

# Margrit Betke

Curriculum Vitae, September 2018  
<http://www.cs.bu.edu/faculty/betke>

Margrit Betke is a Professor of Computer Science at Boston University. She co-leads the BU Artificial Intelligence (AI) Research Initiative and the Image and Video Computing Research Group. Her focus is integrative research in AI, computer vision, and human computer interaction that benefits other fields, including social, health, and natural sciences, and the arts.

## PROFESSIONAL PREPARATION

### Massachusetts Institute of Technology, Cambridge, MA

Ph.D. in Electrical Engineering and Computer Science, June 1995  
Research Mentor: Professor Ronald L. Rivest, Turing Award Winner  
S.M. in Electrical Engineering and Computer Science, February 1992

### Bonn University, Germany

Vordiplom in Computer Science and Operations Research, September 1988

## ACADEMIC APPOINTMENTS

### Boston University

Professor, Department of Computer Science	<i>2011–present</i>
Affiliated Professor, Department of Biomedical Engineering	<i>2016–present</i>
Affiliated Professor, Department of Electrical and Computer Engineering	<i>2015–present</i>
Director of Graduate Studies, Department of Computer Science	<i>2014–present</i>
Associate Chair, Department of Computer Science	<i>2009–2012</i>
Director of Undergraduate Studies, Department of Computer Science	<i>2004–2006, 2007–2008</i>
Associate Professor, Department of Computer Science	<i>2004–2011</i>
Assistant Professor, Department of Computer Science	<i>2000–2004</i>

### Harvard Medical School and Massachusetts General Hospital

Research Scientist	<i>1999–2007</i>
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### Boston College

Assistant Professor, Computer Science Department	<i>1997–2000</i>
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### University of Maryland

Postdoctoral Research Associate, Institute for Advanced Computer Studies	<i>1995–1997</i>
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## HONORS AND AWARDS

**HERS Leadership Institute Award**, Wellesley Class of 2018.

**2018 ASAR Competition Award**, presented by The 2nd IEEE International Workshop on Arabic and derived Script Analysis & Recognition (ASAR), held at The Alan Turing Institute, United Kingdom, March 12-14, 2018, to Saad, Elanwar, Abel Kader, Mashali, and Betke for winning the “Layout Analysis of Arabic Historical Manuscripts – Segmentation Challenge.”

**2016 Best Paper Runner-up Award** for “CrowdTrack: Interactive Tracking of Cells in Microscopy Image Sequences with Crowdsourcing Support” at the GroupSight Workshop at The Fourth AAI Conference on Human Computation and Crowdsourcing (HCOMP 2016), Austin, Texas, 2016.

**2014 Best Paper Award for Innovative Idea** for “How to use level set methods to accurately find boundaries of cells in biomedical images? Evaluation of six methods paired with automated and crowdsourced initial contours” at the MICCAI Workshop on Interactive Medical Image Computation (IMIC), 2014.

**Outstanding Reviewer** for the IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR), 2014.

**Best Paper Award** for “SAGE: An approach and implementation empowering quick and reliable quantitative analysis of segmentation quality” at the IEEE Workshop on Applications in Computer Vision (WACV), 2013.

**ACM Senior Member** since October 2012

**IEEE Senior Member** since September 2012

**Top 10 Women to Watch in New England Award**, one of two academic honorees, selected from more than 100 contenders in science and technology, Mass High Tech, February 2005

**NSF CAREER Award** (National Science Foundation Faculty Early Career Development) for “Video-Based Computer Interfaces for People with Severe Disabilities,” 2001–2006

Elected Member of the Sigma Xi Honor Society since 1995

Germanistic Society of America Scholarship, 1994–1995

**Friedrich-Ebert-Stiftung Scholarship**, 1987–1992

## GRANTS

### Principal Investigator:

: National Science Foundation: BIGDATA Principal Investigator, 09/15/18 – 09/14/22 “BIGDATA: IA: Multiplatform, Multilingual, and Multimodal Tools for Analyzing Public Communication in over 100 Language”	\$1,000,000
Google Research: Principal Investigator, AY 18/19 “Providing Real-time Content with Balanced Political Views”	\$88,301
National Science Foundation: Integration Principal Investigator, 09/01/16 – 08/30/20 “INT: Collaborative Research: Detecting, Predicting and Remediating Student Affect and Grit using Computer Vision.”	\$614,990
National Science Foundation: Robust Intelligence Principal Investigator, 08/01/14 – 07/31/18 “RI: Small: Using Humans in the Loop to Collect High-quality Annotations from Images and Time-lapse Videos of Cells.”	\$370,151
The Rafik B. Hariri Institute for Computing and Computational Science & Engineering, Boston University Principal Investigator, 6/12/2017– “ExerciseCheck: Remote Monitoring and Evaluation Platform for Home Based Physical Therapy”	\$50,000

Adobe Research, Cambridge, MA Principal Investigator, AY 2016/2017 “Deep Learning of Motion Representations for Animation Movies”	\$8,100
National Science Foundation: Human-Centered Computing Principal Investigator, 10/01/13 – 09/30/16 “MRI Collaborative: Development of iRehab, an Intelligent Closed-Loop Instrument for Adaptive Rehabilitation.”	\$287,713 (\$200,109 plus \$85,604 cost share)
National Science Foundation: Human-Centered Computing Principal Investigator, 09/01/09 – 08/31/15 “HCC: Large: Intelligent Tracking Systems that Reason about Group Behavior.”	\$2,858,292
Naval Undersea Warfare Center, Division Newport Principal Investigator, 08/27/09 – 12/31/09 “Research in support of in-house laboratory independent research (ILIR) proposal for the investigation of image analysis methods for automating identification of objects for real-time large-area surveillance performed in naval environments by unmanned vehicles.”	\$10,000
National Science Foundation: Human-Centered Computing Principal Investigator, 09/15/07 – 09/14/10 “HCC: Intelligent Interfaces to Empower People with Disabilities to Participate in the Information Society.”	\$385,840
National Science Foundation Faculty Early Career Development Award Principal Investigator, 08/01/01 – 07/31/06 “CAREER: Video-Based Computer Interfaces for People with Severe Disabilities.”	\$412,734
MIT Lincoln Laboratory under US Air Force Prime Contract Principal Investigator, 09/01/05 – 12/31/05 “Detecting and Tracking People in Video Sequences.”	\$23,602
The Whitaker Foundation: Biomedical Engineering Research Grant Principal Investigator, 05/01/01 – 04/30/04 “Automated Detection of Pulmonary Nodules on Computed Tomography and Assessment of Change over Time.”	\$205,912
National Science Foundation: Major Research Instrumentation Program Principal Investigator, 09/15/1998 – 08/31/1999, “CISE Major Research Instrumentation: Research Laboratory for Computer Science.”	\$150,000

**Co-Principal Investigator:**

The Rafik B. Hariri Institute for Computing and Computational Science & Engineering, Boston University Co-Principal Investigator, 6/12/2017– “IKEA: Product, Pricing, and Exchange Rate Pass-through.”	\$25,000
Office of Naval Research: Multidisciplinary University Research Initiative Co-Principal Investigator on Boston University subcontract to University of	\$7.5 Million

Washington 10/1/10 – 1/30/16. Subcontract award to BU: \$3,127,730

“AIRFOILS: Animal Inspired Robust Flight with Outer and Inner Loop Strategies.”

National Science Foundation: Division of Computer and Network Systems Co-Principal Investigator, 09/01/09 – 8/31/12 “II-EN: Infrastructure for Gesture Interface Research Outside the Lab.”	\$591,445
Air Force Office of Scientific Research Co-Principal Investigator, 04/15/09 – 04/14/10 “Acquisition of an Advanced Thermal Infrared Imaging System for Tracking Multiple Targets in Three Dimensions.”	\$523,050
Bat Conservation International Co-Principal Investigator, 05/01/09 – 04/30/10 “A novel BatCam for censusing maternity colonies of bats in regions affected by white-nose syndrome.”	\$5,000
US Fish and Wildlife: Illinois Natural History Survey Co-Principal Investigator, 09/01/07 – 12/31/08 “Effects of Topography and Weather in Vermont and Use of Appropriate Technology to Support Such Investigations.”	\$114,960
National Science Foundation: Information Technology Research Program Co-Principal Investigator, 10/01/03 – 09/30/08 “ITR: Advanced Imaging and Information Technology for Assessing the Ecological and Economic Impact of Brazilian Free-tailed Bats on Agroecosystems.”	\$2,400,000
National Science Foundation: Human Computer Interaction Program Co-Principal Investigator, 09/01/03 – 08/31/06 “Pattern Discovery in Signed Languages and Gestural Communications.”	\$774,096
National Science Foundation: Information and Data Management Program Co-Principal Investigator, 09/15/03 – 09/14/06 “Mining and Indexing Spatio-Temporal Patterns in Video Databases of Human Motion.”	\$494,580
National Science Foundation: Research Infrastructure Co-Principal Investigator, 09/01/02 – 08/31/07 “CISE Research Infrastructure: SENSORIUM: Research Infrastructure for Managing Spatio-Temporal Objects in Video Sensor Networks.”	\$1,247,395
Office of Naval Research: Defense University Research Instrumentation Program Co-Principal Investigator, 04/01/01 – 03/31/02 “DURIP: Lab Upgrade for Machine Vision Research and Research-Related Education.”	\$246,242

## PUBLICATIONS

### Peer-reviewed Book

[B1] M. Betke and Z. Wu. Data Association for Multi-Object Visual Tracking. Morgan & Claypool Lecture Series on Computer Vision. 2016. 120 pages. pdf

## Articles in Journals

- [J1] M. Betke, R. L. Rivest, and M. Singh. Piecemeal learning of an unknown environment. *Machine Learning*, 18(2/3):231–254, February/March 1995. pdf.
- [J2] M. Betke and L. Gurvits. Mobile robot localization using landmarks. *IEEE Transactions on Robotics and Automation*, 13(2):251–263, April 1997. pdf.
- [J3] B. Awerbuch, M. Betke, R. L. Rivest, and M. Singh. Piecemeal graph exploration by a mobile robot. *Information and Computation*, 152(2):155–172, August 1999. pdf.
- [J4] M. Betke, E. Haritaoglu, and L. S. Davis. Real-time multiple vehicle detection and tracking from a moving vehicle. *Machine Vision and Applications*, 12(2):69–83, September 2000. pdf.
- [J5] J. P. Ko and M. Betke. Chest CT: Automated nodule detection and assessment of change over time – preliminary experience. *Radiology*, 218(1):267–273, January 2001. pdf.
- [J6] M. Betke and N. C. Makris. Recognition, resolution and complexity of objects subject to affine transformation. *International Journal of Computer Vision*, 44(1):5–40, August 2001. pdf.
- [J7] M. Betke, J. Gips, and P. Fleming. The Camera Mouse: Visual tracking of body features to provide computer access for people with severe disabilities. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, 10(1):1–10, March 2002. pdf.
- [J8] M. Betke, H. Hong, D. Thomas, C. Prince, and J. P. Ko. Landmark detection in the chest and registration of lung surfaces with an application to nodule registration. *Medical Image Analysis*, 7(3):265–281, September 2003. pdf.
- [J9] J. P. Ko, H. Rusinek, E. Jacobs, J. S. Babb, M. Betke, G. McGuinness, and D. P. Naidich. Volume measurement of small pulmonary nodules on chest CT: A phantom study. *Radiology*, 228(3):864–870, September 2003. pdf.
- [J10] K. Grauman, M. Betke, J. Lombardi, J. Gips, and G. R. Bradski. Communication via eye blinks and eyebrow raises: Video-based human-computer interfaces. *International Journal Universal Access in the Information Society*, 2(4):359–373, November 2003. pdf.
- [J11] D. P. Gierga, G. T. Y. Chen, J. H. Kung, M. Betke, J. Lombardi, and C. G. Willett. Quantification of respiration-induced abdominal tumor motion and the impact on IMRT dose distributions. *International Journal on Radiation Oncology - Biology - Physics*, 58(5):1584–1595, April 2004. pdf.
- [J12] W. Mullally, M. Betke, J. Wang, and J. Ko. Segmentation of nodules on chest computed tomography for growth assessment. *Medical Physics*, 31(4):839–848, April 2004. pdf.
- [J13] D. P. Gierga, J. Brewer, G. C. Sharp, M. Betke, C. G. Willett, and G. T. Y. Chen. The correlation between internal and external markers for abdominal tumors: Implications for respiratory gating. *International Journal on Radiation Oncology - Biology - Physics*, 61(5):1551–1558, April 2005. pdf.
- [J14] M. Betke, O. Gussyatin, and M. Urinson. SymbolDesign: A user-centered method to design pen-based interfaces and extend the functionality of pointer input devices. *Universal Access in the Information Society*, 4(3):223–236, March 2006. pdf.

