

# CENTRE FOR VISION RESEARCH

York University, North York, Toronto, Ontario, M3J 1P3

Annual Report, July 1992 to July 1993

## Faculty

- John Amanatides      Assistant Professor of Computer Science.  
Research Associate in the Human Performance in Space Laboratory.  
Interests: computer graphics.
- Otmar Bock             Senior Scientist in the Human Performance in Space Laboratory.  
Adjunct Professor of Psychology.  
Interests: intersensory and sensory-motor coordination and robotics.
- Keith Grasse         Associate Professor of Psychology and Biology.  
Principal Investigator in the Human Performance and Space Laboratory.  
Interests: neurophysiology of the visual system, eye movements, auditory neurophysiology, neuropharmacology.
- Marc Green            Adjunct Associate Professor, York University.  
Interests: visual psychophysics and computer vision.
- Laurence Harris      Associate Professor of Psychology.  
Investigator in the Human Performance and Space Laboratory.  
Interests: electrophysiology of the vestibular and oculomotor systems.
- Peiyuan He            Scientist in the Human Performance in Space Laboratory.  
Adjunct Assistant Professor in Psychology.  
Interests: neuromagnetometry of visual and auditory evoked magnetic brain activity, visual evoked potentials, eye movements.
- Ian Howard            Professor of Psychology and Biology.  
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 Kaiser           Professor 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.
- Masao Ohmi            Scientist in the Human Performance in Space Laboratory.  
Adjunct Assistant Professor of Psychology.  
Interests: oculomotor system and visual-vestibular interactions.
- Hiroshi Ono            Professor of Psychology.  
Principal Investigator in the Human Performance in Space Laboratory.  
Interests: the visual perception of direction and distance, eye movements.

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

### **Faculty cont'd**

David Regan Professor of Psychology and Biology at York University.  
Professor of Ophthalmology and Medicine at the University of Toronto.  
Co-Director of the 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.

Josee Rivest Assistant Professor of Psychology, Glendon College, York University.  
Interests: multiple attributes in localization of contour combined representation.

Minas Spetsakis Assistant Professor of Computer Science.  
Research Associate in the Human Performance in Space Laboratory.  
Interests: computer vision and robotics.

Paul Stager Professor of Psychology.  
Research Associate in the Human Performance in Space Laboratory.  
Interests: Human factors in aerospace performance and system design.

Martin Steinbach Professor of Psychology and Biology.  
Associate Director of 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.

### **Visiting Scientists 1992-93**

Dr. Richard Abadi	Manchester University, England
Dr. Brian Rogers	Oxford University, England
Dr. Nicholas Wade	Dundee University, Scotland

### **Visiting Scientists 1993-94**

Dr. B. Gilliam	Working with H. Ono
Mr. T. Mihashi	Working with D. Regan

## **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
Dr. John Lipitkas	Working with O. Bock
Dr. Marian Regan	Working with D. Regan
Mr. T. Mihashi	Working with D. Regan
Mr. Ziqiang Wu	Working with E. Milios

## **Post Doctoral Fellows**

Allan Ho	Working with I. Howard
Hirohiko Kaneko	Working with I. Howard
Piotr Jasiobedzki	Working with E. Milios at U. of T.
Lori Lott	Working with L. Harris
Trefford Simpson	Working with D. Regan
Li Sun	Working with I. Howard
Laura Telford	Working with I. Howard
Hiroyasu Ujike	Working with H. Ono
Alex Vincent	Working with D. Regan
Honguy Zhang	Working with L. Harris

## **Graduate students (supervisors)**

Laura Childerson (Howard)	Obtained MA in September, 1992
Carol Dengis (Steinbach)	3rd year Ph.D.
Jingyu Dong (Howard)	2nd year M.Sc.
Tim Field (Ostroff)	3rd year M.Sc.
Roger Gray (Regan)	1st year Ph.D.
Herb Goltz (Steinbach)	2nd year Ph.D
Carl Gruden (Ostroff)	3rd year M.Sc.
Lorraine Gunther (Ono)	3rd year M.A.
Stan Hamstra (Regan)	4th year Ph.D.
Sean Hickey (Bock)	1 yr. M.A.
Suneeti Kaushal (Regan)	Obtained MA in June 1993
Renate Korn (Ono)	2nd year M.A.
Cao Lianqun (Kaiser)	Obtained MA., Dec. 1992
Feng Lu (Milios)	5th Ph.D at U of T.
Bernard Majaris (Jenkin)	2nd year M.Sc.
Peter Mente (Harris)	1st year M.A.
X. Sun (Spetsakis)	Obtained M.Sc. Winter, 1993
Ziqiang Wu (Milios)	Obtained M.Sc.in August 1992
Sun Zuening (Spetsakis)	2nd year M.Sc.
Ling Yao (Amanatides)	2nd year M.Sc.
Christine Yeomans (Regan)	1st year Ph.D.
Jay Ying (Milios)	2st year M.Sc.
James Zacher (Howard)	4th year M.A.
Yian Zhang (Milios)	1st year M.Sc.
Hong Zhao (Milios)	2nd year M.Sc.

