Michael J. Black

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Research Interests

Computer Vision: Optical flow estimation, human pose and motion capture, probabilistic models of images, natural scene statistics.

Neural Engineering: Statistical models of neural coding, brain-machine interfaces, neural prostheses, biologically-embedded computing.

Education

YALE UNIVERSITY New Haven, CT
Ph.D., Computer Science, 1992.

STANFORD UNIVERSITY Stanford, CA
M.S., Computer Science, 1989.

THE UNIVERSITY OF BRITISH COLUMBIA Vancouver, BC
B.Sc., First Class, Honours Computer Science, 1985.

Experience

BROWN UNIVERSITY Providence, RI
Professor, Department of Computer Science, 7/04 – present,
Associate Professor, Department of Computer Science, 7/00 – 6/04.

My vision research addresses problems of probabilistic inference using machine learning and statistical estimation techniques. My work in early vision includes learning Markov random fields, modeling image statistics, and estimating optical flow. At higher levels, my work addresses human motion detection, estimation, tracking and analysis.

My work on brain-machine interfaces focuses on probabilistic models of neural coding in motor cortex and the decoding of this activity using Bayesian inference. This work is part of an interdisciplinary effort to develop prosthetic devices for the severely disabled.

XEROX PALO ALTO RESEARCH CENTER Palo Alto, CA
Area Manager, Digital Video Analysis, 8/98–7/00,
Area Manager, Image Understanding Area, 1/96–1/99,
Member of Research Staff, II, 9/93–12/95.

Research on motion estimation with an emphasis on human motion. Learning linear models of motion, generalizing motion estimation to other forms of appearance change, recovering motion discontinuities, probabilistic methods for motion estimation, recognition of facial expressions and gestures.

Management responsibilities included: performance evaluation, budgeting, internal grant writing, hiring, coordinating with senior management, contracting with Xerox business groups, presentations to Xerox and the external world, and career development.

ROYAL INSTITUTE OF TECHNOLOGY (KTH) Stockholm, Sweden
Visiting Scientist, Computational Vision and Active Perception group, 9/98–1/99.

Pursued research on learning parameterized spatio-temporal models of motion events and computational techniques based on stochastic search for exploiting these models for motion-based recognition.

UNIVERSITY OF TORONTO Toronto, Ontario
Adjunct Professor, Department of Computer Science, 1995–1996,
Assistant Professor, (not tenure-track), Department of Computer Science, 8/92–9/93.

Research included the introduction of mixture models for optical flow estimation, detection and tracking of surface discontinuities using motion information, and robust surface recovery in dynamic environments.

YALE UNIVERSITY, New Haven, CT
Research Assistant, Department of Computer Science, 9/89–8/92.

Introduced robust statistical approaches for estimating optical flow. Also pursued research on incremental estimation, temporal continuity, and the early detection of motion discontinuities.

NASA AMES RESEARCH CENTER Moffett Field, CA
Visiting Researcher, Aerospace Human Factors Research Division, 6/90–8/92.

Developed motion estimation algorithms in the context of an autonomous Mars landing and nap-of-the-earth helicopter flight and studied the psychophysical implications of a temporal continuity assumption.

ADVANCED DECISION SYSTEMS Mountain View, CA
Computer Scientist, Image Understanding Group, 12/86–6/89.

Research on spatial reasoning for robotic vehicle route planning and terrain analysis. Vision research including perceptual grouping, object-based translational motion processing, the integration of vision and control for an autonomous vehicle, object modeling using generalized cylinders, and the development of an object-oriented vision environment.

GTE GOVERNMENT SYSTEMS Mountain View, CA
Engineer, Artificial Intelligence Group, 6/85–12/86.

Developed expert systems for multi-source data fusion and fault location.

Teaching Experience

BROWN UNIVERSITY, Spring 2004, 2006, 2008 Providence, RI
Topics in Computer Vision. This graduate research course takes a single advanced topic in machine vision explores it in an integrated fashion through the use of a course-long project, readings of research papers, and lectures on the mathematical and computational foundations. In 2004, the course focused on 3D human motion tracking and each of the students built a state-of-the art 3D human tracking system. In 2006 and 2008 the course

focused on forensic computer vision. Each course was focused around a single real crime video. The problem provided the structure around which a coherent set of topics was explored. For examples the students leared about camera calibration, single-view metrology, image denoising, deinterlacing, super-resolution, optical flow, shape from specularity and 3D tracking. The students of the 2006 class all received commendations from a Virginia police departmeht for their efforts.

BROWN UNIVERSITY, Fall 2003, 2004, 2005, 2007 — Providence, RI
Introduction to Computer Vision. Undergraduate computer vision course with emphasis on vision as a problem of probabilistic inference.

BROWN UNIVERSITY, Fall 2001, 2002; Spring 2005 — Providence, RI
Topics in Brain-Computer Interfaces. Focuses on the mathematical and computational foundations of the field while introducing the basic concepts in neuroscience, interface design, recording technologies, applications, and ethical issues.

BROWN UNIVERSITY, Spring 2001, 2002, 2003 — Providence, RI
Introduction to Software Engineering. Advanced programming techniques including object-oriented design in C++. Basic software engineering concepts are covered including modeling, requirements analysis, design, testing, reuse, the software life cycle, and project management.

BROWN UNIVERSITY, Fall 2000 — Providence, RI
Topics in Machine Vision and Learning. Learning in high dimensional spaces, linear models, probabilistic methods, and applications in vision. Co-taught with Thomas Hofmann.

UNIVERSITY OF TORONTO, Spring 1993 — Toronto, Ontario
Applications of Artificial Intelligence. Senior undergraduate course introducing the fundamentals of AI with emphasis on applications.

YALE UNIVERSITY — New Haven, CT
1/91–12/91, Supervision of three undergraduate senior projects.
9/89–12/89, *Teaching Assistant,* Department of Computer Science.

UNIVERSITY OF BRITISH COLUMBIA, 9/84–5/85 — Vancouver, BC
Teaching Assistant, Department of Computer Science.

Consulting

Rexee Inc., San Mateo, CA., Scientific Advisory Board member. Oct. 2006 – present.

Intel Research, Computational Nano-Vision Group, Nov. 2001 – Dec. 2007.

Cyberkinetics Inc., Foxboro MA, July 2004 – Dec. 2004.

Xerox Palo Alto Research Center, July 2000 – Dec. 2001.

Walt Disney, Feature Animation, August 2000 – Dec. 2000.

Grants

Rhode Island Economic Development Corporation (RIEDC), Science and Technology Advisory Committee (STAC) Award. $118,773, Jan 2008 – Dec 2008. "Forensic computer vision: High-quality evidence from low-quality video." Principal Investigator (with D. Pincince).

Office of Naval Research award N00014-07-1-0803. “Neurotechnology Center at Brown University,” $1,594,680, March 1, 2007 – August 31, 2008, With J. Donoghue and A. Nurmikko (PI).

Intel Corporation, “Accurate optical flow estimation for media applications,” $171,688, April 2007 – April 2010.

NSF OISE-0624015, “U.S.-Uruguay Workshop: Vision in Brains and Machines, Montevideo, Uruguay, November, 2006,” $59,983, Sept. 15 2006 – August 31, 2007. Principal Investigator (with G. Randall).