- [J15] C. J. Cleveland, M. Betke, P. Federico, J. D. Frank, T. G. Hallam, J. Horn, J. D. López Jr., G. F. McCracken, R. A. Medellín, A. Moreno-Valdez, C. G. Sansone, J. K. Westbrook, and T. H. Kunz. Economic value of the pest control service provided by Brazilian free-tailed bats in south-central Texas. *Frontiers in Ecology and the Environment*, 4(5):238–248, June 2006. pdf.
- [J16] J. Wang, M. Betke, and J. P. Ko. Pulmonary fissure segmentation on CT. *Medical Image Analysis*, 10(4):530–547, August 2006. pdf.
- [J17] M. Gorman, A. Lahav, E. Saltzman, and M. Betke. A camera-based music making tool for physical rehabilitation. *Computer Music Journal*, 31(2):39–53, Summer 2007. pdf.
- [J18] P. J. McNerney, J. Konrad, and M. Betke. Block-based MAP disparity estimation under alpha channel constraints. *IEEE Transactions on Circuits and Systems for Video Technology*, 17(16):785–789, June 2007. pdf.
- [J19] M. Betke, D. E. Hirsh, N. C. Makris, G. F. McCracken, M. Procopio, N. I. Hristov, S. Tang, A. Bagchi, J. D. Reichard, J. W. Horn, S. Crampton, C. J. Cleveland, and T. H. Kunz. Thermal imaging reveals significantly smaller Brazilian free-tailed bat colonies than previously estimated. *Journal of Mammalogy*, 89(1):18–24, February 2008. pdf. Also discussed in *Nature*, 452, Research Highlights, p. 507, pdf.
- [J20] J. Wang, V. Athitsos, S. Sclaroff, and M. Betke. Detecting objects of variable shape structure with hidden state shape models. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 30(3):477–492, March 2008. pdf, videos.
- [J21] P. Federico, T. G. Hallam, G. F. McCracken, S. Purucker, W. Grant, A. N. Sandoval, J. Westbrook, R. Medellín, C. Cleveland, C. G. Sansone, J. D. López Jr., M. Betke, A. Moreno-Valdez, and T. H. Kunz. Brazilian free-tailed bats (*tadarida brasiliensis*) as insect pest regulators in transgenic and conventional cotton crops. *Ecological Applications*, 18(4):826–837, June 2008. pdf.
- [J22] N. I. Hristov, M. Betke, and T. H. Kunz. Applications of thermal infrared imaging for research in aeroecology. *Integrative and Comparative Biology*, 48(1):50–59, July 2008. pdf.
- [J23] J. J. Magee, M. Betke, J. Gips, M. R. Scott, and B. N. Waber. A human-computer interface using symmetry between eyes to detect gaze direction. *IEEE Transactions on Systems Man & Cybernetics Part A: Systems and Humans*, 38(6):1–14, November 2008. pdf, video.
- [J24] W. Mullally, M. Betke, M. Albert, and K. Lutchen. Explaining clustered ventilation defects via a minimal number of airway closure locations. *Annals of Biomedical Engineering*, 37(2):286–300, February 2009. pdf.
- [J25] N. I. Hristov, M. Betke, D. Hirsh, A. Bagchi, and T. H. Kunz. Seasonal variation in colony size of Brazilian free-tailed bats at Carlsbad Caverns using thermal imaging. *Journal of Mammalogy*, 91(1):183–192, February 2010. pdf.
- [J26] T. G. Hallam, A. Raghavan, H. Kolli, D. Dimitrov, P. Federico, H. Qi, G. F. McCracken, M. Betke, J. K. Westbrook, K. Kennard, and T. H. Kunz. Dense and sparse aggregations in complex motion: Video coupled with simulation modeling. *Ecological Complexity*, 7(1):69–75, March 2010. pdf, videos.

- [J27] D. H. Theriault, M. Walker, J. Y. Wong, and M. Betke. Cell morphology classification and clutter mitigation in phase-contrast microscopy images using machine learning. *Machine Vision and Applications*, 23(4):659–673, July 2012. Online Article.
- [J28] S. Epstein, E. Missimer, and M. Betke. Using kernels for a video-based mouse-replacement interface. *Personal and Ubiquitous Computing*, 18:47–60, January 2014. Open Access Online.
- [J29] S. Epstein and M. Betke. The kernel semi-least squares method for sparse distance approximation. *Neural Computation*, 25(3):532–548, February 2013.
- [J30] X. Yang, C. Schaaf, A. Strahler, T. Kunz, N. Fuller, M. Betke, Zu, Z. Wang, D. Theriault, D. Culvenor, D. Jupp, G. Newnham, and J. Lovell. Study of bat flight behavior by combining thermal image analysis with a LiDAR forest reconstruction. *Canadian Journal of Remote Sensing*, 39(S1):S112–S125, 2013. Online Article.
- [J31] D. H. Theriault, N. W. Fuller, B. E. Jackson, E. Bluhm, D. Evangelista, Z. Wu, M. Betke, and T. L. Hedrick. A protocol and calibration method for accurate multi-camera field videography. *The Journal of Experimental Biology*, 217:1843–1848, February 2014. Open access online, pdf.
- [J32] C. W. Kwan, I. Paquette, J. J. Magee, and M. Betke. Adaptive sliding menubars make existing software more accessible to people with severe motion impairments. *Universal Access in the Information Society*, 13(1):5–22, March 2014. Online Article.
- [J33] Z. Wu and M. Betke. Global optimization for coupled detection and data association in multiple object tracking. *Computer Vision and Image Understanding*, 143:25–37, 2016. Online Article.
- [J34] Z. Kong, N. Fuller, S. Wang, K. Özcimder, E. Gillam, D. Theriault, M. Betke, and J. Baillieul. Perceptual modalities guiding bat flight in a native habitat. *Scientific Reports*, June 2016. 10 pages, Open access.
- [J35] A. Joshi, C. Monnier, M. Betke, and S. Sclaroff. Comparing random forest approaches to segmenting and classifying gestures. *Image and Video Computing*, 58:86–95, February 2017. Online Article.
- [J36] J. Zhang, S. Ma, M. Sameki, S. Sclaroff, M. Betke, Z. Lin, X. Shen, B. Price, and R. Mech. Salient object subitizing. *International Journal of Computer Vision*, 124(2):169–186, September 2017. 10 pages, pdf.
- [J37] N. L. Brace, T. L. Hedrick, D. H. Theriault, N. W. Fuller, Z. Wu, M. Betke, J. K. Parrish, D. Grünbaum, K. A. Morgansen, and W. E. Boeing. Using collision cones to assess biological deconfliction methods. *Journal of the Royal Society Interface*, 2016. Open Access Online.
- [J38] D. Gurari, K. He, B. Xiong, J. Zhang., M. Sameki, S. D. Jain, S. Sclaroff, M. Betke, and K. Grauman. Predicting foreground object ambiguity and efficiently crowdsourcing the segmentation(s). *International Journal of Computer Vision*, 126:714–730, 2018. pdf.
- [J39] R. I. Elanwar, Wenda Qin, and M. Betke. Making scanned Arabic documents machine accessible using an ensemble of SVM classifiers. *International Journal on Document Analysis and Recognition*, 21:59–79, June 2018. pdf.
- [J40] W. Feng, M. Sameki, and M. Betke. Exploration of assistive technologies used by people with quadriplegia caused by degenerative neurological diseases. *International Journal of Human Computer Interaction*, 34(9):834–844, 2018. pdf.

## Articles in Peer Reviewed Conference and Workshop Proceedings

- [C1] M. Betke, R. L. Rivest, and M. Singh. Piecemeal learning of an unknown environment. In *Proceedings of the 1993 Conference on Computational Learning Theory (COLT)*, pages 277–286, Santa Cruz, California, July 1993. ACM Press. pdf.
- [C2] M. Betke and L. Gurvits. Mobile robot localization using landmarks. In *Proceedings of the IEEE/RSJ/GI International Conference on Intelligent Robots and Systems*, pages 135–142, Munich, Germany, September 1994. pdf.
- [C3] M. Betke and N. C. Makris. Fast object recognition in noisy images using simulated annealing. In *Proceedings of the Fifth International Conference on Computer Vision (ICCV)*, pages 523–530, Cambridge, MA, June 1995. IEEE Computer Society. pdf.
- [C4] B. Awerbuch, M. Betke, R. L. Rivest, and M. Singh. Piecemeal graph exploration by a mobile robot. In *Proceedings of the 1995 Conference on Computational Learning Theory (COLT)*, pages 321–328, Santa Cruz, California, July 1995. ACM Press. pdf.
- [C5] M. Betke, E. Haritaoglu, and L. S. Davis. Multiple vehicle detection and tracking in hard real time. In *Proceedings of the 1996 IEEE Intelligent Vehicles Symposium*, pages 351–356, Seikei University, Tokyo, Japan, September 1996. IEEE Industrial Electronics Society. pdf.
- [C6] M. Betke, E. Haritaoglu, and L. S. Davis. Multiple vehicle detection and tracking. In D. Schaefer and E. F. Williams, editors, *25th Applied Imagery Pattern Recognition (AIPR) Workshop: Emerging Applications of Computer Vision*, pages 104–110. SPIE–The International Society for Optical Engineering, Bellingham, WA, October 1996. pdf.
- [C7] M. Betke, E. Haritaoglu, and L. S. Davis. Highway scene analysis in hard real time. In *Proceedings of the IEEE Conference on Intelligent Transportation Systems*, pages 812–817, Boston, MA, November 1997. pdf.
- [C8] M. Betke and N. C. Makris. Information-conserving object recognition. In *Proceedings of the Sixth International Conference on Computer Vision (ICCV)*, pages 145–152, Mumbai, India, January 1998. IEEE Computer Society. pdf.
- [C9] M. Betke and H. Nguyen. Highway scene analysis from a moving vehicle under reduced visibility conditions. In *Proceedings of the International Conference on Intelligent Vehicles*, pages 131–136, Stuttgart, Germany, October 1998. IEEE Industrial Electronics Society. pdf.
- [C10] M. Betke and J. P. Ko. Detection of pulmonary nodules on CT and volumetric assessment of change over time. In C. Taylor and A. Colchester, editors, *Medical Image Computing and Computer-Assisted Intervention – MICCAI’99*, pages 245–252, Cambridge, UK, September 1999. Springer-Verlag, Berlin. pdf.
- [C11] M. Betke and J. Kawai. Gaze detection via self-organizing gray-scale units. In *Proceedings of the International Workshop on Recognition, Analysis, and Tracking of Faces and Gestures in Real-Time Systems*, pages 70–76, Kerkyra, Greece, September 1999. IEEE. pdf.
- [C12] M. Betke, W. J. Mullally, and J. Magee. Active detection of eye scleras in real time. In *Proceedings of the IEEE CVPR Workshop on Human Modeling, Analysis and Synthesis (HMAS 2000)*, Hilton Head Island, SC, June 2000. 8 pp., pdf.