## Research Grants (Annual)

### **Amanatides**

NSERC Research Research Grant. Ray tracing and sampling	\$	22,000
NSERC Equip Grant with Jenkin, Milios and Spetsakis. High-performance graphics equipment		16,412
President's NSERC. NTSC encoder		3,000
President's NSERC with E. Milios. Conference GI/VI '93		1,200

### **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.		120,000
Canadian Space Agency Contract with K. Money. Eye-hand coordination in microgravity.		55,000

### **Grasse**

NSERC Operating Grant.		28,000
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### **Harris**

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

NSERC Operating Grant. Visual pursuit and induced visual motion.		39,000
NSERC Conference Grant with Jenkin and Regan. Stereopsis and Optic Flow.		8,000
NATO Travel Grant with Rogers. Stereoscopic Vision.		7,000
NATO Conference Grant with Rogers. Stereopsis and Optic Flow.		22,000
Ontario Centre of Excellence Grant with Bock, Grasse, Harris, Ono and Regan, Human Performance Lab		485,000

### **Jenkin**

NSERC Operating Grant. Representation and control in dynamic stereopsis.		17,000
PRECARN ARK Project with Milios.		81,042
Sabbatical leave fellowship fund. Robotic sensor evaluation.	3,500	
President's NSERC Grant. Seed grant for a pool playing robot.		1,800
President's NSERC Grant with Milios, Armanatides & Spetsakis. Sensor based robotics lab.facility		4,000

### **Kaiser**

NSERC Operating Grant. Studies in colour vision.		44,800
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### **Milios**

NSERC Operating Grant.		17,000
Ontario-Quebec Exchange grant with Jenkin and Dudek. Robot navigation and range sensing.		1,950
Presidents' NSERC Equipment Grant		3,000

### **Ohmi**

NSERC Operating Grant. Frames of reference for perceived direction of self motion.		15,000
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### **Ono**

NSERC Operating Grant. Sensory and motor aspects of space perception.		35,000
NATO Travel Grant with Wade and Swanston. Motion and orientation in spatial vision.		8,500

### **Ostroff**

NSERC Operating Grant		20,000
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### **Regan**

NSERC Operating Grant.		72,000
MRC Operating Grant.		61,192
NIH Grant.		68,616
AROSR		180,000

### **Rivest**

President's NSERC		3,000
Minor Research Grant		3,500
Junior Faculty Fund		1,172
SCOTL - Teaching/Learning Development Grant		1,800

### **Spetsakis**

NSERC Operating Grant. Visual motion analysis.		18,000
President's NSERC, Moving Platforms		2,000
NSERC Conference Grant	700	

### **Stager**

Transport Canada. Human engineering in canadian automated air traffic system		
Transport Canada. Human engineering for the canadian airspace management simulator	115,000	

### **Steinbach**

NSERC Operating Grant. Human oculomotor control.		31,000
MRC Operating Grant. Visual function in strabismic and monocularly enucleated children		64,000

**Publications June 1992-June 1993****Books**

- Green, M. (Ed.). *Knowledge Aided Design*. Academic Press, London, 1992.
- Harris, L.R. and Jenkin, M.J. (Eds.). *Spatial Vision in Humans and Robots*. Cambridge University Press. New York, 1993, in press.
- Ono, H. *Precision and Accuracy*. [Educational Computer Package]. Santa Barbara: Intellimation, 1993.
- Wise, J.A., Hopkin, V.D. and **Stager, P.** (Eds.). *Verification and Validation of Complex Systems: Human Factors Issues*. NATO ASI Series F, Vol. 110. Berlin: Springer-Verlag, 1993, in press.

**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, in press.
- Green, M. Conceptions and misconceptions of design. In M. Green (Ed), *Knowledge Aided Design*, Academic Press, London, 1992.
- 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*, 1992, in press.
- Harris, L.R. and Jenkin, M.J. Spatial vision in humans and robots. In Harris L.R. and Jenkin M.J. (Eds) *Spatial Vision in Humans and Robots*. Cambridge University Press, New York, 1993, in press.
- Harris, L.R. Visual motion due to movements of the eye, head and body. In A.T. Smith and R. Snowden (Eds), *Visual Motion*, Academic Press, 1993, in press.
- Howard, I.P. The optokinetic system. In J.A. Sharpe and H.O. Barber (Eds.) *The Vestibulo-ocular Reflex, Nystagmus and Vertigo*. New York: Raven Press, 1993, 163-184.
- Howard, I. P. Cycloverision, cyclovergence and perceived slant. In L. Harris and M. Jenkin (Eds.), *Spatial Vision in Humans and Robots*. New York: Cambridge University Press, 1993, in press.
- Howard, I.P. The stability of the visual world and the perception of self motion. To appear in Wallman, J. and Miles, F.A. (Eds.) *Visual Motion and its Role in the Stabilization of Gaze*. Elsevier, 1993, 103-118.
- Li, Y.E. and **Jenkin, M.R.M.** Building octree models of small objects. In A. Basu and X. Li (Eds.), *Computer Vision: Systems, Theory and Application*. World Scientific Press, Singapore, 1993, 221-236.
- Wang, Z. and **Jenkin, M.** Using complex gabor filters to detect and localize edges and bars. In C. Archibald (Ed.), *Advances in Machine Vision: Strategies and Applications*. Singapore: World Scientific, 1992, 151-170.
- Wilkes, D., Dudek, G., **Jenkin, M.** and **Milios, E.** Modelling sonar range sensors. In C. Archibald (Ed.), *Advances in Machine Vision: Strategies and Applications*. Singapore: World Scientific Press, 1992, 361-370.
- Ono, H. and Swanston, M.T. Commentary on Gogal's "phenomenal space." In S. Masin (Ed.), *Theories in Perception*, 1993, in press.
- Ostroff, J.S. Synthesizing reactive systems, real-time: Theory in practice, *LNCS 600*, Springer-Verlag, 1992.
- Regan, D. Detection and discrimination of spatial form in patients with eye or visual pathway disorders. Fifth Annual Retina Research Foundation Symposium. *Contrast Sensitivity: From Receptors to Clinic*, M.I.T. Press, 1993, in press.
- Regan, D. Detection and discrimination of motion-defined and luminance-defined two-dimensional form. In L. Harris and M. Jenkins (Eds.) *Spatial Vision in Humans and Robots*, Cambridge University Press, 1993, in press.
- Regan, D. Nonlinearities in psychophysical models of the processing of spatial form and motion. In R. Pinter and B. Nabet (Eds.) *Nonlinear Vision*, London: CRC Press, 1992, 293-307.