NSF IIS-0636838, “Planning Workshop: Corpora for Computational Neuroscience,” $21, 320, June 15, 2006 – May 31, 2007 (with Kenneth D. Harris and Bruno A. Olshausen)

Office of Naval Research, Defense University Research Instrumentation Program (DURIP), “Neural interfaces to enhance human motor performance: Instrumentation for modeling dexterous manipulation,” 2006, $314,880, Principal Investigator (with J. P. Donoghue and O. C. Jenkins).

Honda Research, $25,000, March 2006.

NSF IIS-0534858, “Statistical Models of the Primate Neocortex: Implementation and Application,” $479,999, 15/11/2005–31/10/2008, co-investigator with T. Dean (PI) and O. C. Jenkins.

NSF #0535075 “Learning Rich Statistical Models of the Visual World for Robust Perception,” $268,597, 8/1/2005–7/29/2008, Principal Investigator. Plus $8,750 (2006) and $9,626 (2007) REU supplements.

Intel Corporation, “Learning Probabilistic Models for Image Motion Analysis,” $178,699, Nov 2004 - Nov 2006, Principal Investigator.

NIH–NINDS, R01 NS 50967-01, “CRCNS: Learning the Neural Code for Prosthetic Control,” 8/1/2004–7/30/2007, $1,116,350, Principal Investigator (with M. Mehta, E. Bienenstock, and J. P. Donoghue).

Veteran’s Administration, #A3772C, “Rebuilding, Regenerating and Restoring Function after Traumatic Limb Loss,” 8/1/04–7/31/09, $146,776 (Brown sub-contract), Named Investigator (with J. Donoghue, P.I.).

Office of Naval Research award N0014-06-0185. “Neural Interfaces to Understand Human Motor Performance,” 10/25/2005–10/26/2006, $963,000. With J. Donoghue and A. Nurmikko.

Office of Naval Research award N0014-04-1-082, “Neural Interfaces to Enhance Human Motor Performance,” 10/4/2004–12/30/2005, $960,000. With J. Donoghue and A. Nurmikko.

European Commission, Beyond Robotics Program, “NEUROBOTICS – The Fusion of Neuroscience and Robotics,” 1/1/2004–1/1/2008, International partner in large European consortium, total grant of 5,640,048 Euro for 60 months (100,000 Euro for the Brown partnership).

Siemens Corporate Research, \$25,000, Jan. 2003; \$25,000, Apr. 2004.

NIH–NINDS Contract N01-NS-2-2345, "Cortical Control of Neural Prostheses," \$1,900,000, Sept. 2002 – Sept. 2005. Co-investigator (with J. Donoghue (PI) and E. Bienenstock).

NIH–NINDS, grant NS25074, "Static and Dynamic Organization of Primate Cortex", \$1,470,456, May 2002 – Mar. 2007. Co-investigator (with J. Donoghue (PI) and E. Bienenstock).

NSF, ITR, "The Computer Science of Biologically Embedded Systems," \$446,969, Sept. 2001 through Aug. 2005. Principal Investigator (with E. Bienenstock and J. Donoghue).

ONR contract N000140110886, "Motion Capture for Statistical Learning of Human Appearance and Motion," \$339,340, May 1, 2001 through May 1, 2004, (DARPA Human-ID project). Principal Investigator.

Xerox Foundation, University Affairs Committee Grant, \$15,000, Nov. 2001.

Xerox Foundation, University Affairs Committee Grant, \$15,000, May 2000.

Natural Sciences and Engineering Research Council of Canada, Individual Research Grant, April 1993, \$20,000/year for three years.

Connaught Fund, Operating Grant, University of Toronto, April 1993, \$3,000.

NASA Graduate Student Researchers Program, Training Grant, NGT–50749, 8/91–8/92, \$22,000.

Paper Awards

Best Paper Award, Forth International Conference on Articulated Motion and Deformable Objects (AMDO-e 2006), with L. Sigal for the paper "Predicting 3D People from 2D Pictures."

Marr Prize, Honorable Mention, Int. Conf. on Computer Vision, ICCV-2005, Beijing, China, Oct. 2005 with S. Roth for the paper "On the Spatial Statistics of Optical Flow."

Marr Prize, Honorable Mention, Int. Conf. on Computer Vision, ICCV-99, Corfu, Greece, Sept. 1999 with D. J. Fleet for the paper "Probabilistic detection and tracking of motion discontinuities."

IEEE Computer Society, Outstanding Paper Award, Conference on Computer Vision and Pattern Recognition, Maui, Hawaii, June 1991 with P. Anandan for the paper "Robust dynamic motion estimation over time."

Other Awards & Honors

Commendation and Chief's Award, Henrico County Division of Police, County of Henrico, Virginia, April 19, 2007.

Distinguished Paper Track, invited talk, Int. Joint Conf. on Artificial Intelligence, "Probabilistic detection and tracking of motion boundaries," with D. Fleet, Aug. 2001.

University of Maryland, *Invention of the Year*, 1995, "Tracking and Recognizing Facial Expressions," with Y. Yacoob.

University of Toronto, Computer Science Students' Union *Teaching Award* for 1992–1993.

Nomination: ACM Doctoral Dissertation Award, 1993.

National Research Council, Research Associateship Award, 1992 (declined).

Yale University Fellowship, 89–90 academic year.

University of British Columbia, Dean's Honour List, 1985.

National Science Foundation, Graduate Fellowship, Honorable Mention, 1985.

Natural Sciences and Engineering Research Council, Summer Research Scholarship, 1984.

Professional Service

Editorial

Editorial Board, *International Journal of Computer Vision*. Jan. 2004 – present.
Guest Editor (with Leonid Sigal), *International Journal of Computer Vision*, Special Issue on Evaluation of Articulated Human Motion and Pose Estimation, 2008.
Guest Editor (with Ben Kimia), *International Journal of Computer Vision*, Special Issue on Vision at Brown, 2003.
Associate Editor, *IEEE Transactions on Pattern Analysis and Machine Intelligence,* March 1998 – Dec. 2000.

Program Chair or Organizer

Co-organizer, EHuM-2: Evaluation of Articulated Human Motion and Pose Estimation, Workshop at CVPR 2007.
Co-organizer, EHuM: Evaluation of Articulated Human Motion and Pose Estimation, Workshop at NIPS 2006.
General Co-Chair, International Symposium on Vision by Brains and Machines, November 13–17, 2006, Montevideo, Uruguay.
Co-organizer, NSF Planning Meeting on Data Sharing in Computational Neuroscience, Arlington, VA June 2006.
Program Co-Chair, Fourth International Conference on Automatic Face and Gesture Recognition, Grenoble, France, March 2000.

Area Chair (or equivalent)

IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2009, 2008, 2007, 2006, 2004, 2001, 2000, 1998.
European Conference on Computer Vision (ECCV), 2008, 2006, 2002.
International Conference on Computer Vision (ICCV), 2001, 1999.
Neural Information Processing Systems (NIPS), 2007.
Theme chair, 1st IEEE/EMBS Int. Conf. on Neural Engineering, 2003.
Papers Committee member, SIGGRAPH 2002.

Program Committee Member, Conferences

International Conference on Computer Vision (ICCV), 2005, 2003, 1995.
IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2005, 2003, 1999.
European Conference on Computer Vision (ECCV), 2004, 2000.
16th International Conference on Pattern Recognition (ICPR), 2002.
International Conference on Automatic Face and Gesture Recognition, 2002, 2000, 1998, 1996.