- [C13] J. Gips, M. Betke, and P. Fleming. The Camera Mouse: Preliminary investigation of automated visual tracking for computer access. In *Proceedings of the Rehabilitation Engineering and Assistive Technology Society of North America 2000 Annual Conference (RESNA 2000)*, pages 98–100, Orlando, FL, July 2000. pdf.
- [C14] M. Betke and W. Mullally. Preliminary investigation of real-time monitoring of a driver in city traffic. In *Proceedings of the International Symposium on Intelligent Vehicles*, pages 563–568, Dearborn, MI, October 2000. IEEE Industrial Electronics Society. pdf.
- [C15] G. Kollios, S. Sclaroff, and M. Betke. Motion mining: Discovering spatio-temporal patterns in databases of human motion. In *Proceedings of the 2001 ACM SIGMOD Workshop on Research Issues in Data Mining and Knowledge Discovery (DMKD 2001)*, pages 25–32, Santa Barbara, CA, May 2001. pdf.
- [C16] J. Gips, M. Betke, and P. A. DiMattia. Early experiences using visual tracking for computer access by people with profound physical disabilities. In C. Stephanidis, editor, *Universal Access In HCI: Towards an Information Society for All, Volume 3, Proceedings of the 1st International Conference on Universal Access in Human-Computer Interaction (UA-HCI)*, pages 914–918. Lawrence Erlbaum Associates, Mahwah, NJ, 2001. pdf.
- [C17] M. Betke, H. Hong, and J. P. Ko. Automatic 3D registration of lung surfaces in computed tomography scans. In W. J. Niessen and M. A. Viergever, editors, *Medical Image Computing and Computer-Assisted Intervention – MICCAI 2001: 4th International Conference*, pages 725–733, Utrecht, The Netherlands, October 2001. Springer-Verlag, Berlin. pdf.
- [C18] M. Betke, E. Naftali, and N. C. Makris. Necessary conditions to attain performance bounds on structure and motion estimates of rigid objects. In *Proceedings of the IEEE Computer Vision and Pattern Recognition Conference (CVPR)*, volume 1, pages 448–455, Kauai, Hawaii, December 2001. pdf.
- [C19] K. Grauman, M. Betke, J. Gips, and G. R. Bradski. Communication via eye blinks - detection and duration analysis in real time. In *Proceedings of the IEEE Computer Vision and Pattern Recognition Conference (CVPR)*, volume 2, pages 1010–1017, Kauai, Hawaii, December 2001. pdf.
- [C20] H. Hong, M. Betke, S. Teng, D. Thomas, and J. P. Ko. Multilevel 3D registration of lung surfaces in computed tomography scans – preliminary experience. In *Proceedings of the International Conference on Diagnostic Imaging and Analysis (ICDIA)*, pages 90–95, Shanghai, China, August 2002. pdf.
- [C21] W. Mullally, M. Betke, H. Hong, K. Mann, and J. P. Ko. Multi-criterion 3D segmentation and registration of pulmonary nodules on CT: A preliminary investigation. In *Proceedings of the International Conference on Diagnostic Imaging and Analysis (ICDIA)*, pages 176–181, Shanghai, China, August 2002. pdf.
- [C22] J. Wang, M. Betke, and J. P. Ko. Segmentation of pulmonary fissures on diagnostic CT – preliminary experience. In *Proceedings of the International Conference on Diagnostic Imaging and Analysis (ICDIA)*, pages 107–112, Shanghai, China, August 2002. pdf.

- [C23] J. Gips, P. DiMattia, and M. Betke. Collaborative development of new access technology and communication software. In *Proceedings of the 10th Biennial Conference of the International Society for Augmentative and Alternative Communication (ISAAC 2002)*, Odense, Denmark, August 2002. pdf.
- [C24] S. Crampton and M. Betke. Finger counter: A human-computer interface. In *Proceedings of the 7th ERCIM Workshop on User Interfaces for All*, pages 195–196, Paris, France, October 2002. pdf.
- [C25] J. Lombardi and M. Betke. A camera-based eyebrow tracker for hands-free computer control via a binary switch. In *7th ERCIM Workshop on User Interfaces for All*, pages 199–200, Paris, France, October 2002. pdf.
- [C26] R. L. Cloud, M. Betke, and J. Gips. Experiments with a camera-based human-computer interface system. In *7th ERCIM Workshop on User Interfaces for All*, pages 103–110, Paris, France, October 2002. pdf.
- [C27] C. Fagiani, M. Betke, and J. Gips. Evaluation of tracking methods for human-computer interaction. In *IEEE Workshop on Applications in Computer Vision*, pages 121–126, Orlando, Florida, December 2002. pdf.
- [C28] S. Crampton and M. Betke. Counting fingers in real time: A webcam-based human-computer interface with game applications. In *Proceedings of the Conference on Universal Access in Human-Computer Interaction (UA-HCI)*, pages 1357–1361, Crete, Greece, June 2003. pdf.
- [C29] O. Gussyatin, M. Urinson, and M. Betke. A method to extend functionality of pointer input devices. In C. Stary and C. Stephanidis, editors, *Proceedings of the 8th International ERCIM Workshop on User Interfaces for All, Revised Selected Papers, Lecture Notes in Computer Science 3196*, pages 426–439. Springer-Verlag, Vienna, Austria, June 2004. pdf.
- [C30] J. J. Magee, M. R. Scott, B. N. Waber, and M. Betke. Eyekeys: A real-time vision interface based on gaze detection from a low-grade video camera. In *IEEE Workshop on Real-Time Vision for Human-Computer Interaction (RTV4HCI)*, Washington, D.C., July 2004. IEEE Computer Society. 8 pp. A revised version appeared under the title “A Real-Time Vision Interface Based on Gaze Detection – EyeKeys.” In B. Kisacanin, V. Pavlovic, and T. S. Huang, editors, *Real-Time Vision for Human-Computer Interaction*, 2005, pages 141–157, Springer-Verlag, pdf.
- [C31] J. Brewer, M. Betke, D. P. Gierga, and G. T. Y. Chen. Real-time 4D tumor tracking and modeling from internal and external fiducials in fluoroscopy. In C. Barillot and D. R. Haynor, editors, *Medical Image Computing and Computer-Assisted Intervention – MICCAI 2004: 7th International Conference, Proceedings, Part II, LNCS 3217*, pages 594–601, Saint-Malo, France, September 2004. pdf.
- [C32] J. Wang, M. Betke, and J. P. Ko. Shape-based curve growing model and adaptive regularization for pulmonary fissure segmentation in CT. In C. Barillot and D. R. Haynor, editors, *Medical Image Computing and Computer-Assisted Intervention – MICCAI 2004: 7th International Conference, Proceedings, Part I, LNCS 3217*, pages 541–548, Saint-Malo, France, September 2004. pdf.

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- [A8] D. E. Hirsh, M. Betke, and T. H. Kunz. Computer vision for tracking bats in infrared thermal video: A tool for understanding the behavior of bats in flight. In *Proceedings of the 34th Annual North American Symposium on Bat Research (NASBR)*, page 50, Salt Lake City, UT, October 2004. pdf.

- [A9] T. H. Kunz, M. Betke, D. Hirsh, N. Hristov, E. Lee, L. Allen, J. Reichard, M. Bamberger, and J. D. Bamberger. Build it and they will come: Establishment of a founder colony of Brazilian free-tailed bats (*Tadarida brasiliensis*) in a man-made cave. In *Proceedings of the 34th Annual North American Symposium on Bat Research (NASBR)*, pages 58–59, Salt Lake City, UT, October 2004. pdf.
- [A10] E. Y. Lee, M. Betke, and T. H. Kunz. Bats in motion: Stereo object recognition and trajectory analysis of flying bats. In *Proceedings of the 34th Annual North American Symposium on Bat Research (NASBR)*, page 61, Salt Lake City, UT, October 2004. pdf.
- [A11] N. I. Hristov, M. Betke, and T. H. Kunz. Seasonal monitoring of Brazilian free-tailed bats at Carlsbad Caverns National Park using advanced infrared thermal imaging. In *Proceedings of the 35th Annual North American Symposium on Bat Research (NASBR)*, Sacramento, CA, October 2005.
- [A12] N. I. Hristov, M. Betke, and T. H. Kunz. Assessment of Brazilian free-tailed bat (*Tadarida brasiliensis*) populations using advanced infrared thermal imaging. *Symposia and Oral Abstracts. Integrative and Comparative Biology*, 45(6):1015, 2005. Oral presentation at The Society for Integrative and Comparative Biology Annual Meeting, Orlando, FL, January 2006, Abstract.
- [A13] L. B. Premerlani, M. Betke, N. Hristov, J. J. Magee, J. Reichard, S. Sclaroff, and T. H. Kunz. Stereoscopic reconstruction of flight paths of foraging bats using multiple thermal infrared cameras. In *Proceedings of the 36th Annual North American Symposium on Bat Research (NASBR)*, Wilmington, NC, October 2006. pdf.
- [A14] N. I. Hristov, M. Betke, and T. H. Kunz. Lessons in history: Colony size and population decline of Brazilian free-tailed bats at Carlsbad Caverns. In *Proceedings of the 36th Annual North American Symposium on Bat Research (NASBR)*, Wilmington, NC, October 2006.
- [A15] N. I. Hristov, M. Betke, and T. H. Kunz. Lessons in history: Colony size and population decline of Brazilian free-tailed bats at Carlsbad Caverns. In *Society for Integrative and Comparative Biology (SICB), 2007 Annual Meeting*, Phoenix, AZ, January 2007. Abstract.
- [A16] N. I. Hristov, M. Betke, L. Premerlani, M. Procopio, and T. H. Kunz. Thermal imaging reveals highly variable nightly and seasonal activity patterns of Brazilian free-tailed bats at Carlsbad Caverns. In *Proceedings of the XIV International Bat Research Conference (IBRC) and the 37th Annual North American Symposium on Bat Research (NASBR)*, Mérida, Mexico, August 2007.
- [A17] T. H. Kunz, N. Hristov, and M. Betke. Seasonal emergence behavior of Brazilian free-tailed bats at Carlsbad Caverns. In *Proceedings of the International Conference on Complex Systems (ICCS 2007)*, Boston, MA, October 2007. Abstract.
- [A18] L. B. Premerlani, M. Betke, S. Sclaroff, and T. H. Kunz. Stereoscopic reconstruction and analysis of infrared videos of bats. In *Proceedings of the International Conference on Complex Systems (ICCS 2007)*, Boston, MA, October 2007. Abstract.
- [A19] N. I. Hristov, M. Betke, and T. H. Kunz. Applications of thermal infrared imaging in field biology. *Symposia and Oral Abstracts. Integrative and Comparative Biology*, 47(Supplement 1):e1–e152, December 2007. Oral presentation at The Society for Integrative and Comparative Biology Annual Meeting, San Antonio, TX, January 2008, Abstract.