- Regan, M.P. and Regan, D. A frequency domain method for testing nonlinear multi-neuron models against data. In R. Pinter and B. Nabet (Eds.) *Nonlinear Vision*, London: CRC Press, 1992, 265-291.
- Sun, X. and **Spetsakis, M.** A two-step robust approach to 3-D motion estimation. In X. Li and A. Basu (Eds.) *Computer Vision: Systems, Theory, and Applications*, World Scientific Press, 1993, in press.
- Stager, P. Validation in complex systems: Behavioral issues. In J.A. Wise, V.D. Hopkin and P. Stager (Eds.), *Verification and Validation of Complex Systems: Human Factors Issues. NATO ASI Series F, Vol. 110.* Berlin: Springer-Verlag, 1993, in press.
- Steinbach, M. J. The need for eye muscle proprioception. In L. Jami, E. Pierrot-Deseilligny and D. Zytznicki (Eds.), *Muscle Afferents and Spinal Control of Movement.* Oxford, Pergamon Press, 1992, 239-244.

### **Papers in Refereed Journals**

- Bock, O., D'Eleuterio, G.M.T., Lipitkas, J. and Grodski, J.J. Parametric motion control of robotic arms: A biologically based approach using neural networks. *Telematics and Informatics*, in press.
- Bock, O. Localization of objects in the peripheral visual field. *Behavioural Brain Research*, in press.
- Bock, O. and Arnold, K.E. Error accumulation and error correction in sequential pointing movements. *Experimental Brain Research*, in press.
- Bock, O. Early stages of load compensation in human aimed arm movements. *Behavioural Brain Research*, 1993, 55, 61-68.
- Bock, O., Howard, I.P., Money, K.E. and Arnold, K.E. Accuracy of aimed arm movements in changed gravity. *Aviation space and environmental Medicine*, 1992, 63, 994-998.
- Bock, O. Adaptation of aimed arm movements to sensory-motor discordance: Evidence for direction-independent gain control. *Behavioural Brain Research*, 1992, 51, 41-50.
- Bock, O. and Arnold, K.E. Motor control prior to movement onset: Preparatory mechanisms for pointing at visual targets. *Experimental Brain Research*, 1992, 90, 209-216.
- Dengis, C.A., Steinbach, M.J., Ono, H., Draft, S.P., Smith, D.R. and Graham, J.E. Egocenter location in strabismic is the median plane and is unchanged by surgery. *Investigative Ophthalmology and Visual Science*, in press.
- Dengis, C.A., Steinbach, M.J., Goltz, H.C. and Stager. C. Visual alignment from the midline: a declining developmental trend in normal, strabismic and monocularly enucleated children. *Journal of Pediatric Ophthalmology and Strabismus*, 1993, in press.
- Gonzalez, E.G., Steinbach, M.J., Ono, H. and Rush-Smith, N. Vernier acuity in monocular and binocular children. *Clinical Vision Sciences*, 1992, 7, 257-261.
- Grasse, K.L., Douglas, R.M. and Mendelson, J.R. Expansion of visual receptive fields in the superficial layers of the superior colliculus induced by amphetamine. *Experimental Brain Research*, 1993, 92, 453-466.
- Mendelson, J.R. and **Grasse, K.L.** A comparison of monaural and binaural responses to frequency modulated (FM) sweeps in cat primary auditory cortex. *Experimental Brain Research*, 1992, 91, 435-454.
- Mendelson, J.R., Schreiner, C.E., Sutter, M. and **Grasse, K.L.** Functional topography of cat primary cortex: II. Responses to frequency modulated sweeps. *Experimental Brain Research*, 1993, 94, 65-87.
- Green, M. Visual Search: Detection, identification and localization. *Perception*, 1992, 21, 765-777.
- Harris, L.R. and Smith, A.T. Second-order motion stimuli do not evoke optokinetic nystagmus. *Visual Neuroscience*, 1992, 9, 565-570.
- Wall, C., **Harris, L.R.** and Lathan C. Interactions between otoliths and vision revealed by the response to z-axis linear movements. *Annals of the New York Academy of Sciences*, 1992, 656, 898-900
- Harris L.R., Lewis T.L. and Maurer, D. Brainstem and cortical contributions to the generation of optokinetic eye movements in humans. *Visual Neuroscience*, 1993, 10, 247-259
- Findlay J.M. and **Harris L.R.** Horizontal saccades to stereoscopically presented targets of differing disparity. *Vision Research*, 1993, 33, 1001-1010.
- Harris, L.R., Goltz, H. and Steinbach M.J. The effect of gravity on the resting position of the cat's eye. *Experimental Brain Research*, 1993, in press.