Program Committee Member, Workshops

2nd Workshop on Human Motion Understanding, Modeling, Capture and Animation, 2007.
IEEE Computer Society Workshop on Motion and Video Computing, 2005.
Workshop on Analysis and Modeling of Faces and Gestures, at ICCV 2003.
3rd Int. Workshop on Statistical and Computational Theories of Vision, 2003, 1999.
Computer Vision for the Nano-Scale, workshop at CVPR, 2003.
ECCV Workshop on Vision and Modelling of Dynamic Scenes, 2002.
IEEE Int. Workshop on Cues in Communication, 2001.
IEEE Workshop on Human Motion, 2000.
IEEE Human Modeling, Analysis and Synthesis Workshop 2000.
VISALGS – Vision Algorithms: Theory and Practice, 1999.
Workshop on Non-Rigid and Articulate Motion, 1997.

Other

Organizer, 2nd San Francisco Bay Area Vision Meeting. *Motion: The next 10 years.* Xerox Palo Alto Research Center, Dec. 1997.
Planning meeting member for the Capitol Hill Congressional Conference on "New Frontiers in Breast Cancer Imaging and Early Detection," Washington D.C., July 1994.
Chair of the 1993 IJCAI panel on Action, representation, and purpose: Re-evaluating the foundations of computational vision.

Reviewing Reviewed journal papers for:

IEEE Transactions on Biomedical Engineering,
IEEE Transactions on Neural Systems and Rehabilitation Engineering,
International Journal of Computer Vision,
IEEE Transactions on Pattern Analysis and Machine Intelligence,
Computer Vision and Image Understanding,
Machine Vision and Applications,
International Journal of Robotics Research,
IEEE Transactions on Circuits and Systems for Video Technology,
Computer Vision Graphics and Image Processing: Image Understanding,
IEEE Transactions on Image Processing,
Journal of Visual Communication and Image Representation.

Reviewer (conferences and workshops):

International Conference on Computer Vision (1993, 1995, 1999),
Computer Vision and Pattern Recognition (1991, 1997, 1998, 1999),
European Conference on Computer Vision (2000, 2004),
Int. Conf. on Automatic Face and Gesture Recognition (1996, 1998),
Neural Information Processing Systems (NIPS) (2003, 2006),
SIGGRAPH (1998, 2003),
Graphics Interface, 2000,
Interactive 3D Symposium, I3D, 2000,
IEEE Human Modeling, Analysis and Synthesis Workshop 2000,
VISALGS Workshop – Vision Algorithms: Theory and Practice 1999,
IEEE Workshop on Non-rigid and Articulate Motion 1997,
International Joint Conference on Artificial Intelligence 1993,
IEEE Workshop on Visual Motion 1991.

Reviewed grant applications for:

National Science Foundation (2000, 2006 (CRCNS)),
NSERC Canada (2000, 2001, 2002, 2004, 2005),
National Institutes of Health (2000),
University of California at Berkeley MICRO (Microelectronics Innovation and Computer Research Opportunities) Program (1996).

Reviewed books for Morgan Kaufmann Publishers, Inc.

Reviewed book chapters for: "Motion-Based Recognition," M. Shah and R. Jain (eds.), Kluwer Academic Pub.

University Service

Director of Graduate Studies (Jan. 2008 – present).

Co-Director of Graduate Studies (Sept. 2007 – Dec. 2007).

Director, Industrial Partners Program, Dept. of Computer Science. (Jan. 2002 – Sept. 2003); Co-Director (Sept. 2003 – July 2006).

Standing Appeals Committee for the Brown University Patent and Invention Policy, Feb. 2006 – June 2006.

Chair, Computer Science faculty search committee (Machine Learning), 2005–2006.

Member, Faculty search committee (Neuro-technology), Brain Science Program, 2005–2006.

Chair, Computational science concentration committee, Computer Science (July 2005 – present).

Executive committee member, Brain Science Program. (May 2002 – present).

Faculty search committee, Affirmative action representative, Dept. of Computer Science. (Sept. 2001 – 2005).

Facilities committee, Dept. of Computer Science. (June 2002 – Aug. 2004).

Patent and Invention Advisory Committee (Feb 2004 – July 2004).

Digital Initiatives Committee (April 2003 – Feb. 2004).

Theoretical Neuroscience recruiting committee, Brain Sciences Program, 2002-2003.

Recruiting committee, NSF Integrative Graduate Education and Research Training Program, "Learning and Action in the Face of Uncertainty: Cognitive Computational and Statistical Approaches." (Sept. 2000 – Dec. 2002).

Industrial Partners Program, Dept. of Computer Science. (Oct. 2000 – Dec. 2001).

Organizer, Industrial Partners Program Symposium on *Vision-based Interfaces*, May 2001.

Undergraduate Advising

Teodor Mihai Moldovan, Summer 2006 – present.

Benjamin Aisen, Fall 2004.

Ben Sigelman, Summer 2002, Fall 2002, Spring 2003. Honors Thesis: "Video-Based Tracking of 3D Human Motion Using Multiple Cameras."

Tiferet Levine, Fall 2002.

Matthew Ivester, Summer 2002.

Timothy Bentley, Summer 2002.

Richard Peter Weistroffer and Dmitri Lemmerman, "Independent Study in the Use of EMG Signals as a Control Device," Spring 2002.

Robert Altshuler, "Tracking Walking People using a Probabilistic Model of Optical Flow," Brown University, Dept. of Computer Science, Spring 2001.

Curren Nachbar, "Hit or Miss: Perspectives on Time-to-Contact Estimation," Brown University, Dept. of Computer Science, Fall 2000.

Master's Advising

Payman Yadollahpour, Brown University, Dept. of Computer Science, Fall 2005 – Aug. 2006; jointly with Gregory Shakhnarovich.

Sidharth Bhatia, "3D human limb detection using space carving and multi-view eigen models," Brown University, Dept. of Computer Science, Spring 2004.

Robert Altshuler, "Decomposing Image Sequences into Layers According to Motion with the use of an Appearance Model," Brown University, Dept. of Computer Science, Fall 2001 – Spring 2003.

Wei Wu, "Neural Decoding of Motor Cortex using a Kalman Filter," Brown University, Dept. of Computer Science, Spring 2003.

Yun Gao, "Nonparametric Representation of Neural Activity in Motor Cortex," Brown University, Dept. of Computer Science, Spring 2002.

Philip F. Chen, "Statistical Method for Motion Estimation from Omnidirectional Image Sequences," Brown University, Dept. of Computer Science, Spring 2001.

Xuan Ju, "Estimating time-to-contact by detecting and tracking motion boundaries," Sept. 1992 – Jan. 1994, University of Toronto.

Ph.D. Advising Deqing Sun, Sept. 2007 – present, Brown University, Dept. of Computer Science.

Payman Yadollahpour, Sept. 2006 – present, Brown University, Dept. of Computer Science; jointly with Gregory Shakhnarovich.

Alexandru Balan, Jan. 2004 – present, Brown University, Dept. of Computer Science.

Leonid Sigal, Ph.D. Thesis: "Continuous-state graphical models for object localization, pose estimation and tracking," Aug. 2001 – Oct. 2007, Brown University, Dept. of Computer Science.

Frank Wood, Ph.D. Thesis: "Non-parametric Bayesian models of neural data," Jan. 2003 – May 2007, Brown University, Dept. of Computer Science.

Stefan Roth, Ph.D. Thesis: "High-order Markov random fields for low-level vision," Aug. 2001 – May 2007, Brown University, Dept. of Computer Science.

