BASICS 2000

Banff Annual Seminar in Cognitive Science
May 19-21, 2000

From Action to Vision and from Vision to Action

Friday, May 19 *Glacier Salon*

7:30-10:00 pm Reception & Poster Session

Sponsored by the *Canadian Journal of Experimental Psychology* and the Canadian Psychological Association.

Drink ticket available in registration packet.

Register with Peter Dixon if you have not already done so ($60 for faculty, $20 for students and postdoctoral fellows).

Poster Presentations

Gasser Auda. *Modularity, cooperation, and specialization: Visual-cortex motivations for designing artificial neural classifiers*

Jennie Baxter, Suzanne Hala, & Annette Henderson. *Reducing the executive demands involved in false belief tasks*

Cindy M. Bukach & Daniel N. Bub. *Discrimination, configural processing, and viewpoint dependence in a prosopagnosic patient*

Verna Chow & Christopher R. Sears. *The effects of reader skill on orthographic processing*

Linnsie Clark, Jason Tangen, Melody Polych, & John R. Vokey. *Pragmatic text processing in the Wason selection task*

Peter Dixon. *Hypothesis tests do not describe results*

J. Fugelsang & V. Thompson. *Reasoning about causes and effects: Do people know what they're doing?*

J. D. Kingsmith & P. M. Pexman. *The role of the modifier in understanding positive and negative sarcasm*

Karen Litke. *When retrieval fails: Conscious influences on unconscious processing*

Kara M. Olineck & P.M. Pexman. *Interpreting sarcastic praise and sarcastic insult*

W. J. Owen, R. Borowsky, & L. Blake. *Word frequency and word length effects: Examing their utility as indices of sight vocabulary and phonetic decoding use*

Ann M. Penny, Andrea N. Welder, & Susan A. Graham. *Factors that predict the disambiguation effect in infants*

Cherie Peterson. *Modularity effects of stress hormones on explicit memory*

Thomas Phenix. *Fan effects reveal context-specific numerical concepts*

Marc Pomplin, Eyal M.Reingold, & Jiye Shen. *Modelling saccadic selectivity in visual search*

Carmen Rasmussen & Suzanne Hala. *Source monitoring in normally developing children and in children with autism*

Sara Unsworth. *The impact of reader skill on phonological processing*

Saturday, May 20 *Black Bear Room*

8:30 am   Coffee, tea, & pastries

Register with Peter Dixon if you have not already done so.

8:45 am   Welcome and opening remarks by Peter Dixon (University of Alberta)

9:00 am   **Aaron Bobick** (Georgia Tech)

Introduced by Penny Pexman (University of Calgary)

Representation and Recognition of Human Behavior for Perception

We have developed several approaches to the representation and recognition of human behavior, focusing primarily computer vision. We divide behaviors into movement, activity, and action. Movements are the most atomic primitives, requiring no contextual or sophisticated sequence knowledge to be recognized; movement is often represented and recognized using either

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view-invariant or view-specific geometric techniques. Activity refers to sequences of movements, represented primarily by statistical descriptions; much of the recent work in gesture understanding falls within this category of behavior recognition. Finally, actions are larger scale events that typically include interaction with the environment and causal relationships; action understanding straddles the division between perception and cognition, computer vision and artificial intelligence/cognitive science. Fundamental questions underlying these techniques include how is time represented, what is the relationship between structural and statistical representations of behavior, and can the recognition of high level actions - involving, for example, intentionality - be achieved by compiled visual routines. I will present examples of our work in each of these areas covering domains ranging from the recognition of aerobics movements, to recovering parametric gestures, to visual surveillance, to interpreting football plays. I will also show video of some interactive spaces that leverage the techniques described.

10:30 am   Coffee & tea

11:00 am   **Marcia Spetch** (University of Alberta)

Introduced by Roberto Cabeza (University of Alberta)

An Avian Perspective on Vision and Action: From Scene Analysis to Place Finding

Pigeons, like humans, depend upon efficient perceptual and behavioural mechanisms in order to solve critical and recurrent problems in their daily lives. The research I will present investigates several basic processes underlying pigeons' ability to solve one such problem, namely "Where's my dinner?" Remembering and finding a goal may require the solution of numerous subproblems, including scene and object recognition, selection of spatial cues, encoding of metric information and spatial relationships, determination of heading, and navigation to the goal. Pigeons' use of spatial information is surprisingly general across tasks that vary dramatically in scale of space, nature of visual information, and type of response. Comparative studies suggest interesting similarities and differences between how pigeons and other species solve object recognition and place finding tasks.