- Harris, L.R. Keeping track of visual codes which move from cell to cell during eye movements. *Behavioural and Brain Sciences*, 1993, in press.
- He, P. and Fowler, E. The role of saccades in the perception of texture patterns. *Vision Research*, 1992, 32, 2151-2163.
- Cheung, B.S.K., Money, K., **Howard, I.P.**, Kirienko, N., Johnson, W., Lackner, J. and Evanoff, J. Human ocular torsion during parabolic flights: An analysis with scleral search coils. *Experimental Brain Research*, 1992, 90, 180-188.
- Howard, I.P. and Marton, C. Visual pursuit over textured backgrounds in different depth planes. *Experimental Brain Research*, 1992, 90, 625-630.
- Cheung, B.S.K., Money, K.E. and **Howard, I.P.** Human gaze stability during brief exposure to reduced gravity. *Vestibular Research*, in press.
- Howard, I.P. and Sun, L. Cyclovergence: a comparison of objective and psychophysical measurements. *Experimental Brain Research*, 1993, in press.
- Jenkin, M., Milios, E. and Tsotsos, J. 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.
- Jenkin, M.R.M. and Jepson, A. D. Stereopsis from local phase differences: A cross-correlation based approach. *CVGIP: Image Understanding*, in press.
- Kaiser, P.K. and Y. Nakano. Color fusion and flicker fusion frequencies using tritanopic pairs. *Vision Research*, 1992, 8, 1417-1423.

### **Papers in Refereed Journals cont'd.**

- Kaiser, P.K., Kremers, J. and Lee, B.B. Sensitivity of Macaque Retinal Ganglion cells and human observers to combined luminance and chromatic modulation. *Journal of the Optical Society of America, A*, 1992, 9, 1477-1485.
- Kaiser, P.K., Valberg, A., Lee, B.B. and Kremers, J. Responses of macaque ganglion cells to movement of chromatic borders, *Journal of Physiology*, 1992, 458, 579-602.
- Cooperstock, J. and **Milios, E.** A Neural-Network Operated Vision-Guided MobileRobot Arm for Docking and Reaching. *Journal of Robotics and Autonomous Systems*, 1993, in press.
- Feng Lu and **Milios, E.** Optimal Spline Fitting to Planar Shape. *Signal Processing*, Elsevier Science Publishers, in press.
- Milios, E., Jenkin, M. and Tsotsos, J. Design and performance of TRISH, a binocular robot head with torsional eye movements. *International Journal of Pattern Recognition and AI* special issue on "Mobile robots, robot heads and active vision", 1993, 7, 51-68.
- Swanston, M.T., Wade, N.J., **Ono, H.** and Shibuta, K. The interaction of perceived distance with the perceived direction of visual motion during movements of the eyes and of the head. *Perception and Psychophysics*, 1992, 52, 705-713.
- Nakamizo, S., Shimono, K., Kondo, M. and Ono, H. Visual directions of two stimuli in the Panum's limiting case. *Perception*, 1993, in press.
- Ostroff, J. S. A verifier for real-time systems. *Real-Time Systems Journal*, 1992, 4, 5-35.
- Ostroff, J. S. Formal methods for the specification and design of real-time safety critical systems. *Journal of Systems and Software*, 1992, 1, 33-60.
- Giaschi, D., **Regan D.**, Kraft, S. and Kothe, A.C. Crowding and contrast in amblyopia. *Optometry and Vision Science*, 1993, 70, 192-197.
- Regan, D., Kaushal, S. Monocular judgement of the direction of motion in depth. *Vision Research*, 1993, in press.
- Regan, M.P. and Regan, D. Nonlinear terms produced by passing amplitude-modulated sinusoids through Corey and Hudspeth's hair cell transducer function. *Biological Cybernetics*, in press.
- Regan, D. The divergence of velocity and visual processing. *Perception*, 1993, 22, ?? - ??.
- Regan, D. Binocular correlates of the direction of motion in depth. *Vision Research*, 1993, in press.
- Regan, D., Kaiser, P.K. and Nakano Y. Dissociation of chromatic and achromatic processing of spatial form by the titration method. *Journal of the Optical Society of America*, 1993,10, 1314-1323.

- Regan, D., Giaschi, D. and Fresco, B. Measurement of glare sensitivity in cataract patients using low-contrast letter charts. *Ophthalmic and Physiological Optics*, 1993, 13, 115-123.
- Regan, D. and Lee, B.B. A comparison of the human 40 Hz response with the properties of macaque ganglion cells. *Visual Neuroscience*, 1993, 10, 439-445.
- Regan, D. Spatial vision in children and adults: A tribute to Russel Harter. *International Journal of Neuroscience*, 1993, in press.
- Regan, D., Giaschi, D., Kraft, S. and Kothe, A.C. Method for identifying amblyopes whose reduced line acuity is caused by defective selection and/or control of gaze. *Ophthalmic and Physiological Optics*, 1992, 12, 425-432.
- Regan, D. and Hamstra, S. Dissociation of discrimination thresholds for time to contact and for rate of angular expansion. *Vision Research*, 1993, 33, 447-462.
- Giaschi, D., **Regan, D.**, Kraft, S. and Hong, X.H. Defective processing of motion in the fellow eye of unilateral amblyopes. *Investigative Ophthalmology Visual Science*, 1992, 33, 2483-2489.
- Regan, D., Giaschi, D., Sharpe J.A. and Hong X.H. Visual processing of motion-defined form: selective failure in patients with parieto-temporal lesions. *Journal of Neuroscience*, 1992, 12, 2198-2210.
- Regan, D. and Hamstra, S. Shape discrimination and the judgement of perfect symmetry: dissociation of shape from size. *Vision Research*, 1992, 32, 1845-1864.
- Regan, D. Visual judgements and misjudgements in cricket, and the art of flight. *Perception*, 1992, 21, 91-115.
- Regan, D. and Hamstra S. Dissociation of orientation discrimination from form detection for motion-defined bars and luminance-defined bars: effects of dot lifetime and presentation duration. *Vision Research*, 1992, 33, 1655-1666.
- Rivest, J., Cavanagh, P. and Lassonde, M. Interhemispheric depth judgement. *Neuropsychologia*, 1993, in press.
- Spetsakis, M. Linear Algorithm for the point and Line Correspondence Problem, Computer Vision, Graphics and Image Processing. *Image Understanding*, 1992, 52, 230-241.
- Spetsakis, M. and Aloimonos, J. (Yiannis). A Multi-Frame Approach to Visual Motion Perception. *International Journal of Computer Vision*, 6, 1991.