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- [A21] N. I. Hristov, L. C. Allen, E. Gillam, M. Betke, Z. Wu, and T. H. Kunz. Mechanisms of self-organization in flying brazilian free-tailed bats (*Tadarida brasiliensis*). In *45th Annual Meeting of the Animal Behavior Society (ABS)*, Snowbird, UT, August 2008.
- [A22] N. I. Hristov, L. C. Allen, E. Gillam, M. Betke, Z. Wu, and T. H. Kunz. Mechanisms of self-organization in flying brazilian free-tailed bats (*Tadarida brasiliensis*). In *Proceedings of the 38th Annual North American Symposium on Bat Research (NASBR)*, Scranton, PA, October 2008.
- [A23] M. L. Walker, D. M. House, M. Betke, and J. Y. Wong. Using automated cell tracking tools to quantify durokinesis and durotaxis in real time. In *Proceedings of the Biophysical Society 53rd Annual Meeting*, Boston, MA, USA, February 2009. Abstract.
- [A24] N. Hristov, M. Betke, and T. H. Kunz. Conservation and management of the Brazilian free-tailed bat: colony size and activity patterns using thermal imaging. In *Symposium on the "Protection and Management of Rare and Endangered Subterranean Fauna," co-located with the 15th International Congress of Speleology, Kerrville, Texas USA*, July 2009.
- [A25] K. M. Gillman, G. Towne, A. J. Harwick, A. Gatnick, T. D. Little, M. Betke, Z. Wu, J. D. Reichard, D. S. Reynolds, and T. H. Kunz. *Myotis lucifugus* at maternity colonies in Massachusetts: Assessing impacts of white-nose syndrome. In *Proceedings of the 41st Annual North American Symposium on Bat Research (NASBR 2011)*, Toronto, Canada, October 2011. Abstract.
- [A26] N. Fuller, D. Theriault, A. Greco, Z. Wu, T. Kunz, J. Baillieul, and M. Betke. Describing the *Myotis* superhighway: Characteristics of aggregated 3D trajectories through a cluttered environment. In *Proceedings of the XLII North American Symposium on Bat Research (NASBR)*, San Juan, Puerto Rico, October 2012. Abstract.
- [A27] A. Greco, N. Fuller, D. Theriault, Z. Wu, T. Kunz, J. Baillieul, and M. Betke. Understanding obstacle avoidance in *Myotis velifer* through analysis of reconstructed 3D flight trajectories. In *Proceedings of the XLII North American Symposium on Bat Research (NASBR)*, San Juan, Puerto Rico, October 2012. Abstract.
- [A28] D. H. Theriault, N. Fuller, and M. Betke. Understanding collective behavior in *Tadarida brasiliensis* using computer vision and multi-target tracking. In *Proceedings of the 16th International Bat Research Conference*, San José, Costa Rica, August 2013.
- [A29] M. Betke, D. Theriault, Z. Wu, N. Fuller, M. Breslav, and B. Borucki. Seeing in the dark – an analysis of bat flight through stereographic infrared videography. In *Proceedings of the 16th International Bat Research Conference*, San José, Costa Rica, August 2013. Abstract.

## SOFTWARE ARTIFACTS, PATENTS, AND TECHNOLOGY DISCLOSURES

1. *Camera Mouse: Automated Visual Tracking for Computer Access*. Inventors M. Betke and J. Gips. Patent submitted June 2001 but denied 2006. The technology was commercialized by CM Solutions, Inc., Austin, TX, <http://www.cameramouse.com>. In April 2007, a new version was made available for free at <http://www.cameramouse.org>. It has emerged as a popular mouse-replacement tool for children and adults of all ages. The Camera Mouse software has been downloaded over 3,000,000 times and is used world wide as an alternative communication interface by people with severe motion impairments.
2. *Method and System for the Detection, Comparison and Volumetric Quantification of Pulmonary Nodules on Medical Computed Tomography Scans*. Inventors Margrit Betke and Jane P. Ko. U.S. Patent 7,206,462, issued on April 17, 2007.
3. *BU Microsight: An Automated Cell Tracking Protocol*. Inventors Margrit Betke, David House, Matthew Walker, and Joyce Y. Wong. Technology disclosure, February 27, 2009.
4. *Method for Detection of Shapes of Variable Structure in Images*. Inventors V. Athitsos, J. Wang, S. Sclaroff, M. Betke. Technology disclosure, June 13, 2005.
5. *Registration of Pulmonary Nodules*. Inventors M. Betke and J. P. Ko. Technology disclosure, April 8, 2002.

## INVITED LECTURES, SEMINARS, AND CONFERENCE TALKS

1. Invited Plenary Lecture at the ACM 11th Annual International Conference on Pervasive Technologies Related to Assistive Environments (PETRA'18), *Towards Fast and Comfortable Text Entry Using Gaze Paths*, Corfu, Greece, June 27, 2018.
2. ACM 11th Annual International Conference on Pervasive Technologies Related to Assistive Environments (PETRA'18), *Enabling Early Gesture Recognition by Motion Augmentatio*, Corfu, Greece, June 28, 2018.
3. CVPR 2018 Area Chair Workshop, *Looking at People: Personalized Face and Gesture Analysis using Hierarchical Bayesian Neural Networks*, Toronto, CA, February 19, 2018.
4. University of São Paulo, Computer Science Department, *Looking at People: Gesture Segmentation and Classification*, São Paulo, Brazil, January, 31, 2018.
5. IEEE International Conference on Computer Vision and Pattern Recognition (CVPR) Computer Vision and Microscopy Image Analysis (CVMI) Workshop. *Human Computation Approaches to Microscopy Analysis*, Honolulu, Hawaii, July 21, 2017.
6. University of São Paulo, Computer Science Department, *Vision-based Human-Computer Interfaces, Personalization, and Crowdsourcing*. São Paulo, Brazil, March 7, 2017.
7. CVPR 2017 Area Chair Workshop, *Personalizing Gesture Recognition Using Hierarchical Bayesian Neural Networks*, University of Maryland, College Park, February 27, 2017.
8. Boston University, Department of Biomedical Engineering Seminar, *Microscopic and Macroscopic Image Analysis: Crowdsourcing, Machine Learning, and 4D Modeling to Aid BME Research*, September 23, 2016.

9. ACM 9th Annual International Conference on Pervasive Technologies Related to Assistive Environments (PETRA'16), *BCE-Arabic-v1 dataset: A step towards interpreting Arabic document images for people with visual impairments*, Corfu, Greece, June 30, 2016.
10. Keynote Lecture at Science-Engineering-Technology in the City, *SET in the City: Making a Difference with Computer Vision*, Merck Research Laboratories, Boston, MA, April 2, 2016.
11. BU Data Science Day, *Image and Video Computing for Data Science*, Boston, MA, January 22, 2016.
12. IEEE International Conference on Computer Vision and Pattern Recognition (CVPR) Workshop on Perception Beyond the Visible Spectrum, *Analyzing the Flight Behavior of Bats in Thermal Infrared Video*, Keynote Address, Boston, MA, June 2015.
13. IEEE International Conference on Robotics and Automation, Workshop on Recent Advances in Sensing and Navigation for Bioinspired Agile Flight, *3D Flight Analysis: Individual and Group Motion*, Seattle, May 2015.
14. University of Maryland Institute for Advanced Computer Studies, *Pedestrians of the Sidewalk and the Sky: Visual Tracking of Humans and Bats*, College Park, January 29, 2015.
15. Office of Naval Research Investigator Meeting, *3D Sensing of Bat and Bird Flight*, University of Maryland, College Park, September 22, 2014.
16. National Academies of Science, Engineering, and Medicine, Workshop on *Robust Methods for the Analysis of Images and Videos for Fisheries Stock Assessment Multi-Object Multi-View Tracking*, Washington DC, May 16, 2014.
17. Massachusetts Institute of Technology, Computer Vision Group Seminar *Pedestrian of the Sidewalk and the Sky: Visual Tracking of Humans and Animals*, Cambridge, MA, April 15, 2014.
18. Biomedical Signal Analysis Conference – 3D Imaging in Medicine, *Microscopy Imaging of Living Cells – Research Questions and Solutions, including “I’m Cell: A Touch Pad Tool for Annotating Cell Images”*, Florianópolis, Brazil, March 26, 2014.
19. University of São Paulo, Computer Science Department, *Computer Vision for Tracking of Humans and Animals*, São Paulo, Brazil, March 21, 2014.
20. Massachusetts Institute of Technology, Graphics Group Seminar *Insight into Animals in Flight*, Cambridge, MA, November 20, 2013.
21. 2nd ACM International Workshop on Multimedia Analysis for Ecological Data (MAED 2013), *Understanding Animal Flight with Three-dimensional and Infrared Computer Vision*, Barcelona, Spain, October 21.
22. The 12th European AAATE Conference by the Association for the Advancement of Assistive Technology in Europe, *emPower, an Infrastructure for Remote Assessment of Interfaces for Individuals with Severe Motion Impairments*, Vilamoura, Portugal, September 20, 2013.
23. The 16th International Bat Research Conference, *Seeing in the Dark – an Analysis of Bat Flight through Stereographic Infrared Videography*, San José, Costa Rica, August 15, 2013.

24. Office of Naval Research Investigator Meeting, *Computer Vision Techniques to Estimate Flight Paths of Bats*, Arlington, VA, April 24, 2013.
25. GE Global Research, *Evaluation of Image Segmentation, Cell Morphology Classification, and Computational Models of the Airway Tree*, Niskayuna, NY, January 11, 2013.
26. Video Analytics: Applying Automated Feature Extraction to Questions of Driver Behavior Workshop, *Challenges of Video-based Human-Computer Interfaces and Experiences in Analyzing Videos of Driver Faces*, FHWA Turner-Fairbank Highway Research Center, McLean, VA, October 2012.
27. Fudan University, Shanghai, China, *Seeing in the Dark – Unveiling the Flight Behavior of Gregarious Bats Using Thermal Imaging*, USA-Sino Summer School in Vision, Learning, Pattern Recognition (VLPR 2012), July 29, 2012.
28. The 14th International Conference on Human Computer Interaction (HCII International), *An Information Theoretic Mouse Trajectory Measure*, Orlando, Florida, July 2011.
29. First Workshop on Computer Vision Tracking of Cell Populations, *Cell Tracking and Cell Morphology Classification*, Carnegie Mellon University and Intel Labs Pittsburgh, Pittsburgh, PA, March 2011.
30. University of Washington, *Bio-Inspired Flight Control: Flight Control in Bats*, Investigator Meeting for ONR Project “AIRFOILS: Animal Inspired Robust Flight with Outer and Inner Loop Strategies,” Seattle, WA, October 2010.
31. Keynote Lecture at The 3rd ACM International Conference on Pervasive Technologies Related to Assistive Environments (PETRA), *Assistive Environments that Empower Individuals with Severe Disabilities*, Pythagorion, Samos, Greece, June 2010.
32. National Technical University of Athens, Colloquium, School of Electrical and Computer Engineering, Division of Computer Science, *Image and Video Computing Research in Computer Science at Boston University*, Athens, Greece, June 2010.
33. Keynote Address at the Second Annual New England Undergraduate Computing Symposium: Celebrating Excellence and Diversity in Computing, *Video-based Human-Computer Interaction*, Boston, MA, April 2010.
34. Technical University Berlin, Department of Computer Science, Computer Vision and Remote Sensing Group, *Camera-based Human-Computer Interfaces for People with Disabilities and 3D Video Understanding*, Berlin, March 2010.
35. Deutsches Zentrum für Luft- und Raumfahrt, Institut für Verkehrssystemtechnik, *2D and 3D Feature Tracking for Human-Computer Interfaces and Animal Flight Analysis*, Berlin, March 2010.
36. University of Maryland, Department of Computer Science, *Camera-based Human-Computer Interfaces and 3D Video Understanding*, College Park, MD, September 2009.
37. Naval Undersea Warfare Center, *Automated Video-Based Interpretation of the Behavior of Moving Objects*, Newport, RI, July 2009.



38. IEEE Computer Society Workshop on Mathematical Methods in Biomedical Image Analysis (MMBIA), *Tracking of Cell Populations to Understand their Spatio-Temporal Behavior in Response to Physical Stimuli*, Miami Beach, FL, June 2009.
39. Invited Plenary Lecture at The 2nd International Conference on Pervasive Technologies Related to Assistive Environments (PETRA), *Camera-based Interfaces for People with Severe Motion Impairments*, Corfu, Greece, June 2009.
40. INRIA, the French National Institute for Research in Computer Science and Control, *Diagnostic Image Analysis of the Chest: Computational Models and Approaches*, Sophia Antipolis, May 2009.
41. The 9th International Workshop on Pattern Recognition in Information Systems – PRIS 2009, *RefLink: An Interface that Enables People with Motion Impairments to Analyze Web Content and Dynamically Link to References*, Milan, Italy, May 2009.
42. Tufts University, Colloquium, Computer Science Department, *Visual Tracking of Large Numbers of Bats*, Medford, MA, November 2008.
43. 2007 RUMBUS, Research by Undergraduates in Mathematics Boston University Symposium, *What Is Mathematics?* Boston, MA, November 2007.
44. BBN Technologies, *A Method to Track Large Variable Numbers of Objects in Clutter and its Application to Censusing Millions of Bats*, Cambridge, MA, June 2007.
45. 2007 NSF CISE/CRI PI Meeting, *Overview of Sensorium Research at Boston University* with Azer Bestavros, Boston, MA, June 2007.
46. Harvard University, Women, Science, and Society Lecture Series, *Video-based Tracking for Human-computer Interaction and Conservation Biology* Cambridge, MA, May 2007.
47. Harvard University, National Symposium for the Advancement of Women in Science, *The Future of Computer Science*, Cambridge, MA, April 2007.
48. Massachusetts Institute of Technology, Path of Professorship Workshop @ MIT, *Running A Lab*, Cambridge, MA, October 2006.
49. The 9th International ERCIM Workshop “User Interfaces For All” UI4ALL 2006, *Web Mediators for Accessible Browsing*, Königswinter, Germany, September 2006.
50. The 6th International Workshop on Pattern Recognition in Information Systems – PRIS 2006, *Tracking and Prediction of Tumor Movement in the Abdomen*, Paphos, Cyprus, June 2006.
51. Massachusetts Institute of Technology, Machine Vision Colloquium 2005/2006, *Detection, Segmentation, and Registration Techniques for Lung Image Analysis*, Cambridge, MA, May 2006.
52. University of Massachusetts Lowell, Colloquium Series, Department of Computer Science, *Video-based Communication Interfaces for People with Severe Paralysis*, Lowell, MA, February 2005.
53. Massachusetts Institute of Technology, Human-Computer Interaction Seminar Series, *Communication Interfaces for People with Severe Disabilities via Video-based Gesture Detection*, Cambridge, MA, October 2004.