Jessica Fisher, Sept. 2004 – May 2006, Brown University, Dept. of Computer Science.

Wei Wu, Ph.D. Thesis: "Statistical models of neural coding in motor cortex," May 2002 – May 2004, Brown University, Division of Applied Mathematics, jointly with David Mumford.

Hulya Yalcin, Ph.D. Thesis: "Implicit models of moving and static surfaces," March 2002 – May 2004, Brown University, Division of Engineering.

Fernando De la Torre, Ph.D. Thesis: "Robust subspace learning for computer vision," June 1999 – Jan. 2002, La Salle School of Engineering, Universitat Ramon Llull, Barcelona, Spain.

Hedvig C. Sidenbladh, Ph.D. Thesis: "Probabilistic tracking and reconstruction of 3D human motion in monocular video sequences," Apr. 1999 – Nov. 2001, Royal Institute of Technology, Stockholm, Sweden, jointly with Jan-Olof Eklundh.

Shanon X. Ju, Ph.D. Thesis: "Estimating image motion in layers: The Skin and Bones model," Jan. 1994–Jan. 1999, University of Toronto, jointly with Allan Jepson.

Thesis Committee Member

Maxime Taron, "Registration & modeling of shapes with uncertainties: Contributions and applications to knowledge based-segmentation," Ecole Nationale des Ponts et Chaussées, Fall 2007. Rapporteur.

Stewart Andrews, Ph.D., "Learning from ambiguous examples," Brown University, Dept. of Computer Science, Fall 2006.

Leonid Taycher, Ph.D., "Coping with uncertain dynamics in visual tracking: Redundant state models and discrete search methods," MIT CSAIL, July 2006.

Morgan McGuire, Ph.D., "Capture and manipulation of single-center, multi-parameter video," Brown University, Dept. of Computer Science, Fall 2005.

Yun Gao, Ph.D., "Statistical models in neural information processing," Brown University, Division of Applied Mathematics, June 2004.

Peng Chang, Ph.D., "Robust tracking and structure from motion with sampling method," Robotics Institute, Carnegie Mellon University, July 2002.

Cristian Sminchisescu, "Estimation algorithms for ambiguous visual models: Three dimensional human modeling and motion reconstruction in monocular video sequences," Ph.D. Inst. National Polytechnique de Grenoble, France, Jul. 2002. Rapporteur.

Cullen Jackson, Ph.D., Brown University, Department of Psychology, Oct. 2001.

François Bérard, "Vision par ordinateur pour l'interaction homme-machine fortement couplé," Ph.D. Joseph Fourier Univ., Grenoble, France, Nov. 1999.

James Davis, M.S. MIT Media Laboratory, July 1996.

Ph.D. Thesis Opponent

Lars Bretzner, Thesis: "Multi-scale feature tracking and motion estimation," Ph.D. Royal Inst. of Tech. (KTH), Sweden, Oct. 1999.

Host for Postdoctoral Researcher

Sung-Phil Kim, Brown University, Sept. 2005 – present.

Gregory Shakhnarovich, Brown University, Oct. 2005 – Dec. 2007.

Ronan Fablet, Brown University, Sept. 2001 – July 2002.

Horst Haussecker, Xerox PARC, July 1999 – June 2000.

Host for Visiting Artist

Pamela Z, PARC Artist in Residence, 1994-1996. Examining the relationship between human motion and music.

Associations

Associate, *Canadian Institute for Advanced Research*, since Feb. 2006.
Brown University Neuroscience Graduate Training Program, since Nov. 2005.
Center for Restorative and Regenerative Medicine, Brown University, since 2004.
IEEE Engineering in Medicine and Biology Society: Member since 2002
Society for Neuroscience: Member since 2001.
Brain Science Program, Brown University: Member since 2000.

Computation and Mathematics of Mind, Brown University: Member 2000–2005
Institute for Electrical and Electronics Engineers: Student Member 1990-1992; Member since 1992.
American Association for Artificial Intelligence: Member 1985–2002.
Institute for Robotics and Intelligent Systems (IRIS, Canada): Principal Investigator, 1992–1994.

Patents

[6] Jepson, A. D., Fleet, D. J., and Black, M. J., *Visual motion analysis method for detecting arbitrary numbers of moving objects in image sequences*, US Pat. 6,954,544, Oct. 11, 2005.

[5] Black, M. J., Ju, S., Minneman, S., and Kimber, D., *Method and apparatus for generating a condensed version of a video sequence including desired affordances*, US Pat. 6,560,281, May 6, 2003.

[4] Black, M. J. and Jepson, A. D., *Apparatus and method for identifying and tracking objects with view-based representations*, US Pat. 6,526,156, Feb. 25, 2003.

[3] Black, M. J. and Yacoob, Y., *Apparatus and method for tracking facial motion through a sequence of images*, US Pat. 5,802,220, Dec. 15, 1995.

[2] Black, M. J. and Yacoob, Y., *Apparatus and method for recognizing facial expressions and facial gestures in a sequence of images*, US Pat. 5,774,591, Dec. 15, 1995.

[1] Black, M. J. and Jepson, A. D., *Image segmentation using robust mixture models*, US Pat. 5,802,203, June 7, 1995.

Software Robust dense optical flow and robust affine motion code. This code has been downloaded several hundred times a year and from more than 25 countries. The code has been licensed to a major corporation and has been used in the making of a number of popular movies.

Thesis *Robust Incremental Optical Flow*, Advisers: P. Anandan and D. V. McDermott, Yale University, Department of Computer Science, Research Report YALEU/DCS/RR-923, 1992.

Journal Publications

PEER REVIEWED JOURNAL PUBLICATIONS:

[26] Wood, F. and Black, M. J., "A Nonparametric Bayesian alternative to spike sorting," to appear *J. Neuroscience Methods*.

[25] Donoghue, J. P., Nurmikko, A., Black, M., J., and Hochberg, L., "Assistive technology and robotic control using MI ensemble-based neural interface systems in humans with tetraplegia," *Journal of Physiology*, Special Issue on Brain Computer Interfaces, 579:603–611. 2007.

[24] Donoghue, J.P., Hochberg, L.R., Nurmikko, A.V., Black, M.J., Simeral, J.D., and Friehs, G., “Neuromotor prosthesis development,” Medicine & Health Rhode Island, Vol. 90, No. 1, pp. 12–15, Jan. 2007.

[23] Roth, S. and Black, M. J., “On the spatial statistics of optical flow,” *Int. J. of Computer Vision*, 74(1):33–50, Aug. 2007.

[22] Ormoneit, D., Black, M. J., Hastie, T., and Kjellström, H., “Representing cyclic human motion using functional analysis,” *Image and Vision Computing*, 23(14):1264–1276, 12 Dec. 2005.

[21] Wu, W., Gao, Y., Bienenstock, E., Donoghue, J. P., and Black, M. J., “Bayesian population decoding of motor cortical activity using a Kalman filter,” *Neural Computation*, 18:80-118, 2005.

[20] Wood, F., Black, M. J., Vargas-Irwin, C., Fellows, M., and Donoghue, J. P., “On the variability of manual spike sorting,” *IEEE Trans. Biomedical Engineering*, 51(6):912–918, June 2004.

[19] Wu, W., Black, M. J., Mumford, D., Gao, Y., Bienenstock, E., and Donoghue, J. P., “Modeling and decoding motor cortical activity using a switching Kalman filter,” *IEEE Trans. Biomedical Engineering*, 51(6):933–942, June 2004.