### **Published Proceedings**

- Amanatides, J. and Szurkowski, E. A simple, flexible, parallel graphics architecture. *Proceedings Graphics Interface '93*.
- Lipitkas, J., **Bock, O.**, D'Eleuterio, G.M.T., and Grodski, J.J. Parametric control of point-to-point robotic arm movements, using artificial neural networks. *Proceedings 7th CASI Conference on Astronautics*, Ottawa, 1992.
- Bock, O., Howard, I., Money, K. and Arnold, K. Motor performance in changed gravity. *Proceedings 7th CASI Conference on Astronautics*, Ottawa, 1992.
- Wall, C., **Harris, L.R.**, Lathan C. Characterization of eye movement responses to z-axis linear acceleration. *Proceedings of the Barany Society Meeting* (Prague), in press.
- Wall, C., Lathan, C. and **Harris L.R.** Visual-vestibular responses to z-axis linear accelerations in humans. *Proceedings of the Barany Society Meeting* (Prague), in press.
- Dudek, G., Jenkin, M., Milios, E. and Wilkes, D. Robust positioning with a multi-agent robotic system. *IJCAI-93 Workshop on dynamically interacting robots*, 1993.
- Dudek, G., Jenkin, M., Milios, E. and Wilkes, D. On the utility of multi-agent autonomous robot systems. *IJCAI-93 Workshop on dynamically interacting robots*, 1993.
- Dudek, G., Jenkin, M., Milios, E. and Wilkes, D. A taxonomy for swarm robotics. *IROS*, Yokohama, Japan, 1993
- Jenkin, M., Milios, E., Jasiobedzki, P., Bains, N. and Tran, K. Global navigation for ARK. *IROS*, Yokohama, Japan, 1993
- Dudek, G., Jenkin, M., Milios, E., and Wilkes, D. Map validation and self-location in a graph-like world. *IJCAI*, 1993.



- Dudek, G., Jenkin, M., Milios, E. and Wilkes, D. Organizational characteristics for multi-agent robotic systems, *VI 93*, 91-96, 1993.
- Regan, D., Hamstra, S. and Kaushal, S. Visual factors in the avoidance of front-to-rear end highway collisions. *Proceedings Human Factors Soc. 36th Annual meeting*, 1992.

### **Conference Presentations and Abstracts**

- Bock, O. Target localisation by the peripheral retina. *NATO Conference on Stereopsis and Optic Flow*, York University, Toronto, 1993.
- Bock, O. Parametric motor control: A strategy for human and robotic arm movements. *IRIS-Workshop*, London, Ontario, 1993.
- Bock, O., D'Eleuterio, G.M.T., Lipitkas, J. and Grodski, J.J. Parametric motion control of robotic arms: A biologically based approach using neural networks. Accepted for *1993 Goddard Conference on Space Application Artificial Intelligence, Greenbelt, USA, 1993*.
- Bock, O., Arnold, K.E. and Cheung, B.S.K. Visuomotor performance under three different display conditions. *Aerospace Medical Association Meeting*, Toronto, 1993.
- Bock, O. Development of a visuo-motor coordination facility for space life science research. *Spacebound '93*, Ottawa, 1993.
- Bock, O. and Arnold, K. Control strategies for aimed arm movements in 3-dimensional space. *Society of Neuroscience Abstract*, 18, 1552, 1992.
- Dengis, C. A., Steinbach, M.J., Goltz, H.C. and Stager, C. Visual alignment from the midline: a declining developmental trend in normal, strabismic and monocularly enucleated children. *Investigative Ophthalmology and Visual Science*, 1993, 34, 1358.
- Dong, J. and Howard, I.P. Human torsional optokinetic nystagmus elicited by the upper versus the lower visual fields. *Investigative Ophthalmology and Visual Science*, 1993, 34, 1126.
- Goltz, H. C., Eizenman, M. and Steinbach, M.J. Fixation instability in darkness: eyes drift upwards. *Investigative Ophthalmology and Visual Science*, 1993, 34, 1499.
- Grasse, K.L. Neuromodulation in the superior colliculus of the cat. Invited lecture before the *Brain and Behaviour and Perception Group*, University of Toronto, December 4, 1992.
- Grasse, K.L. The superficial layers of the superior colliculus revisited. Invited lecture before the *Laboratory of Sensorimotor Research, National Institutes of Health*, Washington, DC. March 31, 1993.
- Grasse, K.L. and Mendelson, J.R. Differential effects of bicuculline eye injections on single units in the accessory optic system, visual cortex and superior colliculus. *Society of Neuroscience Abstract*, 1993.
- Green, M. Temporal sampling requirements for stereoscopic displays. *Stereoscopic Displays and Application III*, 1992, 101-111.
- Green, M. The perceptual basis of temporal aliasing and anti-Aliasing. *Human Vision, Visual Processing and Digital Display III*, 1992, 84-93.