54. 34th Annual North American Symposium on Bat Research (NASBR 2004), *Censusing Brazilian Free-tailed Bats with Infrared Thermal Imaging – Challenges, Lessons Learned, and Initial Results*, Salt Lake City, UT, October 2004.
55. Tufts University, Computer Science Colloquium, *Video-Based Computer Interfaces for People with Severe Disabilities*, Medford, MA, December 2003.
56. University of Massachusetts, Computer Science Department, *Video-based Human-Computer Interfaces for People with Severe Disabilities*, Boston, MA, April 2003.
57. ERCIM Workshop “User Interfaces for All” (UI4ALL 2002) *Experiments with a Camera-Based Human-Computer Interface System*, Paris, France, October 2002.
58. Childrens Hospital, Communication Enhancement Center, *Video-based Assistive Communication Devices*, Boston, MA, October 2002.
59. Zhejiang University, State Key Laboratory of CAD & CG and Institute of Information & Communication Engineering, *Research on Medical Image Analysis and Video-Based Human Computer Interfaces at Boston University*, Hangzhou, P.R. China, August 2002.
60. Rutgers, The State University of New Jersey, Computer Science Department, *Diagnostic Image Analysis of Chest Computed Tomography Scans*, Piscataway, NJ, May 2002.
61. International Conference on Medical Image Computing and Computer-Assisted Intervention (MICCAI 2001), *Registration of Lung Surfaces in Computed Tomography Scans*, Utrecht, The Netherlands, September 2001.
62. Boston University, TeacherTech’01, Gender Equity and Technology Workshop, *Video-Based Human Computer Interfaces*, Boston, MA, August 2001.
63. University of Maryland, Institute for Advanced Computer Studies, *Image Segmentation and Registration to Support Lung Cancer Detection*, College Park, MD, May 2001.
64. Boston University, Multi-Dimensional Signal Processing Laboratory, *Chest CT: Nodule Detection and Assessment of Change over Time*, Boston, MA, March 2001.
65. Wellesley College, Computer Science Colloquium, *Computer Vision to Support Lung Cancer Diagnosis*, Wellesley, MA, March 2001.
66. Boston University, Cognitive and Neural Systems Department, *Computer Vision to Support Lung Cancer Diagnosis*, Boston, MA, March 2001.
67. Massachusetts General Hospital, Department of Radiation Oncology, *Chest CT: Nodule Detection and Assessment of Change over Time*, Boston, MA, March 2001.
68. New York University, Department of Radiology, *Detection of Pulmonary Nodules on CT and Volumetric Assessment over Time*, New York, NY, September 2000.
69. IEEE CVPR Workshop on Human Modeling, Analysis and Synthesis, *Active Detection of Eye Scleras in Real Time*, Hilton Head Island, SC, June 2000.
70. Boston University, Computer Science Colloquium, *Recognition, Resolution, and Complexity of Objects*, Boston, MA, April 2000.

71. Tufts University, Department of Computer Science and Electrical Engineering, *Recognition, Resolution, and Complexity of Objects*, Boston, MA, March 2000.
72. Boston University, Computer Science Colloquium, *Detection of Pulmonary Nodules on CT and Volumetric Assessment over Time*, Boston, MA, November 1999.
73. International Conference on Medical Image Computing and Computer-Assisted Intervention (MICCAI 1999), *Detection of Pulmonary Nodules on CT and Volumetric Assessment over Time*, Cambridge, UK, September 1999.
74. IEEE International Workshop on Recognition, Analysis, and Tracking of Faces and Gestures in Real-Time Systems, *Gaze Detection via Self-Organizing Gray-Scale Units*, Kerkyra, Greece, September 1999.
75. University of Maryland, Center for Automation Research, Computer Vision Laboratory, *Detection and Tracking Problems in Computer Vision*, College Park, May 1999.
76. International Conference on Computer Vision, *Information-Conserving Object Recognition*, Mumbai, India, January 1998.
77. Boston University, Computer Science Colloquium, *Information-Conserving Object Recognition*, Boston MA, November 1997.
78. IEEE Conference on Intelligent Transportation Systems, *Highway Scene Analysis*, Boston, November 1997.
79. National Institute of Standards and Technology, *Multiple Vehicle Detection and Tracking in Hard Real Time*, Gaithersburg, January 1997.
80. 25th Applied Imagery Pattern Recognition Workshop, *Multiple Vehicle Detection and Tracking in Hard Real Time*, Washington, DC, October 1996.
81. Advanced Telecommunication Research Institute International, Media Integration and Communications Research Laboratories, *Multiple Vehicle Detection and Tracking in Hard Real Time*, Kyoto, Japan, September 1996.
82. IEEE Symposium on Intelligent Vehicles, *Multiple Vehicle Detection and Tracking in Hard Real Time*, Tokyo, Japan, September 1996.
83. Daimler-Benz Research, *Fast Object Recognition in Noisy Images Using Simulated Annealing*, Ulm, Germany, December 1995.
84. Catholic University of America, Computer Science Department, *Fast Object Recognition in Noisy Images Using Simulated Annealing*, Washington, DC, December 1995.
85. Siemens Corporate Research, *Fast Object Recognition in Noisy Images Using Simulated Annealing*, Princeton, November 1995.
86. University of Massachusetts, Computer Science Department, *Fast Object Recognition in Noisy Images Using Simulated Annealing*, March 1995.
87. The Pennsylvania State University, Computer Science Department, *Fast Object Recognition in Noisy Images Using Simulated Annealing*, March 1995.

88. University of Maryland Institute for Advanced Computer Studies, *Fast Object Recognition in Noisy Images Using Simulated Annealing*, College Park, March 1995,
89. Rheinische Friedrich-Wilhelms Universität Bonn, Institut für Informatik, *Fast Object Recognition in Noisy Images Using Simulated Annealing*, Bonn, Germany, December 1994.
90. University of Dortmund, Fachbereich Informatik, *Piecemeal Exploration of General Graphs*, Dortmund, Germany, December 1994.
91. IEEE/RSJ/GI International Conference on Intelligent Robots and Systems 1994, *Mobile Robot Localization Using Landmarks*, Munich, Germany, September 1994.
92. University of Dortmund, Fachbereich Informatik, *Piecemeal Learning and Distributed Algorithms*, Dortmund, Germany, January 1994.
93. Sixth Annual Conference on Computational Learning Theory 1993, *Piecemeal Learning of an Unknown Environment*, Santa Cruz, CA, July 1993.
94. The International Computer Science Institute, *Piecemeal Learning of an Unknown Environment*, Berkeley, CA, July 1993.
95. Action Learning Workshop, *On the Job Learning*, GTE, MA, April 1993.
96. Siemens Corporation, *Exploring Unknown Graphs*, Munich, Germany, January 1991.

## TEACHING ACTIVITIES

- Course webpages: <http://www.cs.bu.edu/faculty/betke>
- Undergraduate Courses: Algorithms (F 1998), Computers in Management (F 1999, S 2000), Computer Vision (S 1998, S 2000, developed course), Data Structures (F 1997, S 1998, F 1998, S 1999), Introduction to Artificial Intelligence (F 2002–2005, F 2007, F 2009, S 2012, 2015, revamped course). Geometric Algorithms (F 2010). Between 20 and 144 students per course.
- Graduate Courses: Artificial Intelligence (F 2002–2005, F 2007, F 2009, S 2015–2018, revamped course), Image and Video Computing (S 2001–2011, F 2011, 2012, 2014–2017 revamped course), Topics in Computer Science: Video-based Human Computer Interfaces (F 2001, developed course), Graduate Initiation Seminar (S 2017, S 2018).
- Panelist and Faculty Evaluator of team projects in the MIT course “6.811: Principles and Practice of Assistive Technology,” October 2015.
- Discussion and evaluation of team projects in the undergraduate course “CS 411: Software Engineering,” December 6, 2011.
- Guest Lecture on “The Camera Mouse, a human-computer interface for people with severe motion impairments” in the undergraduate course “CS 101: Introduction to Computers,” February 25, 2011.
- Guest Lecture on “Video-based Human-Computer Interaction and the Camera Mouse” in the undergraduate course “CS 108: Introduction to Application Programming,” April 27, 2010.

- Guest Lecture on “Designing Video-based Interfaces for People with Disability – How Students are Involved” in the course “CS108: Introduction to Application Programming,” November 11, 2008.
- Guest Lecture “A Manual for Writers in Computer Science” in the computer science initiation course for graduate students, May 21, 2008 and April 9, 2010.
- Guest Lecture on “Computer Vision” to students in Boston University’s Trustee Scholars Program, April 14, 2005.
- Guest Lectures in Boston University’s Medical Informatics Program, 2004 and 2005.
- Guest Lecture on “Chest CT: Automated Nodule Detection and Assessment of Change over Time” in the course “CN 730 Models of Visual Perception,” April 14, 2001.
- Ph.D. qualifying exam in computer vision with Prof. Stan Sclaroff. Fall 2002–2009.  
<http://www.cs.bu.edu/groups/ivc/exam>

## RESEARCH ADVISING

Advisor of 4–8 PhD students and several MS or BA students per year.

Co-leader of the **Image and Video Computing Group** with Prof. Stan Sclaroff, Fall 2001–present, and Prof. Kate Saenko, Fall 2016–present, <http://www.cs.bu.edu/groups/ivc>

Created and led the **Computer Vision Research Group** at Boston College, 1998–2001.

### Ph.D. Thesis Supervision

- Elham Saraee, “Computer Vision Support of Rehabilitation” expected May 2019.
- Ajjen Joshi, “Personalized Face and Gesture Analysis Using Hierarchical Neural Networks,” September 2018. Co-Advised with Stan Sclaroff, Boston University.
- Wenxin Feng, “Dwell-free Input Methods for People with Motor Impairments,” September 2018.
- Andrew Kurauchi, “Gaze and Motion Based Interfaces,” March 2018. Co-Advised with Prof. Carlos Morimoto, University of Sao Paulo, Brazil.
- Mehrnoosh Sameki, “Accurate and Budget-efficient Text, Image, and Video Analysis Systems Powered by the Crowd,” September 2017. Now at Rue La La, Boston.
- Mikhail Breslav, “3D Pose Estimation of Flying Animals in Multi-view Datasets” September 2016.
- Diane Hirsh Theriault, “An Optimization-based Model of Collective Motion,” September 2015. Now at Google, Cambridge, MA.
- Danna Gurari, “Combining Crowd Worker, Algorithm, and Expert Efforts to Find Boundaries of Objects in Images,” September 2015. Now Assistant Professor at University of Texas, Austin.
- Samuel Epstein, “Information and Distances,” May 2013. Co-Advised with Leonid Levin, Boston University.