[18] De la Torre, F. and Black, M. J., “Robust parameterized component analysis: Theory and applications to 2D facial appearance models.” *Computer Vision and Image Understanding*, Vol. 91, Issues 1–2, pp. 53–71, (July-August) 2003.

[17] Sidenbladh, H. and Black, M. J., “Learning the statistics of people in images and video,” *International Journal of Computer Vision*, Vol. 54, Issue 1-3, pp. 183–209, Aug. – Oct. 2003.

[16] De la Torre, F. and Black, M. J., “A Framework for Robust Subspace Learning,” *International Journal of Computer Vision*, Vol. 54, Issue 1-3, pp. 117–142, Aug. – Oct. 2003.

[15] Black, M. J. and Fleet, D. J., “Probabilistic detection and tracking of motion discontinuities,” *International Journal of Computer Vision*, 38(3):231–245, July 2000.

[14] Fleet, D. J., Black, M. J., Yacoob, Y. and Jepson, A. D., “Design and use of linear models for image motion analysis,” *Int. J. of Computer Vision*, 36(3), pp. 171–193, 2000.

[13] Black, M. J., Fleet, D. J., and Yacoob, Y, “Robustly estimating changes in image appearance,” *Computer Vision and Image Processing*, Special Issue on Robust Statistical Techniques in Image Understanding, 78(1), pp. 8–31, 2000.

[12] Yacoob, Y., and Black, M. J., “Parameterized modeling and recognition of activities in temporal surfaces,” *Computer Vision and Image Understanding,* 73(2), pp. 232-247, 1999.

[11] Ju, S. X., Black, M. J., Minneman, S., and Kimber, D., "Summarization of video-taped presentations: Automatic analysis of motion and gesture," *IEEE Trans. on Circuits and Systems for Video Technology*, Vol. 8, No. 5, Sept. 1998, pp. 686–696.

[10] Black, M. J., Sapiro, G., Marimont, D., and Heeger, D., "Robust anisotropic diffusion," *IEEE Trans. on Image Processing*, Special Issue on Partial Differential Equations and Geometry Driven Diffusion in Image Processing and Analysis, 7(3), pp. 421–432, March 1998.

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[18] J.P. Donoghue, J.D. Simeral, S-P Kim, G.M. Friehs, L.R. Hochberg, and M.J. Black, "Toward standardized assessment of pointing devices for brain-computer interfaces," Program No. 517.16. 2007 Abstract Viewer and Itinerary Planner. San Diego, CA:*Society for Neuroscience*, 2007. Online.

[17] J. D. Simeral, J. P. Donoghue, M. J. Black, G. M. Friehs, R. H. Brown, L. S. Krivickas, and L. R. Hochberg, "Directional tuning in motor cortex of a person with ALS," Program No. 517.4. 2007 Abstract Viewer and Itinerary Planner. San Diego, CA:*Society for Neuroscience*, 2007. Online.

[16] Simeral, J. D., Kim, S. P., Black, M. J., Donoghue, J. P., Hochberg, L. R., "Ensemble spiking activity as a source of cortical control signals in individuals with tetraplegia," Biomedical Engineering Society, BMES, Sept. 2007.

[15] Kim, S.-P., Simeral, J., Donoghue, J. P., Hochberg, L. R., Friehs, G., Mukand, J. A., Chen, D., Black, M. J., "A comparison of decoding models for imagined motion from human motor cortex," Program No. 256.11. 2006 Abstract Viewer and Itinerary Planner. Atlanta, GA:*Society for Neuroscience*, 2006. Online.

[14] Shakhnarovich, G., Kim, S.-P., Donoghue, J. P., Hochberg, L. R., Friehs, G., Mukand, J. A., Chen, D., Black, M. J., "Modeling neural control of physically realistic movement," Program No. 256.12. 2006 Abstract Viewer and Itinerary Planner. Atlanta, GA:*Society for Neuroscience*, 2006. Online.

[13] Kim, S.-P., Simeral, J. D., Jenkins, O. C., Donoghue, J. P., and Black, M. J., "Finding directional movement representations in motor cortical neural populations using nonlinear manifold learning," Accepted for the presentation at World Congress on Medical Physics and Biomedical Engineering 2006, Seoul, Korea, August 27–September 1, 2006

[12] Sigal L., Black M. J., "Hierarchical Approach for Articulated 3D Pose-Estimation and Tracking," *Learning, Representation and Context for Human Sensing in Video Workshop* (in conjunction with CVPR), 2006.

[11] Wood, F. and Black, M. J., "Energy based models of motor cortical population activity," Program No. 689.20. 2005 Abstract Viewer and Itinerary Planner. Washington, DC:*Society for Neuroscience*, 2005. Online.

[10] Black, M. J. and Roth, S., "On the receptive fields of Markov random fields: Predictions from a probabilistic model of scene statistics," *Cosyne 2005*, Salt Lake City, March 2005.

[9] Shaikhouni, A., Wu, W., Moris, D. S., Donoghue, J. P., and Black, M. J., "A direct brain-machine interface for 2D cursor control using a Kalman filter," *Society for Neuroscience*, 2004. Online.

[8] Wood, F., Fellows, M., Vargas-Irwin, C., Black, M. J., and Donoghue, J., P., "Accuracy of manual spike sorting: Results for the Utah intracortical array," Program No. 279.2. 2003, Abstract Viewer and Itinerary Planner, Washington, DC: *Society for Neuroscience*, 2003. Online.

[7] Wu, W., Mumford, D., Black, M. J., Gao, Y., Bienenstock, E., and Donoghue, J. P., "A Gaussian mixture model for the motor cortical coding of hand motion," *Neural Control of Movement*, Santa Barbara, April 2003.

[6] Roth, S., Domini, F., and Black, M. J., "Specular flow and the perception of surface reflectance," *Journal of Vision*, 3 (9): 413a, 2003.

[5] Wu, W., Black M., Gao, Y., Bienenstock, E., Serruya, M., and Donoghue, J., "Inferring hand motion from multi-cell recordings in motor cortex using a Kalman filter," Program No. 357.5. 2002 Abstract Viewer/Itinerary Planner. Washington, DC: *Society for Neuroscience*, 2002. Online.

[4] Gao, Y., Bienenstock, E., Black, M., Shoham, S., Serruya, M., and Donoghue, J., "Encoding/decoding of arm kinematics from simultaneously recorded MI neurons," *Society for Neuroscience Abst.*, Vol. 27, Program No. 572.14, 2001.

[3] Ormoneit, D., Sidenbladh, H., Black, M. J., and Hastie, T., "Stochastic modeling and tracking of human motion," Learning 2000, Snowbird, UT, April 2000.

[2] Black, M. J. and Rosenholtz, R. "A computational model for shape from texture for multiple textures," *Investigative Ophthalmology and Visual Science Supplement*, Vol. 36, No. 4, March 1995, p. 2202.

[1] Tarr, M. J. and Black, M. J., "Psychophysical implications of temporal persistence in early vision: A computational account of representational momentum," *Investigative Ophthalmology and Visual Science Supplement*, Vol. 33, May 1992, p. 1050.

Refereed Videos

[1] Yalcin, H., Collins, R., Black, M., Hebert, M., "A Flow-Based Approach to Vehicle Detection and Background Mosaicking in Airborne Video," Video Proceedings in conjunction with *IEEE Conf. on Computer Vision and Pattern Recognition, CVPR05*, pp. 1202, San Diego, CA, 2005.