### **Conference Presentations and Abstracts cont'd.**

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- Harris, L.R., Lathan C.E. and Wall, C. The effect of z-axis linear acceleration of the head on vertical optokinetic nystagmus depends on visual velocity. *Investigative Ophthalmology and Visual Science*, 1993, 34, 3964.
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- Howard, I.P. and Sun, L. Cyclovergence, cyclophoria and perceived slant. *Proceedings of the European Conference on Visual Perception, Perception*, 1992, 21, 88.
- Howard, I.P. Visual-vestibular relationships in helmet-mounted displays. *Research Council Conference on Helmet-mounted Displays*, San Diego, July 1992.

- Howard, I.P. Human Cyclovergence: Dynamics and stimulus. Paper presented at the *Clinical Eye Movement Society Conference*, Toronto, October 18, 1992.
- Howard, I.P. Spatial orientation in space. *Distinguished Speaker Series*, Johnson Space Centre, Houston, Feb. 1993.
- Howard, I.P. Shear disparities and the perception of surface inclination. Paper presented at the *NATO Advanced Workshop*, York University, June, 1993.
- Rüttiger, L., Kurtenboch, A., **Kaiser, P.K.** and Zrenner, E. Wavelength discrimination ability depends upon luminance flicker and saturation. *Investigative Ophthalmology and Visual Science*, 1993, 34, 743
- Mendelson, J.R., Schreiner, C.E., **Grasse, K.L.** and Sutter, M. Neural processing of frequency modulated (FM) sweeps in cat primary auditory cortex (AI). *Society of Neuroscience Abstract*, 1993.
- Mendelson, J.R. and **Grasse, K.L.** Neural mechanisms underlying frequency modulated (FM) sweep responses in auditory cortex. *Southern Ontario Neuroscience Association Abstract*, 1993.
- Grasse, K.L. and Mendelson, J.R. Effects of intravitreal bicuculline on response properties in the accessory optic system, the visual cortex and the superior colliculus. *Southern Ontario Neuroscience Association Abstract*, 1993.
- He, P. Human brain magnetic responses to pattern and to motion: Different neural origins. *International Conference and NATO Workshop on Binocular Stereopsis and Optic Flow*, York University, Toronto, 1993.
- He, P. Colour and brightness stimulation evoked different magnetic brain responses in human. *2nd Annual Inhouse Convention of York University*, 1993.
- He, P., Regan, M. and Regan, D. Audio-visual integration area in human brain: Identification and localization. *Canadian Society for Brain, Behaviour and Cognitive Science*, 1993.
- Jenkin, M. Computing disparities from phase. *NATO Workshop and York Vision Conference on Binocular Stereopsis and Optic Flow*, York University, June, 1993.
- Jenkin, M. Commentary on heads, stereo and robotics. *Canadian Institute for Advanced Research*, Chaffey's Locks, June, 1993.
- Jenkin, M., Milios, E., Tsotsos, J. and Down, B. A binocularrobotic head system with torsional eye movements" *IEEE International Conference on Robotics and Automation*, Atlanta, GA, May 2-6, 1993, pp. 776-781.
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- Nickerson, S. B., **Jenkin, M., Milios, E.,** Down, B., Jasiobedzki, P., Jepson, A., Terzopoulos, D., Tsotsos, J., Wilkes, D., Bains, N. and Tran, K. Design of ARK, a sensor-based mobile robot for industrial environments. *Intelligent Vehicles*, Tokyo, July, 1993, pp. 252-257.
- Nickerson, S. B., Long, D., **Jenkin, M., Milios, E.,** Down, B., Jasiobedzki, P., Jepson, A., Terzopoulos, D., Tsotsos, J., Wilkes, D., Bains, N. and Tran, K. ARK: Autonomous navigation of a mobile robot in a known environment. *International Conference on Intelligent Autonomous Systems: IAS-3*, Pittsburgh, 288-296, 1993.
- Dudek, G. and **Jenkin, M.** A Multi-level development environment for mobile robotics. *International Conference on Intelligent Autonomous Systems: IAS-3*, Pittsburgh, 542-550, 1993.
- Kaneko, H. and Howard, I.P. The perception of inclination and relative shear disparities. *Investigative Ophthalmology and Visual Science*, 1993, 34, 1185.
- Deng, X. **Milios, E.** and Mirzaian, A. Landmark Selection for Path Execution. *1993 IEEE/RSJ International Conference on Intelligent Robots and Systems*, July, 1993.
- Cooperstock, J. and **Milios, E.** An Efficiently Trainable Neural Network based Vision-Guided Robot Arm. *IEEE International Conference on Robotics and Automation*, Atlanta, GA, May 2-6, 1993, pp. 738-743.
- Wilkes, D., Dudek, G., **Jenkin, M.** and **Milios, E.** Multi-transducer sonar Interpretation. *IEEE International Conference on Robotics and Automation*, Atlanta, GA, May 2-6, 1993, pp. 392-397.

### **Conference Presentations and Abstracts cont'd.**

- Cooperstock, J. and **Milios, E.** Neural Network Control for a Vision-Guided Mobile Robot Arm. *IASTED International Conference on Control and Robotics*, Vancouver, Canada, August 4-7, 1992.
- Cooperstock, J. and **Milios, E.** Adaptive Neural Networks for Vision-Guided Position Control of a Robot Arm", *IEEE International Symposium on Intelligent Control*, August 11-13, 1992, Glasgow, Scotland, U.K.

