Harris
NASA Ames (California, US). Project on intra-vestibular interactions.
MIT/Massachusetts Eye and Ear Infirmary (Mass, US). project on visual-vestibular interactions.
Co-author of a planned book on "Seeing During Motion" with Dr. Graham Barnes (London, UK).

Ian P. Howard
Co-author with Dr. Brian Rogers of Oxford University, book on Binocular Vision and Stereopsis.
Collaboration with Dr. Ron Kruk of CAE on visual factors in flight simulators.
Coinvestigator with C. Oman of MIT on the space shuttle Neurolab mission.

Evangelos Milios
With G. Dudek, Dept.of Computer Science, McGill University.
With D. Wilkes, Ontario Hydro Technologies, on Swarm robotics.
With E. Prassler, FAW, University of Ulm, Germany, on Dynamic Mobile robot navigation using distributed representations
With J. Tsotsos, Dept. of Computer Science, Univ. of Toronto, on Architectures for Auditory attention.

Hiroshi Ono
With Drs. Nicholas Wade and Michael Swanston at University of Dundee on visual motion and orientation.
Visiting Scientist, ATR Human Information Processing Research Laboratories, Kyoto, Japan, 1994.

David Regan
With Dr. R. Kruk (CAE) on visual factors in aviation and flight simulator design.
With Dr. L. Reid (Institute of Aerospace Science and Engineering, Univ. of Toronto) on flight simulators.

Josée Rivest
Collaboration with James Intriligator at Harvard University on perceptual learning experiments.

Martin Steinbach
Collaboration with Professor Iain Donaldson, University of Edinburgh, planned for early 1996.

Centre for Vision Research Lecture Series - 1994/95

K. Grasse	Psych. York	Motor Control
L. Harris	Psych. York	Linear Motion
M. Steinbach	Psych. Atk	Eye position and gravity
I. Howard	Psych. York	Binocular eye movements

J. Tsotsos	Comp. Sci. U of T	Attention
P. Cavanagh	Psych. Harvard	Visual Attention
J. Rivest	Psych. Glendon	Multi-dimensional Vision
V. Goel	Psych. York	Face recognition
I. Donaldson	Ctr. for Vision, UK	The role of proprioception in eye movement control