- Zheng Wu, “Occlusion Reasoning for Multiple Object Visual Tracking,” September 2012. Now Software Engineer at Mathworks.
- John J. Magee, “Adaptable Interfaces for People with Motion Disabilities,” May 2012. Now Professor at Clark University, Worcester, MA.
- William Mullally, “Image Registration and Computational Modeling of the Lung,” May 2009. Now Software Design Engineer at KEYW Corporation, Boston, MA.
- Jingbin Wang, “Object Segmentation Using Shape Constraints,” May 2007. Now Senior Software Engineer at Google Research, Mountain View, CA.

#### **M.A. Thesis Supervision**

- Ajjen Joshi, “A Random Forest Approach to Segmenting and Classifying Gestures,” July 2014. Co-advised with Stan Sclaroff. Currently PhD student at BU.
- Seule Ki Kim, “Integrating Computer Vision Techniques into a Touch Pad System,” May 2013. Now at Intuit in San Francisco.
- Lisa Premerlani, “Stereoscopic Reconstruction and Analysis of Infrared Video of Bats,” May 2007. Now at MIT Lincoln Labs.
- Wajeeha Akram, “Designing and Evaluating Computer Vision Based Interfaces for Users with Disabilities,” May 2007. Computer science professor in Pakistan.
- Angshuman Bagchi, “A Clustered Data Association Technique for Expedited Multi Target Tracking,” September 2006. Now at Bloomberg.
- Johanna Brewer, “3D Tracking and Prediction of Abdominal Tumor Motion using Internal and External Markers,” September 2004. Now in PhD program in Human-Computer Interaction at UC Irvine.
- Stephen C. Crampton, “Counting Fingers in Real Time Using Computer-Vision Techniques,” September 2004. Now at Amazon.
- John J. Magee, “A Real-Time Human-Computer Interface Based on Gaze Detection from a Low-Grade Video Camera,” May 2004. Graduated with a PhD degree from Boston University and is now Professor at Clark University, Worcester, MA.
- Jason Ruel, “Tracking and Predicting of Tumor Motion in the Abdomen,” May 2003. MBA at University of Washington, Seattle, then consultant for Microsoft.
- William Mullally, “Segmentation and Registration of Pulmonary Nodules,” May 2003. Graduated with a PhD degree from Boston University and is now at the KEYW Corporation, Boston, MA.
- Harrison Hong, “Landmark Detection in the Chest and Registration of Lung Surfaces with an Application to Nodule Registration,” May 2003. Now at Reveal Imaging Technologies, Bedford, MA.

#### **M.A. Project Supervision**

1. Srivathsa Rajagopal, “Video Analysis of Politicians,” M.S., Jan. 2017.
2. Saurabh Singh, “Exercising with the Proficio Robotic Arm in Virtual Reality,” M.Eng., Jan. 2017.
3. Jun Xu, “Newborn Recognition using Ear Biometrics Controlling for Growth Pattern,” May 2016. Co-advised with Stan Sclaroff.

4. Ming Chen, "Improving the Selection Mechanism "Goal Crossing" used in Mouse-replacement Interfaces," May 2014.
5. Andrew Barbarello, "A Semi-supervised Approach for Classifying Tens of Thousands of 3D Trajectories," 12 pages, December 2013. Now at the National Institute of Standards and Technology (NIST), Gaithersburg, MD.
6. Zhongchen Shen. "Determining the Orientation of Driver's head by measuring the length of nose shadow," May 2013.
7. Gordon Towne, "Error Analysis and Design Considerations for Stereo Vision Systems Used to Analyze Animal Behavior," May 2012. Now at TrainingPeaks.
8. Luis Carrasco, "Picture Identification by Mining Existing Image Search Platforms," January 2012. Now at Microsoft, Seattle.
9. Tianqiang Liu, "Hand Detection and Tracking with Multiple Dynamic Hidden State Shape Models," September 2011. Now at Orbeus.
10. Leyong Tan, "A Gesture-based Human-computer Interface of Google Earth using the Kinect Game Console," September 2011.
11. Christopher Kwan, "Camera Canvas: Image Editing Software for People with Disabilities," May 2011. Now at Lattice Engines.
12. Jiayu Fu, "3D Camera Mouse by Virtual Tracking of 3D Face Features Using Stereo Cameras," May 2011. Co-advisor: Janusz Konrad.
13. Byung Hyung Kim, "Interactive Art Using a Camera-based Hands Tracking Tool for Interaction between Humans and Computers," September 2010. Now at UC Riverside.
14. Chao Chung Hsieh, "Data capture and calibration of a multi-camera system," September 2010.
15. Yili Pan, "Diagnostic Image Analysis of the Chest: Intensity-based Registration Techniques," May 2010. Co-advisor: Thomas Little. Now at Mathworks.
16. Shuo Zeng, "Diagnostic Image Analysis of the Chest: Feature-based Registration Techniques," May 2010. Co-advisor: Thomas Little.
17. Hari Mohan, "Visual Tracking at Sea using the Covariance Tracking Algorithm," May 2010. Co-advisor: Thomas Little.
18. Yun Wang, "Visual Tracking at Sea using the Mean Shift Algorithm," May 2010. Co-advisor: Thomas Little.
19. Harshith Chennamaneni, "MCC: A Multi-Camera Capture System for Human-Computer Interaction," January 2010. Now at WhitePages.
20. Esra Ataer Cansizoglu, "An Information Fusion Approach for Multiview Feature Tracking," May 2009. Now at Northeastern University.
21. Jawad Mahmood, "Facial Modeling: Progeny Phenotype Revelation," January 2009. Co-advisor: M. Alanyali.
22. Kevin Hu, "Segmentation of the Minor Fissure on CT," May 2007. Now at Bloomberg.
23. Marianne Procopio, "Bat Flight Analysis: Further Insight into the Emergence of Brazilian Free-Tailed Bats," May 2007. Now at MIT Lincoln Labs.
24. Jared Wickman, "Graphical User Interface Layouts and the Camera Mouse," May 2007.

25. Benjamin N. Waber, "Web Mediators for Accessible Browsing," May 2006. Now in PhD program at MIT.
26. Laura Tiberii, "A customizable camera-based human computer interaction system allowing people with disabilities autonomous hands free navigation of multiple computing tasks," May 2006. Now at Raytheon.
27. Mikhail Gorman, "MusicMaker: A Camera-based Music Making Tool for Physical Rehabilitation," January 2006. Now at Bluestreak.
28. Omar Al-Hinai, "Real-time Suppression of Tremor Motion from Camera Mouse Signal Using Finite Impulse Response Filters," September 2005. Now at Aramco.
29. Vladimir Rydzevsky, "Computing a Uniform Scaling Parameter for 3D Registration of Lung Surfaces," September 2005.
30. Michael Chau, "Real Time Eye Tracking and Blink Detection with USB Cameras," May 2005. Now analyst at Goldman Sachs in New York.
31. Edward Lee, MA project and NASBR conference abstract on "Bats in Motion: Stereo Object Recognition and Trajectory Analysis of Flying Bats," May 2005.
32. Michelle Paquette, MA project on "IWebExplorer: A Web browser designed for use with an eye controlled mouse device," May 2005. Now at Fidelity.
33. Eugen Tsykinovskyy, "Segmentation of the Respiratory Vessel Tree on CT," May 2005.
34. Shuang Tang, MA project and NASBR conference abstract on "Challenges of censusing colonies of Brazilian free-tailed bats at Eckert James River, Frio, and Davis Blowout caves using infrared thermal imaging and initial censusing results," January 2005.
35. Kashan Arshad, "Dimensionality Reduction and Efficient Retrieval of Medical Images from Large Databases," September 2004 (co-supervision with George Kollios).
36. Peter McNerney, "A Stereo-based Approach to Digital Image Compositing," September 2003 (co-supervision with Janusz Konrad). Now at DreamWorks.
37. Oleg Gusyatin and Mikhail Urinson, "A Method to Extend Functionality of Pointer Input Devices," September 2003.
38. Thomas J. Castelli, "Facial Feature Tracking and Detection of Facial Occlusion due to Hand Gestures," September 2003. Now at Raytheon.
39. Ramasri Raghavan, "Chromosome Detection Using Image Analysis," September 2003.
40. Emily Stuckey, "Methods of Token-Based Authorship Attribution for an English-Language Online Discussion Community," May 2004.
41. Haobing Wang, "Comparison of Methods to Predict Abdominal Tumor Motion," May 2003. Now at Massachusetts Eye and Ear Infirmary.
42. Yannis Minadakis, "GazePoint: Tracking Eye Movement to Determine Gaze Direction," January 2003. Now at Teradyne.
43. Jonathan Lombardi, "A Self-initializing Eyebrow Tracker for Binary Switch Emulation," May 2002. Now at Massachusetts General Hospital.
44. Robyn Cloud, "Experimentation and Evaluation of a Human-Computer Interface System," May 2002. Now at Lockheed Martin.

## **B.A. Thesis Supervision**



- Diane E. Hirsh, “Evaluation of Computer Vision Methods for Analyzing Infrared Thermal Video and Censusing Brazilian Free-tailed Bats,” May 2004. Now at Google.
- Christopher Fagiani, “An Evaluation of Tracking Methods for Human-Computer Interaction,” Honor’s Thesis, May 2002. Now at NBC.
- Kristen Grauman, “Automatic Eye Blink Detection and Duration Analysis in Real Time for Communication Purposes,” Honor’s Thesis, May 2001. PhD at MIT, now computer science professor at University of Texas at Austin.
- John J. Magee, “Finding Eyes in Faces,” May 2001. Now professor at Clark University.
- William Mullally, “Region Classification for Factory Circuit Board Error Detection,” May 2001. Now at Reveal Imaging, Bedford, MA.
- Peter Fleming, “The Camera Mouse,” Honor’s Thesis, May 2000. Now at Accenture, formerly Andersen Consulting.
- Cleo V. Bertrand, “Computer Enhancement Techniques for CT Scans,” May 2000. MA at NYU.
- Jun Kawai, “Gaze Detection via Self-Organizing Gray-Scale Units,” May 1999. J. Kawai works at Sony in Japan.

#### **Undergraduate Research Projects, Advisor**

1. Shreya Ramesh, “Patient Movement Feedback for Exercise Check,” spring 2017, fall 2017, spring 2018.
2. Jia Yao, “Rendering OptFlock in Action to Simulate Group Behavior,” fall 2016.
3. Mattia Gentil, “Crowdsourcing the cell tracking problem” and “Finding the Optimal Number of Crowdworkers to Analyze Political Tweets,” summer 2016.
4. Brian Borucki, “Multi-view Tracking of Fish Schools,” summer 2014. MS 2015.
5. Sridevi Suresh, REU project “Image Segmentation and Multi-view Tracking in Videos of Bat Flight,” Fall 2013, and spring and summer 2014.
6. Dasom Lee, “Multi-view Multi-object Tracking in Videos of Schools of Fish,” February–December 2013.
7. Ester Wu, REU project “Annotating Videos of Bat Flight,” Fall 2013.
8. Tatiana Schmidt Goncalves, REU project “Video Annotation via Crowd Sourcing,” Spring and Summer 2013.
9. Maxwell Porter, UROP project “Expanding a 3D Computer Model of Bats in Flight Using Visible Light Footage,” Summer 2012
10. Seule Ki Kim and Eugene Yang, REU project “Generating Ground Truth for Cell Segmentation,” Summer 2012.
11. Ashley Banks and Alison Greco, REU project “Annotating Ground Truth for 3D Flight Analysis of Foraging Bats,” Summer 2012.
12. Gordon Towne, UROP project “Three Dimensional Reconstruction for Intelligent Tracking Systems,” Summer 2011.
13. Sarah Hall, REU project “Hand gesture based drawing using the Kinect,” AY 2011/2012.
14. Jamal Rasheed, REU project “Visualization of flight paths of bats,” Summer 2011 and AY 2011/2012.