- Milios, E. and Horton, T. A Combined Extended Circular Image and Spatial Occupancy approach to 2-D Contour Matching. *1992 IEEE/RSJ International Conference on Intelligent Robots and Systems*, July 7-10, 1992.
- Nakamizo, S. and **Ono, H.** Subjective staircase: A variation of the wallpaper illusion. *Japanese Vision Society Meeting*, Nagoga, Japan, 1993.
- Ono, H., Wade, N.J. and Swanston, M.T. William Charles Wells and binocular visual direction: A bicentennial tribute. *15th European Conference on Visual Perception*. Pisa, Italy, 1992.
- Ujike, H. and **Ono, H.** Two different lower thresholds for motion parallax. *15th European Conference on Visual Perception*, Pisa, Italy, 1992.
- Ono, H. and Ujike, H. zone in which motion parallax is completely effective. *Investigative Ophthalmology and Visual Science*, 34, 1721.
- Ujike, H. and **Ono, H.** Displacement signal is used for parallax depth. *Investigative Ophthalmology and Visual Science*, 34, 2399.
- O'Shea, R.P., Blackburn, S.G. and **Ono, H.** Aerial perspective, contrast, and depth perception. *Investigative Ophthalmology and Visual Science*, 34, 2367.
- Swanston, M.T. Wade, N.J. and **Ono, H.** The interaction of induced movement and eye movement. *EPS/Brain and Behaviour Society Joint Meeting*, Toronto, 1993.
- Ono, H. Visual direction and stereopsis. Invited paper. *International Conference and NATO Workshop on Binocular Stereopsis and Optic Flow*, York University, Toronto, 1993.
- Regan, M.P. and Regan, D. Nonlinear terms produced by passing amplitude modulated sinusoids through a hair cell transducer function. *Canadian Society for Brain, Behaviour and Cognitive Science*, Toronto, 1993.
- Giaschi, D., **Regan, D.**, Trope, G.E., Kothe, A.C. and Hong, X.H. Abnormal processing of motion-defined form in patients with primary open angle glaucoma and ocular hypertension. *Investigative Ophthalmology and Visual Science*, 1993, 34, 1265.
- Regan, D. and Kaushal, S. Monocular discrimination of the direction of motion in depth. *Canadian Society for Brain, Behaviour and Cognitive Science*, Toronto, 1993.
- Regan, D. and He., P. Magnetic brain responses to chromatic contrast in human. *Investigative Ophthalmology and Visual Science*, 1993, 34, 462.
- Bowns, L., Kirshner, L. and **Steinbach, M.J.** Hemifield relative motion bias in adults monocularly enucleated at an early age. *Investigative Ophthalmology and Visual Science*, 1993, 34, 1030.
- Rivest, J. and Cavanagh, P. Interattribute interaction contour localization. *Investigative Ophthalmology and Visual Science*, 1992, 33, 1342.
- Sun, X. and **Spetsakis, M.** A comparison of weighted LS methods with LS methods in 3-D motion estimation from stereo image sequences. *CVPR '93*, New York, NY.
- Hong, Z., **Milios, E.** and **Spetsakis, M.** Robot position estimation using higher order moments of laser profiles. *Proceedings of the Third Annual IRIS PRECARN Conference*, 1993.
- Steinbach, M.J. The need for eye muscle proprioception (with J. Lerman, B. Braude, L. Harris and H. Goltz). *Clinical Eye Movement Society*, 1992.
- Steinbach, M.J. Eye muscle proprioception. *American Association of Certified Orthoptists, Eastern Regional Meeting*, Toronto, 1993.
- Sun, L., Howard, I.P. and Kaiser, P. Asymmetrical cyclofusional responses. *Society for Neuroscience, Abstracts*, 1992.
- Telford, L. Howard, I. P. and Ohmi, M. The effects of discordant visual-motor or visual-vestibular information on judgments of heading. *Proceedings of the European Conference on Visual Perception, Perception*, 1992, 21, 50.

## Colloquia

### **Otmar Bock**

Dept. of Psychology, Univ. of Toronto, CDN, 1993  
Dept. of Aeronautics&Astronautics, MIT, USA, 1993  
Dept. of Psychology, Univ. of Massachusetts, USA, 1993  
Dept. of Computer Science, Univ. of Massachusetts, USA, 1993  
Dept. of Psychology, York Univ., CDN, 1993  
L'Ecole de Readaptation, Univ. de Montreal, CDN, 1992  
Inst. of Physiology, CS Academy of Sciences, Praha, CSFR, 1992

### **Marc Green**

Smith-Kettlewell Eye Research Institute  
Armstrong Aerospace Medicine Laboratory  
Rotman Research Institute

### **Laurence Harris**

University of Toronto, Computer Vision Dept.

### **Peiyuan He**

Tianjin University, May, 1993.  
Tianjin Medical School, May, 1993

### **Ian Howard**

School of Optometry, University of California Berkeley, Jan 1993  
Department of Computer Science, University of Toronto, March 1993

### **Michael Jenkin**

Kodak Incorporated, Rochester, NY, 1993.  
NTT Communication Science Laboratory, Kyoto, July 19, 1993  
Toshiba Research Laboratory (Computer Vision), Kansai area, Kobe, July 20, 1993  
Osaka University, Department of Systems Engineering, July 21, 1993  
Toshiba Energy and Mechanical Research Laboratory, Kawasaki, July 22, 1993  
Electrotechnical Laboratory, Tsukuba, July 23, 1993  
Mechanical Engineering Laboratory, MITI, Tsukuba, July 23, 1993  
NTT Human Interfaces Laboratory, Kanagawa, July 26, 1993