12:30 pm   Lunch

2:00 pm   **Michael Tarr** (Brown University)

Introduced by Michael Masson (University of Victoria)

Exploring Visual Navigation and Object Recognition with Virtual Reality: Early Lessons from the VENLab

We have developed a large-scale (50'x50') virtual environment (the VENLab) for studying questions in visual navigation and object recognition. Unique to our facility is the ability of subjects to actively walk around an artificial environment in which we can carefully control the position and the appearance of objects. The first experiments we have run in the VENLab address four questions: 1) What is the role of visual flow information in different regions of the scene with regard to the accuracy of dead reckoning ? 2) What are the relative roles of dead reckoning and landmarks in navigation? And are local and global landmarks weighted equally? 3) Are there differences in the spatial updating that occurs with regard to viewpoint when orientation changes are generated by observer motion as opposed to object rotation? 4) Does falling off a 50' virtual cliff hurt?

3:30 pm   Coffee, tea, & refreshments

4:00 pm   **Barrie Frost** (Queen's University)

Introduced by Valerie Thompson (University of Saskatchewan)

Neural selectivity for different classes of complex visual motion

Many tectal neurons are selective for local relative motion such as that produced by moving objects or animals, and this selectivity is produced by a double opponent process, centre-surround directionally specific mechanism. This motion system is subsequently differentiated so that higher order cells can perform figure/ground discrimination, or are sensitive to moving occluding edges, or are specifically responsive to 'time to collision' with moving objects. We are currently investigating other higher order cells in the tectofugal pathway, to determine if they selectively respond to "Biological Motion" patterns produced by conspecific behaviour, particularly those involved in the dynamics of courtship displays. In contrast, the Accessory Optic System (AOS) contains neurons responsive to large areas of optic flow, that are implicated in the optokinetic control of eyes, head and posture, and maybe are even involved in navigation.

Recent experiments on both the Tectofugal *animate motion pathway* and the AOS *self-motion pathway* will be described. Nucleus rotundus neurons that respond very selectively to looming objects will be shown to fall neatly into three classes, one group computes rho or rate of image expansion, another

computes tau or relative rate of expansion, and a third group computes eta, an early warning device for approaching objects. In the AOS our recent research has shown that translation specific neurons prefer simulated panoramic translation flow-fields and are maximally responsive to translation along three orthogonal axes (vestibular frame of reference) oriented 45 degrees on either side of the midline, and vertical. The different functions these different classes of motion neurons are performing will be discussed.

5:30 pm   Announcement of the winner of the 1999 volume of *Canadian Journal of Experimental Psychology* (Registered students and postdoctoral fellows are eligible)

Sunday, May 21 *Black Bear Room*

9:30 am   Coffee & tea

10:00 am   **Dave Fleet** (Xerox PARC and Queen's University)

Introduced by Jamie Campbell (University of Saskatchewan)

Bayesian Analysis of Image Sequences: Detection and Tracking of Motion Boundaries

Visual motion analysis concerns the estimation and recognition of motion from image sequences. Tasks include the estimation of image velocity (e.g., for video compression), the detection and estimation of scene structure (e.g., locating surface boundaries), and the detection and tracking of objects (e.g., 3d human motion capture from video).

This talk will address a long-standing problem in motion analysis, namely, the detection and estimation of motion in the neighborhoods of surface boundaries. Motion in these regions is discontinuous, and occlusions cause image structure to appear or disappear from one image to the next. Although these "motion boundaries" are often viewed as a source of noise for current motion estimation techniques, we can also view them as a rich source of information about the location of surface boundaries and the depth ordering of surfaces at these locations.

We propose a Bayesian framework for representing and estimating image motion in terms of multiple motion models, including both smooth motion and local motion discontinuity models. We compute the posterior probability distribution over models and model parameters, given the image data, using discrete samples and a particle filter for propagating beliefs through time. This talk will introduce the problem and describe our Bayesian approach, including our generative models, the likelihood computation, the particle filter, and a mixture model prior from which samples are drawn. I will present several experimental results on tracking motion discontinuities, and if time permits I will also show results of some related projects in the Digital Video Analysis (DiVA) group at Xerox PARC.

11:30 pm   Closing remarks by Michael Masson (University of Victoria)