15. Christopher Kwan, UROP project “Camera Canvas: Image Editing Software for People with Disabilities,” Summer 2010, and BA/MA project AY 2010/2011.
16. Gordon Towne, UROP project “A Computer Vision Approach to Track Running Performance,” Summer 2010.
17. Eric Missimer, REU project “Automatic eye blink detection,” Summer 2009 – Summer 2010.
18. Rufat Mammadyarov, REU project “Hand gesture recognition,” Fall 2009.
19. David House, UROP project “Image Analysis of Microorganisms: Developing a System for the Detection, Segmentation, and Tracking of Cells and Cell Populations,” Summer and Fall 2008 and 2009.
20. Caitlin Connor, UROP project “Automated Initialization of HCI and Automated Recovery from Breakdown of HCI Features of Camera Mouse for Users with Severe Disabilities,” Summer and Fall 2008.
21. Emily Yu, Williams College, Computing Research Association Distributed Mentor Project “Improving the Camera Mouse,” Summer 2008.
22. Jacqueline Crescimanno, REU project “Stereo Reconstruction of Bat Flight,” Summer 2008.
23. Eric Immermann, BA’08, “EcoTracker Software,” Spring 2007–2008.
24. Maria Shugrina, BA’07, “Animate!” A program that enables people with disabilities to create animations of an anthropomorphic figure. Spring 2007. Now software engineer at Google, New York, NY.
25. Maria Shugrina, “Empathic Painting: Interactive stylization through observed emotional state.” Spring-Fall 2006.

### **Doctoral Thesis, Examining Committee Member**

- Hanwen Wu, “Session Types in Practical Programming,” September 2018 (Chair).
- Huijuan Xu, “Vision and Language Understanding with Localized Evidence,” September 2018 (2nd reader).
- Kun He, “Learning Deep Embeddings by Learning to Rank,” September 2018 (Chair).
- Fatih Cakir, “Online Hashing for Fast Similarity Search,” May 2017 (2nd reader).
- Qinxun Bai, January 2017 (3rd reader).
- Jianming Zhang, “Visual Saliency Computation for Image Analysis,” September 2016 (2nd reader).
- Shugao Ma, “Learning Space-time Structures for Human Action Recognition and Localization,” May 2016 (2nd reader).
- Jonathan Wu, “Gesture Passwords: Concepts, Methods, and Challenges.” May 2016 (3rd reader).
- Matthew Walker, “Analysis of Fibroblast Morphology and Migration on Bioengineered Substrata Aided by Machine Vision and Learning Techniques,” May 2013 (4th reader).
- Vitaly Ablavsky, “Layers of Graphical Models for Tracking and Action Recognition,” March 2011 (2nd reader).
- Tai-Peng Tian, “Efficient Discrete Optimization for Large State Space Pictorial Structures with Non-Tree Graphs,” January 2011 (Chair and 5th reader)

- Mingyan Shao, “Feature Analysis of Diagrams with Applications to Retrieval and Classification,” Northeastern University, May 2010 (2nd reader)
- Rui Li, “Switching Dynamic Global Coordination Model,” January 2010 (2nd reader)
- Panagiotis Papapetrou, “Embedding-Based Subsequence Matching,” January 2010 (3rd reader)
- Quan Yuan, “Learning of a Family of Detectors,” January 2010 (2nd reader)
- Kyle Burke, “Science for Fun: New Impartial Board Games,” May 2009 (2nd reader)
- Michael Ocean, “The Sensor Network Workbench: Towards Functional Specification, Verification and Deployment of Constrained Distributed Systems,” January 2009 (4th reader)
- Jason Horn, “Nightly and Seasonal Behavior of Bats in the Aerosphere Assessed with Thermal Infrared Imaging and NEXRAD Doppler Radar,” May 2007 (2nd reader)
- Vassilis Athitsos, “Learning Embeddings for Indexing, Retrieval, and Classification, with Applications to Object and Shape Recognition in Image Databases,” May 2006 (3rd reader)
- Jonathan Alon, “Spatiotemporal Gesture Segmentation,” May 2006 (2nd reader)
- John Isidoro, “Stochastic Mesh-based Multiview Reconstruction,” May 2004 (2nd reader)
- Romer Rosales, “The Specialized Mappings Architecture, with Applications to Vision-Based Estimation of Articulated Body Pose,” January 2002 (4th reader)
- Lifeng Liu, “Shape Model-Based Region Grouping, a Method for Deformable Object Detection and Retrieval,” January 2001 (reader)

#### **Master’s Thesis, Examining Committee Member**

- He Kun, “Stochastic Functional Descent for Learning Support Vector Machines,” August 2013 (2nd reader)
- Gokberk Cinbis, “Learning Actions from the Web,” September 2010 (2nd reader)
- Alexandra Stefan, “Indexing Methods for Efficient Multiclass Recognition,” September 2008 (2nd reader)
- Luke Skelly, “Rotation Invariant 3D Feature Description,” May 2007 (2nd reader)

#### **Bachelor’s Thesis, Examining Committee Member**

- Kunihiko Ken Hayakawa, “Made in our Image: Japanese and Western Views of Robots and Their Creators,” May 2006 (2nd reader)

### **STUDENT AWARDS**

PhD student Wenxin Feng and her team at the startup Pison Technology won the Assistive Technology Challenge in December 2016. The \$400,000 award was given by two teams by the ALS Association and Price4Life. Wenxin’s team was praised for creating a “motionless communication and control system for people with ALS and other neuromuscular conditions. It will allow a person with little to no movement ability to have full control of a laptop, a phone, and home robotics 24/7.” Wenxin is responsible for designing and implementing the interaction software.

PhD student Danna Gurari won the 2014/2015 Boston University Computer Science Research Excellence Award.

PhD student Ajjen Joshi won the 2014/2015 Boston University Computer Science Teaching Excellence Award.

Ph.D. advisees Danna Gurari, Diane Theriault and Mehrnoosh Sameki were authors of the paper “How to use level set methods to accurately find boundaries of cells in biomedical images? Evaluation of six methods paired with automated and crowdsourced initial contours,” which won the “Best Paper Award for Innovative Idea” at the MICCAI Workshop on Interactive Medical Image Computation (IMIC) in September 2014. BU Announcement.

Ph.D. student Danna Gurari and MA. student Seule Ki Kim were first and second authors on the paper “SAGE: An Approach and Implementation Empowering Quick and Reliable Quantitative Analysis of Segmentation Quality,” which won a “Best Paper Award” at the IEEE Workshop on the Applications of Computer Vision (WACV) in Clearwater, Florida, in January 2013. This was one of two awards selected among 161 submitted and 75 accepted papers at WACV.

Ph.D. advisee Zheng Wu won the Boston University Computer Science Department’s Research Achievement Award for 2011–2012 for his contributions to “video-based multi-object tracking.” BU CS Award Announcement.

Ph.D. student Samuel Epstein won a 2011 Solomonoff Student Prize at the Fourth Conference on Artificial General Intelligence (AGI) for the co-authored paper “An Information Theoretic Representation of Agent Dynamics as Set Intersections,” August 2011.

MA student Christopher Kwan won the Graduate School of Arts and Sciences Award on his work entitled “Camera Canvas: Image Editing Software for People with Disabilities,” Boston University Science Day, March 2011. Award Announcement

Undergraduate research assistant Christopher Kwan won the 2nd Place Poster Award at the Boston University Undergraduate Research Symposium for the presentation *Camera Canvas: Image Editing Software for People with Disabilities* in Fall 2010. UROP News.

Undergraduate research assistant David House won the “Best Poster Award” at the Boston University Undergraduate Research Symposium for the presentation of *Image Analysis of Microorganisms: Developing a System for Tracking Cell Populations* in Fall 2009. BU CAS Magazine.

Undergraduate research assistant Caitlin Connor was selected the 2008 Clare Boothe Luce Summer Research Fellow.

Undergraduate research assistant Maria Shugrina won the Boston University “College Prize for Excellence in Computer Science” in May 2007.

Ph.D. advisee Jingbin Wang won the Boston University Computer Science Department’s Research Achievement Award for 2006–2007. BU CS Announcement.

Undergraduate research assistant Benjamin Waber won the Boston University Computer Science Department “Research Achievement Award” in May 2006.

Research assistant Michael Chau won the Boston University “College Prize for Excellence in Computer Science” in May 2005.

Boston University President’s Award for Science and Technology to Betke’s graduate student Angshuman Bagchi for *Tracking Large Variable Numbers of Objects in Clutter*, selected from more than 150 contenders, March 2005. BU Research Spotlight.

Lubee Bat Conservancy Award at the 33rd Annual North American Symposium on Bat Research to Betke's undergraduate student Diane E. Hirsh for the outstanding oral presentation on *Censusing Brazilian Free-tailed Bats Using Infrared Thermal Imaging and Computer Vision Methods*, October 2003. Award Report. She also won the Boston University Computer Science Department "Academic Achievement Award" in May 2004.

Boston University Chancellor's Award for Science and Technology to Betke's graduate student Stephen Crampton for *Counting Fingers in Real Time: A Webcam-based Human-Computer Interface with Game Applications*, selected from 165 contenders, March 2003. BU Research.

Boston University Provost's Award for Science and Technology to Betke's graduate student Harrison Hong for *Automatic 3D Registration of Lung Surfaces in Computed Tomography Scans*, selected from more than 120 contenders, March 2002. BU Bridge.

## MENTORING AND OUTREACH

Mentor for postdoctoral researcher Randa Elanwar, 2015–present. Sponsored by the Cairo Initiative Scholarship Program of the U.S.–Egypt Higher Education Initiative.

Supervised PhD student Ajjen Joshi in developing "Interactive Projections" for the Experimental Performance "Victory Over the Sun: The First Futurist Opera" by Aleksei Kruchenykh, directed by Anna Winestein, in collaboration with Yuri Corrigan, Assist. Prof. of Russian and Comparative Literature, and Minou Arjomand, Assist. Prof. of English, Boston, MA, April 23, 2015.

Mentor for six computer science undergraduate students attending the 2014 Grace Hopper Celebration of Women in Computing conference, Phoenix, AZ, October 2014.

Panelist for the Massachusetts Institute of Technology EECS Postdoc Career Workshop, "Academic Life" Cambridge, MA, January 30, 2014.

Mentor on proposal writing, in particular, NSF Career Grants, for junior faculty at Sargent College, Boston University, June 11, 2013. Helped secure a NSF Career grant for Assistant Professor Cara Stepp, Sargent College and Hariri Junior Faculty Fellow, Boston University, awarded in December 2014.

Mentor for Christopher Hung in the Boston University "Research Internship in Science & Engineering" summer program for high school students. Summer 2013.

Mentor for postdoctoral researcher Zheng Wu, 2012-2013.

Lecture on "Fostering Interest in Computer Science via Computer Vision Case Studies" at the Workshop "Counselors for Computing" by the National Center for Women and Information Technology, Boston, November 2012.

Lecturer for Artemis project, a five-week summer day camp for twenty 9th grade girls who are interested in exploring computer science, June 2012, July 2013, and July 2017.

Lecturer and host for Boston University Workshop on "Designing Leadership – Celebrating Creativity and Innovation," September 24, 2011.

Lecturer and host for a laboratory visit of the Artemis project, a five-week summer day camp for twenty 9th grade girls who are interested in exploring computer science. Summer 2011.

Director of Undergraduate Studies. Advised undergraduate students in computer science and other disciplines. This involved discussion of the student's current and past course performance, course selection for the upcoming semester, course substitutions and credit transfer, career opportunities, continued education in graduate programs, scholarships, etc.

Mentor for the women students in the Computer Science Department. During AYs 2000–2009, Prof. Betke was the only female faculty member in the Computer Science Department at Boston University. She organizes meetings with the students and provides them with information about fellowship programs for women, support networks, career opportunities, conferences, etc.

Host for visit of 20 high school students in the “Pathways to Science” one-week summer program at Boston University to the Image and Video Computing laboratory in 2007–2018.

Host for the visit of 20 middle school girls in the Tech Savvy Camp at Boston University to Image and Video Computing laboratory, July 2010.