Book Reviews

[1] Black, M., Book Review of "The Connection Machine," *The AI Magazine,* Vol. 7, No. 3, 1986.

Technical Reports (not already mentioned above)

Moldovan, T. M., Roth, S., and Black, M. J., "Denoising archival films using a learned Bayesian model," Technical Report CS-07-03, Brown University, Department of Computer Science, Providence, Rhode Island, 2007.

Sigal, L. and Black, M. J. "HumanEva: Synchronized video and motion capture dataset for evaluation of articulated human motion," Technical Report CS-06-08, Brown University, Department of Computer Science, Sept. 2006.

Yalcin, Y., Collins, R., Black, M., Hebert, M., "A flow-based approach to vehicle detection and background mosaicking in airborne video," Technical Report CMU-RI-TR-05-11, Carnegie Mellon University, Robotics Institute, March 2005.

Yalcin, M., Black, M. J. and Fablet, R., "The dense estimation of motion and appearance in layers," Brown University, Dept. of Computer Science, Tech Report CS-04-15 November 2004.

Jepson, A. and Black, M, "Mixture models for image representation," University of Toronto, PRECARN ARK Project Technical Report ARK96-PUB-54, March 1996.

Black, M., Milgram, D., Cioffi, S., and Gelband, P., (1988) "Spatial data structures for robotic vehicle route planning," ADS-TR-3185-01, Advanced Decision Systems, Mountain View, CA.

Milgram, D., Black, M., and Shu, R., (1988) "Digital terrain analysis and support system," ADS-TM-5268, Advanced Decision Systems, Mountain View, CA.

Levitt, T., Ettinger, G., Esselman, T., Black, M., Shaffer, T., Chestek, R., Riley, K., Drazovich, R., and Kirby, R., (1988) "ADRIES prototype system development program," ADS-TR-1131-02, Advanced Decision Systems, Mountain View, CA.

Lawton, D., Levitt, T., McConnell, C., Nelson, P., Black, M., Edelson, D., Koitzch, K., Dye, J., Binford, T., Chelberg, D., Kriegman, D., and Ponce, J., (1987) "Knowledge-based vision techniques task B: Terrain and object modeling recognition," ADS-TR-1093-02, Advanced Decision Systems, Mountain View, CA.

Popular Press Coverage

"Crime Busters," *Science*, Newsmakers, Volume 316, Number 5823, Issue of 20 April 2007.

"2057", *Discovery Channel*, Gruppe 5 Filmproduktion, Jan. 2007. The work originally appeared in Germany as "2057 - Unser Leben in der Zukunft" and also appeared in Australia as "2057: The World in 50 Years."

"Robosapien." *Science Channel* (June 2006), *Discovery Channel* (Fall 2006), *Delta Airlines In-Flight Entertainment* (2006).

InsideBrown, "Whodunit? Computer science brings clarity to grainy crime video," Fall 2006.

fxguide, "Art of Optical Flow", Feb 28, 2006.

BBC Radio 4, Science Frontiers, “Neuroprosthetics”, April 13, 2005.

MIT Technology Review, “Implanting Hope,” March 2005.

Evening Magazine, KPIX, Channel 5, San Francisco. Story on collaboration with Pamela Z.

MSNBC, “The Science of Art,” interview regarding the PARC Artist in Residence program, April 10, 1997.

KQED-FM Radio, San Francisco, “Morning Drive,” interview regarding the PARC Artist in Residence program, Oct. 1996.

Invited Conference/Workshop Presentations

“Markerless human motion capture: Status and prospects”

Int. Workshop on Computer Vision, Venice, Italy, May 2008.

“Can Markov random fields tell us anything about visual receptive fields?”

Beyond Simple Cells: Probabilistic models for visual cortical processing, NIPS 2007 workshop, Whistler, BC, Dec. 2007.

“Fields of Experts: High-order Markov random field models of natural scenes,”

6th Int. Conf. on Energy Minimization Methods in Computer Vision an Pattern Recognition, EMMCVPR, Ezhou, Hubei, China, Aug. 2007.
4th Canadian onference on Computer and Robot Vision, CRV, Montreal, May 2007.
5th Indian Conference on Computer Vision, Graphics and Image Processing, ICVGIP, Madurai, India, December 2006.

“Robust statistics, flow statistics and the estimation of optical flow,”

“Vision Shindig,” *Microsoft Research*, Bangalore, India, December 2006.

“Random fields and random wiring: On probabilistic models of natural images and cortical coding,”

International Symposium on Vision by Brains and Machines, Montevideo, Uruguay, November 13–17, 2006.

“Receptive fields, Markov random fields and probabilistic models of natural images,”

Gordon Conference on Sensory Coding and the Natural Environment, Big Sky, Montana, Aug. 27 – Sept. 1, 2006.

“Bayesian denoising of archival films,”

IMA Workshop W2.6-10.06, Institute for Mathematics and its Applications, University of Minnesota, Workshop on The Mathematics and Art of Film Editing and Restoration, February 6-10, 2006.

"Robust statistics, image statistics and the estimation of optical flow,"

Canadian Institute for Advanced Research, *Workshop on Neural Computation and Adaptive Perception,* Vancouver, BC, Dec. 2005.

"Probabilistic models of the neural code for neural prosthetic control,"

STEP Brain-Machine Interface Technology Workshop, Mitre Crop., MacLean, VA, July 2005.

"Neural motor prostheses: Directly coupling brains and machines to restore lost function,"

International Symposium on the Art of Statistical Metaware, Tokyo, Japan, Mar. 2005.

"Fields of experts: A framework for learning image priors,"

MSRI Workshop on Learning and Inference in Low and Mid Level Vision, Feb. 2005.

"3D markerless motion capture (evaluation, reactions and directions),"

Rank Prize Workshop, "Machine understanding of people and their responses," Grasmere, UK, Jan. 31 – Feb. 3, 2005.

"Video-based human motion capture: Problems and directions,"

Learning in Graphics and Vision, Workshop at NIPS, Whistler, BC, Dec. 18, 2004.

"Probabilistic decoding for a neural motor prosthesis,"

Towards Brain Computer Interfacing, Workshop at NIPS, Whistler, BC, Dec. 17, 2004.

"Inferring people from images,"

International Symposium on Representation of Reality by Brain and Machines: Crossed Views from Neuroscience and Computer Vision, Nov. 2004, Montevideo, Uruguay.

"Probabilistic decoding of motor cortical activity for neural motor prostheses,"

International Symposium on Representation of Reality by Brain and Machines: Crossed Views from Neuroscience and Computer Vision, Nov. 2004, Montevideo, Uruguay.

"Estimating human motion,"

First International Workshop on Complex Motion, Oct. 2004, Schloss Reisenburg, Günzburg Germany.

"Learning to see people,"

Keynote, *21st International Conference on Machine Learning*, Banff, Alberta, July 4–8, 2004.

"From uncertain spikes to prosthetic control,"

Statistical Analysis of Neuronal Data, SAND2, Pittsburgh, PA, May 21–22, 2004.

"Moving on: Trends in the estimation of visual motion,"

Machine Vision Face to Face, Intel Research, Santa Clara, CA, May 20, 2004.

"Inferring people from images,"

Open Challenges in Cognitive Vision , Workshop at NIPS, Whistler, BC, Dec. 13, 2003.