### **Peter Kaiser**

Ontario Eye Institute, March 1993

### **Evangelos Milios**

NTT Communication Science Laboratory, Kyoto, July 19, 1993  
Toshiba Research Laboratory (Computer Vision), Kansai area, Kobe, July 20, 1993  
Osaka University, Department of Systems Engineering, July 21, 1993  
Toshiba Energy and Mechanical Research Laboratory, Kawasaki, July 22, 1993  
Electrotechnical Laboratory, Tsukuba, July 23, 1993  
Mechanical Engineering Laboratory, MITI, Tsukuba, July 23, 1993  
NTT Human Interfaces Laboratory, Kanagawa, July 26, 1993

### **David Regan**

University of Toronto, April 1993  
York University, April 1993

**Josee Rivest**

University of Toronto, Psychology department, 1992  
York University, Glendon, 1992

**Minas Spetsakis**

University of Toronto, AI colloquium, June 29 1993

**Colloquia cont'd.****Martin Steinbach**

University of Toronto, Dept. of Ophthalmology, Dec. 1992  
Hospital for Sick Children, Dept. of Ophthalmology Rounds, May 1993

**Patents****Otmar Bock**

Application filed with G.D'Eleuterio, J.Lipitkas, J.Grodski: "Parametric control device for robotic manipulators".

**Awards****Otmar Bock**

Fellow, Canadian Aeronautics and Space Institute

**Keith Grasse**

McDonnell-Pew Visiting Fellow, McDonnell-Pew Centre for Cognitive Neuroscience,  
Dept. of Physiology, University of Oxford, 1993.

**Michael Jenkin**

Session Co-chair, IEEE Int. Conf. on Robotics and Automation, May 1993.

Session Chair, VI '93, May, 1993.

Member Vision Interface '93 Program Committee.

Member Vision Interface '93 Local Arrangements Committee.

**Evangelos Milios**

Member of the Scientific Committee of the 2nd International Workshop on Visual Form, 1994

Treasurer and Member of the Program Committee, Vision Interface 1993.

Session Co-Chair, IEEE International Conference on Robotics and Automation, 1993,

**David Regan**

NSERC/CAE Industrial Research Chair in Vision in Aviation. Awarded June, 1993.

1992-93 Killam Fellow

1993-95 Steacie Prize Committee (NRC)

**Paul Stager**

Member of the Scientific Advisory Committee for the 13th Triennial Congress of the International Ergonomics Association, August, 1994.

Canadian representative to Human Factors Certification of Advanced Aviation Systems,  
an International Workshop, Bonas, France, July, 1993.

## **Martin Steinbach**

Editorial Board: Binocular Vision

Judge: 1993 Annual Research Day, Dept. of Ophthalmology, University of Toronto

## **Collaborative Projects in Progress**

### **Otmar Bock**

Study on visuo-motor performance in DCIEM-centrifuge completed.

Study on visuo-motor performance in KC-135 aircraft completed.

Joint project with L.R. Young and C.M. Oman (MIT) initiated.

## **Collaborative Projects in Progress cont'd.**

### **Keith Grasse**

Collaboration with Dr. Colin Blakemore at the University of Oxford examining saccadic eye movements in strabismic humans.

Collaboration with Frank Sengpiel and Dr. Colin Blakemore at the University of Oxford examining orientation-specific interactions in visual cortical neurons.

Collaboration with Dr. Bob Wurtz at NIH examining visual neurons in the superficial layers of the superior colliculus in alert, behaving primates.

### **Marc Green**

Collaborative research with Dr. Veron Odom, University of West Virginia on vision and aging.

### **Laurence Harris**

Research project at NASA Ames on interactions between the two major parts of the vestibular system (canals and otoliths).

Research project at MIT on interactions between vision and other cues to linear self motion.

### **Ian 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.

### **Hiroshi Ono**

Collaborative Research with Dr. Nicholas Wade and Dr. Michael Swanston at University of Dundee on motion and orientation in spatial vision

Invited scholar at ATR, Japan to conduct research on motion parallax.

### **Peter Kaiser**

Collaborative research with Dr. A. Kurtenboch Dr. E. Zrenner, University of Tübingen on color vision

### **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 simulator studies.

With Dr. D. Elliott (Dept. of Optometry, Univ. of Waterloo) on vision and mobility in low-vision patients.

With Dr. P. O'Conner (Dept. of Medicine, St. Michael's Hospital) on visual damage in patients with glaucoma.

With Dr. M. Berstein (Dept. of Neurosurgery, The Toronto Hospital) visual processing of texture- and motion-defined in patients with uni-lateral brain lesions.

## **Martin Steinbach**

Set up Ocular Motor Lab at the Eye Institute of Canada with Dr. Moshe Eizenman.  
Studies on visual development at the Hospital for Sick Children with Dr. Stephen Kraft and Dr. Brenda Gallie.

### **Centre for Vision Research Lecture Series**

S. Anstis	San Diego	Flicker-Augmented Contrast
G. Barnes	London, U.K.	Prediction in Smooth Pursuit and Vestibulo-ocular Reflex Control
C. Erkelens	Utrecht	Eye Movements during Visual Search
O.-J. Grüsser	Berlin	The Primate Visual Cortices. Anatomical and Physiological Investigations
R. Hess	McGill	Spatial Coding in Vision
H. Ono	York	William Charles Wells and Binocular Visual Direction: A Bicentennial Tribute
J. Rauschecker	NIMH	Processing of Optic Flow in Cat, Monkey and Man: Psychophysics and Neurophysiology brought Together in a Neural Network Model
G. Riccio	Illinois	The Postural Control System as an Accessory Structure for the Visual System
B. Rogers	Oxford	Differential Perspective and the Appearance of Fronto-Parallel Surfaces
R. Snowden	Cardiff	Processing Visual Motion