Panelist, “Women in Networks: Pre-tenure Mentoring Panel,” Boston University, Fall 2009.

Mentor, Collaborative Research Opportunity for Undergraduate Women (CREW) Project, Computing Research Association, AY 2002/3 and 2003/4.

Mentor, CRA-W Distributed Mentor Project, Computing Research Association's Committee on the Status of Women in Computing Research, Summer 2002 and Summer 2003.

Supervisor for the senior thesis of high school student Tameem Hasan, Boston University Academy, 2002/2003.

Organizer and Mentor, Pathways to Science, one-day visit of hundreds of female public high school students in Massachusetts at Boston University, 2001–2003.

Panelist for the Massachusetts Institute of Technology 2002 Seminar Series on Academic Careers: “Why Choose an Academic Career?” Cambridge, MA, June 2002.

Lecturer, GirlTECH's TeacherTECH'01 Workshop for increasing the participation of inner-city girls in science, mathematics, and technology, Summer 2001.

Co-Host, Belmont Brownie Troop 19-19, November 2002, and Belmont GirlScouts, May 2005, May 2009, and November 2010.

## **SERVICE TO PROFESSION**

Associate Editor, Editorial Board of the journal *IEEE Transactions on Pattern Analysis and Machine Intelligence* (PAMI), August 2016–present.

Associate Editor, Editorial Board of the journal *Computer Vision and Image Understanding* (CVIU), August 2016–present.

Area Chair, IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2018), July 2017–June 2018.

Area Chair, IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2017), July 2016–June 2017.

Program Committee Chair, The 7th International Conference on Pervasive Technologies Related to Assistive Environments (PETRA), Rhodes, Greece, May 2014.

Program Committee Chair, The 6th International Conference on Pervasive Technologies Related to Assistive Environments (PETRA), Rhodes, Greece, May 2013.

Program Committee Chair, The 5th International Conference on Pervasive Technologies Related to Assistive Environments (PETRA), Crete, Greece, June 2012.

Program Committee Chair, The 4th International Conference on Pervasive Technologies Related to Assistive Environments (PETRA), Crete, Greece, May 2011.

Workshop Co-Chair, IEEE Conference on Computer Vision and Pattern Recognition (CVPR), Columbus, Ohio, June 2014.

Organizing Chair, IEEE International Workshop on Cues in Communication, Cues 2001.

Co-Editor, 2011–2012. Special issue “Assistive Environments for the Disabled and Senior Citizens: Theme Issue of the PETRA 2010 and 2011 Conferences” of the journal *Personal and Ubiquitous Computing*, January 2014 (online November 4, 2012).

Co-Editor, 2013. Special issue “Animal and Insect Behaviour Understanding in Image Sequences,” EURASIP Journal on Image and Video Processing. Published online August 12, 2013.

Co-Editor, 2011–2013. Special issue “Pervasive technologies and assistive environments: Cognitive systems for assistive environments: Special issue of PETRA 2010 and 2011 conferences” in the International Journal Universal Access in the Information Society. Published online, July 19, 2013.

Member, Technical Program Committees,

- IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2003, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014
- IEEE Workshop on Perception Beyond the Visible Spectrum (PBVS) 2013, 2015, 2016, 2017, 2018
- Workshop on Computer Vision for Microscopy Image Analysis (CVMI) at CVPR 2016, 2018
- International Conference on Pervasive Technologies Related to Assistive Environments (PETRA) 2016, 2017
- European Conference on Computer Vision (ECCV) 2010, 2014
- IEEE International Conference on Computer Vision (ICCV) 2003, 2005, 2007, 2009
- The Eleventh IEEE International Conference on Automatic Face and Gesture Recognition (FG), 2015
- Workshop on Automated Analysis of Video Data for Wildlife Surveillance (AVDWS), 2015, 2016
- International Conference on Universal Access in Human-Computer Interaction (UAHCI) 2011, 2012
- International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI) 2004, 2007, 2008, 2009, 2010
- The International Conference on Human Computer Interaction (HCI International) 2011, 2013, 2014
- International Conference on Pattern Recognition (ICPR) 2006, 2010, 2014
- IEEE International Workshop on Human Computer Interaction (HCI) 2007

IEEE International Conference on Image Processing (ICIP) 2003, 2004, 2005  
The 12th European AAATE Conference by the Association for the Advancement of Assistive Technology in Europe, 2013  
International Workshop on Video and Image Ground Truth for Computer Vision Applications (VIGTA) 2013  
3rd ACM International Regular-Data Challenge Workshop on Multimedia Analysis of Ecological Data (MAED) 2014  
International Workshop on Visual Observation and Analysis of Animal and Insect Behavior (VAIB) 2012  
International Workshop on Visual Observation and Analysis of Vertebrate and Insect Behavior (VAIB) 2014, 2016  
IEEE Workshop on Projector-Camera Systems (ProCams) 2006, 2007  
IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP) 2005  
IEEE ICCV Workshop on Computer Vision for Biomedical Image Applications 2005  
IEEE Workshop on Applications of Computer Vision (WACS) 2005,  
4th Indian Conference on Computer Vision, Graphics, and Image Processing (ICVGIP) 2004  
IEEE Workshop on Articulated and Nonrigid Motion (ANM) 2004  
IEEE Symposium on Bioinformatics and Bioengineering (BIBE) 2003  
IEEE Workshop on Motion and Video Computing (WMVC) 2002  
IEEE Intelligent Vehicles Symposium (IV) 2000.

Member, Site Visit Panel of the National Science Foundation, May 2002.

Member, National Science Foundation Panels, 1999, 2000, 2001, 2003, 2004, 2005, 2007, 2008, 2010, 2012, 2014, 2015

Reviewer, National Academies for Science, Engineering, and Medicine, September 2014.

Ad hoc Reviewer, National Science Foundation, 2016.

Reviewer of research programs at a foreign university. Review process was conducted by the Oak Ridge Associated Universities (ORAU), 2012–2016.

Reviewer, Dutch National Science Foundation, May 2007.

Member, Bat Working Group, National Center for Ecological Analysis and Synthesis, January 2003–2009.

Session Chair, International Conference on Universal Access in Human-Computer Interaction (UAHCI) 2011, The 3rd International Conference on Pervasive Technologies Related to Assistive Environments (PETRA), June 2010, The 2nd International Conference on Pervasive Technologies Related to Assistive Environments (PETRA), June 2009, IEEE Computer Society Workshop on Mathematical Methods in Biomedical Image Analysis, June 2009, IEEE Workshop on Applications in Computer Vision, December 2002.

Reviewer for Journals:

Algorithmica  
Annals of Biomedical Engineering  
Assistive Technology  
Autonomous Robots



Behavior & Information Technology  
Biological Cybernetics Review  
British Journal of Applied Science & Technology  
Computer Aided Surgery  
Computer Vision and Image Understanding  
Ecological Informatics  
EURASIP Journal on Image and Video Processing  
IEEE Transactions on Education  
IEEE Transactions on Human-Machine Systems  
IEEE Transactions on Information Theory  
IEEE Transactions on Intelligent Transportation Systems  
IEEE Transactions on Robotics and Automation  
IEEE Transactions on Medical Imaging  
IEEE Transactions on Pattern Recognition and Machine Intelligence  
IEEE Transactions on Vehicular Technology  
IEE Proceedings – Vision, Image and Signal Processing  
Image and Video Computing  
Information and Computation  
Integrated Computer-Aided Engineering  
Interacting with Computers  
International Journal of Computer Vision  
International Journal on Human-Computer Interaction  
International Journal of Pattern Recognition and Artificial Intelligence  
Iranian Journal of Electrical and Computer Engineering  
Journal of Field Robotics  
Journal of Zhejiang University – Science  
Machine Vision and Applications  
Medical Image Analysis  
Medical Physics  
Methods in Oceanography  
Multimedia Systems Journal  
Neurocomputing  
Optics Letters  
Pattern Recognition Letters  
Proceedings of the IEEE  
Real-Time Imaging  
Sensors  
Signal, Image and Video Processing  
Transactions on Accessible Computing  
Universal Access in the Information Society

Reviewer for Conferences:

ACM Conference on Human Factors in Computing Systems (CHI) 2016, IEEE International Conference on Robotics and Automation (ICRA) 1999, 2003, IEEE Computer Vision and Pattern Recognition Conference (CVPR) 2001, Sixth International Conference on Computer Vision (ICCV) 1998, Annual ACM Conference on Computational Learning Theory (COLT) 1993, 1996, 1995, 1997, 4th Workshop on Computational Learning and Natural Learning (CLNL) 1993.

## INSTITUTE AND CENTER AFFILIATIONS

Data Science Faculty Fellow of the Boston University Rafik B. Hariri Institute for Computing and Computational Science and Engineering, exp. September 2018.

Co-Director of the Boston University Artificial Intelligence Research (AIR) Initiative at the Boston University Rafik B. Hariri Institute for Computing and Computational Science and Engineering since 2017.

Faculty Affiliate of the Boston University Rafik B. Hariri Institute for Computing and Computational Science and Engineering since 2011.

Participating Faculty at the Boston University Center for Reliable Information Systems and Cyber Security (RISCS) since 2005.

Faculty Associate at the Boston University Center for Ecology and Conservation Biology (CECB) since 2004.

## UNIVERSITY SERVICE

Member of the “BU Strategic Planning Task Force”	2018–present
Member of the “Envision BU Data Sciences” Committee	2018–present
Member of the Graduate Academic Affairs Committee, Graduate School of Arts and Sciences	2014–2017
Member of the Office of the Provost Committee on Senior Faculty Hiring	2013–present
Member of the Executive Steering Committee of the Boston University Rafik B. Hariri Institute for Computing and Computational Science and Engineering	2010–2017
Member of the Committee for the Provost Faculty Hiring Initiative in Data Science	2014–2016
Participant of the Academic Program Review Process, Department of Biology	3/2013
Member of the Teaching & Learning Technologies Governance Committee	2010–2012
Member of the Faculty Advisory Committee for the Undergraduate Research Opportunity Program (UROP)	2006–2009
Chair, Women in Science and Engineering (WISE) Faculty Group	2008–2009
Member, faculty focus group on restructuring of BU’s research administration	12/2009
Member of the Search Committee for the Boston University Vice President of Information Systems and Technology	2008–2009
Speaker and Panel Leader, College of Arts and Sciences Leadership Advisory Board meeting	10/2008
Speaker, College of Arts and Sciences “CAS 101” meeting with The Office of Development and Alumni Relations	1/2008
Member of the University Appointment, Promotion and Tenure Committee (UAPT)	2007–2008
Co-Chair, Women in Science and Engineering (WISE) Faculty Group	2007–2008
Alternate Member of the Faculty Council	2002–2007
Faculty Advisor during Summer Academic Orientation	2005, 2007
Speaker, Spring Open House, College of Arts and Sciences	2007, 2008
Member of the “Institute for the Environment and Global Health” Planning Committee	2006
Member of the Faculty Search Committee, Metropolitan College	2002–2003
Member of the Pathways Planning Committee	2001–2003

## SERVICE TO COMPUTER SCIENCE DEPARTMENT

Director of Graduate Studies	2014–present
Chair of the Faculty Search Committee	2014–2015
Associate Chair	2009–2012
Co-Chair of the Computer Vision Doctoral Written Examination Committee	2001–present
Member of the New Building Planning Committee	2011–2013
Member of the Annual Faculty Merit Review Committee	2002, 2003, 2009, 2013
Member of the CS Distinguished Alumni Award Selection Committee	2009
Director of Undergraduate Studies	2004–2006, 2007–2008
Member, Committee to Study Enrollments in Computer Science Courses	2007–2008
Member of the Faculty Search Committee	2001, 2004, 2005, 2007
Chair of the Space Committee	2001–2004
Member, Committee for the Selection of the Graduate Research Excellence Award	Spring 2004
Member of the Outreach and Public Relations Committee	2003–2004
Member of the Sensorium Acquisition and Hiring Committee	2003
Member of the Planning Committee for the New Computer Science Building	2000–2002
Computer Science Colloquium Chair	2000–2001