"Bayesian decoding of motor cortical activity,"

Case studies in Bayesian Statistics Workshop 7, Carnegie Mellon University, Pittsburgh, Sept. 12–13, 2003.

"Inferring 3D people from 2D images,"

19th Conference on Uncertainty in Artificial Intelligence, UAI-2003, Acapulco, Mexico, Aug 8-10, 2003.

"People from pictures: Past, present, and future,"

The 2003 Stockholm Workshop on Computational Vision, Rosenön, Sweden, July 2003.

"Connecting brains with machines: The neural control of 2D cursor movement,"

Plenary talk, *1st International IEEE EMBS Conference on Neural Engineering*, March 20–22, 2003, Capri Italy.

"Models of neural coding in motor cortex and their application to neural prostheses,"

Plenary talk, *Mathematical Biosciences Institute,* workshop on Neural Coding, Feb 10–14, 2003.

"Connecting brains with machines: Towards the neural control of robotic devices,"

Keynote, *EURON, European Robotics Research Network*, Annual Meeting, Lisbon, Portugal, Jan. 2003.

"Learning the appearance and motion of people in video,"

One-day Workshop on Computer Vision, INRIA Rhône-Alpes, Grenoble, France, Jul. 2002.
Workshop of the ECCV Area Chairs , Lund Univ., Sweden, Feb. 2002.

"Overview of brain-computer interface research at Brown," *Directions in Brain-Computer Interface (BCI) Research,* Whistler, BC, Dec. 7, 2001.

"Smoke & mirrors: Grand challenges in motion imagery,"

Defining a Motion Imagery Research and Development Program Workshop, Herndon, VA, Nov. 28-30, 2001.

"Probabilistic inference of hand motion from neural activity in motor cortex,"

The 2001 Stockholm Workshop on Computational Vision, Rosenön, Sweden, July 30 – August 2, 2001.

"Learning what people look like,"

Workshop on the Convergence of Vision, Video, and Graphics, March 28-30, 2001, Berkeley, CA.

"Beyond perceptual user interfaces: Brain-computer interfaces,"

Workshop on Vision-Based Perceptual Interfaces, March 19, 2001, Interactive Institute, Stockholm, Sweden.

"Probabilistic modeling of neural activity for brain-computer interfaces,"

Microsoft Research Vision Symposium, March 5–6, 2001, Redmond, WA.

"Stochastic tracking of humans,"

Keynote speech, *Vision Interface 2000*, May 15–17, 2000, Montreal, Canada.

"Understanding human behavior,"

Panel presentation, *IEEE Human Modeling, Analysis and Synthesis Workshop*, Hilton Head, June 2000.

"Stochastic tracking of human motion,"

Beckman Institute Computer Vision Workshop, February 14–15, 2000, Urbana, IL.

"Generic recognition of human activity,"

2nd IEEE Workshop on Generic Object Recognition, September 26, 1999, Corfu, Greece.

"Motion: From estimation to explanation,"

IEEE Computer Society Workshop on The Interpretation of Visual Motion, Santa Barbara, June 1998.

"Human motions and computer interfaces,"

ECCV'98 Workshop on Perception of Human Action, Freiburg Germany, June 1998.

"The vision frontier in the early detection of breast cancer,"

New Frontiers in Breast Cancer Imaging and Early Detection, Washington D.C., July 1994.

"Robust tracking of multiple affine motions,"

IRIS–PRECARN III Annual Conference, Ottawa, June 1993.

"Optic flow and motion discontinuities over long image sequences: Experimental results,"

Panelist: Experimental Session on Optic Flow, *IEEE Workshop on Visual Motion*, Princeton, NJ, Oct. 1991.

"Optic flow and nap of the earth helicopter flight,"

Workshop on Motion and Autonomous Navigation, NASA Ames Research Center, July 1990.

Invited Talks

"Detailed human shape pose from images"

Georgia Inst. Tech., Center for Robotics and Intelligent Machines, Feb. 2008,
Google, Tech Talk, Mountain View, Jan. 2008,
Technion, Dept. of Computer Science, Haifa, Israel, Jan. 2008,
Weizmann Inst. of Science, Rehovot, Israel, Jan. 2008,
University of Oxford, Engineering, Visual Geometry Group, Nov. 2007,
Microsoft Research, Cambridge, UK, Nov. 2007,
Ecole Normale Supérieure, Département d'Informatique, Paris, Nov. 2007.

"The development of a human neural interface system: Recent results"

Hebrew University, Dept. of Physiology, Jerusalem, Isreal, Jan. 2008.

"Directly connecting brains and machines: The development of a human neural interface system,"

Tel Aviv University, Dept. of Electrical Engineering, Tel Aviv, Israel, Jan. 2008,
The Gerard Salton Lecture, Cornell University, Dept. of Computer Science, Sept. 2007.

"Restoring movement to the severely disabled with a neural motor interface,"

Univ. of British Columbia, Dept. of Computer Science, Vancouver, May 2007.

"Fields of Experts: High-order Markov random field models of natural scenes,"

Hebrew University, Comp. Sci. & Eng., Jerusalem, Isreal, Jan. 2008,
Oxford Brookes University, Oxford, Nov. 2007
Cornell University, AI Seminar Series, Dept. of Computer Science, Sept. 2007,
Hong Kong Univ. of Science and Technology, Dept. of Computer Science and Engineering and Dept. of Electronic and Computer Engineering, August 2007.
Univ. of British Columbia, Dept. of Computer Science, Vancouver, May 2007.
Stanford Univ., The Probabilistic AI Lunch, October 2006.

"Building the bionic body: Restoring movement to the severely disabled with a brain-machine interface,"

National Hellenic Research Foundation, Public lecture series on Health and Society, Athens, Greece, November 2006.

"Repairing the damaged brain with computation: The development of a neural motor prosthesis,"

Dertouzos Lecturer Series, MIT, CSAIL, April 2006,
National Technical University of Athens, June 2006.

"Bayesian denoising of archival films,"

Intel Research, Santa Clara, CA, March 2006.

"Fields of experts: A framework for learning image priors,"

Royal Institute of Technology (KTH), CVAP, Stockholm, Sweden, Sep. 2005.

"Neural Motor Prostheses: Directly Coupling Brains and Machines to Restore Lost Function,"

German Aerospace Center, DLR, Oberpfaffenhofen, Germany, Jan. 2006,
Salk Institute, La Jolla, CA, June 2005,
Univ. of Maryland, Dept. of Computer Science, Apr. 2005,
Gatsby Computational Neuroscience Unit, Univ. College, London, Feb. 2005,
Karolinska Inst., Nobel Inst. for Neurophys., Stockholm, Sweden, Jan. 2005,
Oxford University, Robotics Research Group Seminar, Dec. 2004,
York University, Computer Science and Engineering Seminar Series, Nov. 2004,
Carnegie Mellon, Robotics Institute Seminar, Sept. 24, 2004.

"Inferring 3D people from 2D images,"

Royal Institute of Technology (KTH), CVAP, Stockholm, Sweden, Jan. 2005,
Johns Hopkins University, Center for Imaging Science, April 20, 2004.

"The probabilistic inference of 3D human motion,"

Columbia Univ., Vision and Graphics Center, Distinguished Lecture Series, Apr. 2003.

"Connecting brains with machines: Towards the neural control of 2D cursor movement,"

McGill Univ., Center for Intelligent Machines Seminar, Montreal, April 2003,
Siemens Corp. Research, Distinguished Seminar Series, Princeton, Apr. 2003,
Ohio State University, Electrical Engineering Colloquium, Feb. 2003,
MIT, AI Lab Colloquium, Oct. 2002,
Middlebury College., Dept. of Math. and Comp. Science, Oct. 2002.

"Connecting brains with machines: Intel inside your brain?,"

Intel Corp., Microprocessor Research Labs (MRL), Santa Clara, Media Graphics Seminar, Mar. 2002.

"Connecting brains with machines: The probabilistic inference of hand motion from neural activity,"

Signals, Sensors, and Systems, KTH, Stockholm, Feb. 2002,
La Salle School of Engineering, Barcelona, Catalonia, Jan. 2002.

"The man who mistook his computer for a hand: The neural control of robotic devices,"

Royal Institute of Technology (KTH), Stockholm, Sweden, Nov. 2001.

"Learning the appearance and motion of people in video,"

Middlebury College, Computer Vision (CX 336), guest lecture, Oct. 2002.
University of Toronto, Vision group, Dept. of Computer Science, Nov. 2002,
Siemens, SRC Distinguished Seminar Series, Princeton, NJ, Aug. 2002,
Yale University, Dept. of Computer Science, Feb. 2002,
University of Rochester, Dept. of Computer Science, Apr. 2001,
University of Western Ontario, Dept. of Computer Science, Apr. 2001.

"Stochastic tracking of humans,"

University of Pennsylvania, GRASP Laboratory, Feb. 2001,
New York University, Center for Neural Science, Feb. 2001,
The Robotics Institute, Carnegie Mellon University, Nov. 2000,
Brown University, Dept. of Applied Mathematics, Sept. 2000.

"Generative spatio-temporal models of optical flow events,"

Imaging Science & Biomedical Eng., Univ. of Manchester, Oct. 1999,
Gatsby Computational Neuroscience Unit, Univ. College, London, Oct. 1999,
Smith-Kettlewell Eye Research Institute, San Francisco, July 1999,
Brown Univ., Dept. of Computer Science, May 1999,
UCLA, Mathematics Dept., April 1999,
Univ. of Southern California, Dept. of Comp. Sci. April 1999,
California Institute of Technology, Vision Seminar, April 1999,
Univ. of California at Berkeley, Vision Seminar, Feb. 1999,
University of Toronto, Dept. of Computer Science, Feb. 1999,
Interval Research, Palo Alto, CA, Feb. 1999.

"Motion: From estimation to explanation,"

Royal Institute of Technology (KTH), Stockholm, Sweden, Sept. 1998.

"A framework for modeling appearance change in image sequences,"

Royal Institute of Technology (KTH), Stockholm, Sweden, Dec. 1998.

"A probabilistic framework for matching temporal trajectories: Condensation-based recognition of gestures and expressions,"

INRIA Rhônes Alpes, Grenoble, France, May 1998.

"Human motions and computer interfaces,"

McGill University, Center for Intelligent Machines, August 1998,
Univ. of Heidelberg, Interdisciplinary Center for Sci. Comp., June 1998,
Harvard Univ., Division of Engineering and Applied Sciences, May 1998,
Brown Univ., Dept. of Computer Science, March 1998,
Stanford Univ., Dept. of Computer Science, March 1998,
Rutgers Univ., Cognitive Science Colloquium, Dec. 1997.

"Looking @ people: Estimation and explanation of human motion,"

MIT, AI Lab Colloquium, Nov. 1997,
Smith-Kettlewell Eye Research Institute, San Francisco, Oct. 1997,
Univ. of California at Berkeley, AI/Robotics/Vision Seminar, Oct. 1997,
Univ. of Toronto, Artificial Intelligence Colloquium, Oct. 1997.

"Motion explanation: Learning parameterized models of optical flow,"

Univ. of Central Florida, Computer Science Dept. Colloquium, March 1997,
Univ. of South Florida, Computer Science Dept., March 1997.

"Introduction to robust statistics with applications in computer vision,"

CS 348D: Vision and Image Processing, Stanford University, Dec. 1996.

"EigenTracking: Robust matching and tracking of articulated objects using a view-based representation,"

Royal Institute of Technology (KTH), Stockholm, Sweden, Nov. 1998,
Courant Institute, NYU, New York, February 1997,
Interval Research Corporation, Palo Alto, CA, Dec. 1996,
Univ. of British Columbia, Dept. of Computer Science, Vancouver, Aug. 1996,
MIT, Department of Brain and Cognitive Science, Cambridge, MA, May 1996.

"Human gestures and the Digital Office,"

Univ. of Maryland, Computer Vision Laboratory, College Park, MD, Sept. 1996.

"If only your computer could see you now: Tracking and recognizing facial expressions in video,"

Univ. of British Columbia, Dept. of Computer Science, Vancouver, Jan. 1996,
Interval Research Corporation, Palo Alto, CA, Sept. 1995.

"Estimating optical flow in segmented images using variable-order parametric models with local deformations,"

Interval Research Corporation, Palo Alto, CA, Sept. 1994,
Univ. of California at Berkeley, Dept. of EECS, Aug. 1994,
Univ. of Maryland, Computer Vision Laboratory, College Park, MD, July 1994,
Univ. of British Columbia, Comp. Science Colloquium, Vancouver, June 1994.

"Robust estimation of multiple motions,"

Stanford University, Department of Psychology, Nov. 1993,
IRISA/INRIA, Rennes, France, Aug. 1993.

"Robust incremental optical flow,"

Xerox PARC, March 1993,
University of Toronto, Research Group in Perception, Jan. 1993,
David Sarnoff Research Center, Aug. 1992,
Teleos Research, July 1992.

"Robust dynamic motion estimation over time,"

Yale University, Industry Liaison Meeting, Oct. 1990,
Yale University, Vision Lunch, May 1991.

"Motion estimation, Markov random fields, and simulated annealing,"

Yale University, Department of Statistics, Sept. 1990.

"Current research in incremental motion estimation,"

Columbia University, Sept. 1990, (with P. Anandan).

"Incremental motion estimation,"

NASA Ames Research Center, June 1990,
Advanced Decision Systems, Aug. 1990.

"Early detection of motion discontinuities,"

Univ. of California, Berkeley, June 1990,
NASA Ames Research Center, June 1990.

Other Talks

"Detailed human shape pose from images"

ECCV'08 Area Chair Workshop, *Ecole Normale Supérieure*, Paris, June 2008.
CVPR'08 Area Chair Workshop, Univ. of Central Florida, March 2008.

"Probabilistic encoding and decoding of motor cortical activity,"

DARPA Bio:Info:Micro PI Meeting, Boston, MA, Oct 31–Nov 1, 2002.

"Connecting brains with computers: The neural control of robotic devices,"

Brown University Mind Brain Retreat, Killington, VT, Mar. 2002.

"The machine inside,"

Voyages of Discovery, Inauguration of Ruth J. Simmons, 18th President of Brown Univ., with E. Bienenstock, D. Sheinberg, and M. Serruya. Providence, RI, Oct. 2001.

"The science of silly walks,"

Brown University Conference on Stochastic and Deterministic Approaches in Vision, Language, and Cognition, Whispering Pines, RI, May 2001.

"Condensation-based gesture recognition,"

3rd San Francisco Bay Area Vision Meeting, Interval Research, April. 1998.

"Motion: Looking back and moving forward,"

2nd San Francisco Bay Area Vision Meeting, Xerox PARC, Dec. 1997.