

# George Bebis

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## Research Interests

Computer Vision  
Image Processing  
Pattern Recognition  
Machine Learning  
Genetic Algorithms

## Education

**Ph.D. in Electrical & Computer Engineering**  
University of Central Florida, Orlando, FL 32816  
Dissertation Topic: *Indexing-Based Object Recognition.*  
Graduation: August 1996

**Master of Science in Computer Science**  
University of Crete, Heraklion, Crete, Greece  
Thesis topic: *Model Based Object Recognition using  
Multi-resolution Segmentation and Neural Network Models.*  
Graduation: July 1991

**Bachelor of Science in Mathematics**  
University of Crete, Heraklion, Crete, Greece  
Major Areas: *Numerical Analysis, Probability Theory and Statistics*  
Graduation: September 1987

## Academic Experience

**July 2008 - present, Professor**  
Department of Computer Science and Engineering, UNR

**July 2002 - June 2008, Associate Professor**  
Department of Computer Science and Engineering, UNR

**January 1998 - present, Founder and Director**  
Computer Vision Laboratory (CVL), UNR

**January 1998 - June 2002, Assistant Professor**  
Department of Computer Science and Engineering, UNR

**August 1997 - December 1997, Visiting Assistant Professor**  
Department of Computer Science and Engineering, UNR

**July 1998 - August 1998, Summer Faculty**  
Center for Applied Scientific Computing (CASC), Lawrence Livermore National Laboratory

**August 1996 - August 1997, Visiting Assistant Professor**  
Department of Mathematics and Computer Science, University of Missouri-St. Louis (UMSL)

## Teaching

CS201 Computer Science I, CS302 Data Structures, CS365 Mathematics of Computer Science, CS477/677 Analysis of Algorithms, CS474/674 Image Processing and Interpretation, CS479/679 Pattern Recognition, CS480/680 Computer Graphics, CS491E/791E Computer Vision, CS791Y Topics in Computer Vision, CS773C Machine Intelligence Advanced Applications, CS791S Neural Networks, CS491Q/790Q SEM: Machine Learning (Biometrics), CS491Y/791Y Mathematical Methods for Computer Vision

## Ph.D. Dissertations

*On-Road Vehicle Detection*, Zehang Sun, Fall 2003.

*Perceptual Grouping Using Tensor Voting*, Leandro Loss, May 2009.

*Hand-Based Biometrics*, Gholmareza Amayeh, May 2010.

## Master Theses

*Computational Models for Regional and Mesoscale Air Quality Modeling in the United States*, Julide Koracin, Spring 2009.

*Gender Classification*, Zhiming Liu, Spring 2007.

*Fingerprint Template Synthesis*, Tamer Uz, Spring 2006.

*Improving the Performance of Fingerprint Classification*, Uday Rajanna, Spring 2006.

*Shape Metamorphism Using  $p$ -Laplacian Equation*, Mehmet Eser, Spring 2005.

*Geometric Approach to Segmentation and Protein Localization in Cell Cultured Assays*, Sreevatsan Raman, Fall 2005.

*Automatic Recognition of a Baby Gesture*, Jigna Bhatt, Spring 2005.

*Global Hand Pose Estimation by Multiple Camera Ellipse Tracking*, Jorge Usabiaga, Spring 2005.

*Rendering Optimizations Guided by Head-Pose Estimates and their Uncertainty*, Javier Martinez, Summer 2005.

*Face Recognition Experiments Using Random Projection*, Navin Goel, Spring 2004.

*Infrared and Visible Image Fusion for Face Recognition*, Saurabh Singh, Spring 2004.

*Heliothis-Zea Classification Using Image Analysis*, Tom Patten, Spring 2004.

*Face Detection Using Multi-Band Fusion*, Jonathan Dowdall, Spring 2003.

*Multiresolution Image Retrieval Through Fusion*, Vladimir Nikulin, Fall 2003.

*Face Recognition Using Image Fusion*, Aglika Gyaourova, Spring 2003.

*Fingerprint Minutiae Extraction*, Chris Smith, Fall 2002.

*Computational Analysis of Functionally Unknown Proteins from Expressed Sequence Tags (EST) Datasets*, Elham Alavi, Fall 2002.

*Improving Fingerprint Recognition*, Xiaosheng Tu, Summer 2000.

*Genetic Search for Face Recognition*, Satish Uthiram, Summer 1999.

*Face Detection using Convex Grouping*, Alexey Kryuchkov, Fall 1998.

*Fingerprint Recognition using Delaunay Triangulation*, Taisa Deaconu, Fall 1998.

## **Honors**

*Donald W. Reynolds Governor's Cup Award, May 2009*

*Lemelson Award for Innovation and Entrepreneurship, May 2002*

## **Patents**

- "Hand-based Verification Using Palm-Finger Segmentation", full patent, filed in June 2007.
- "Hand-Based Gender Classification", provisional patent application, filed in June 2009.
- "Minutiae-based Template Synthesis and Matching", provisional patent application, filed in August 2009.

## **Departmental and College Committee Services**

- 2005 - present**, Graduate Director
- 2008 - present**, Assessment Committee (Member)
- 2002 - 2003**, Strategic Planning Committee (Chair)
- 2003 - 2004**, Evaluation Committee (Member)
- 2003-2005, 2006-2007**, Search Committee (Member)
- 2006 - present**, College Personnel Committee (Member)
- 2007 - present**, College Dean Search Committee (Member)
- 2009 - present**, College FACE Committee (Member)
- 2009 - present**, College Graduate Directors Committee (Member)

## **State, National, and International Committee Services**

- 2002 - present**, IAPR Education Committee
- 2001 - present**, Nevada NASA Space Grant Consortium

## **Professional Activities**

### **Panelist**

- NSF, 2002-2005*
- Nevada NSF-EPSCoR, 2007*
- Nevada NASA-EPSCoR, 2006-2010*
- Nevada DoD-EPSCoR, 2004*
- Nevada Space Grant, 2005-2010*

### **Associate Editor**

- *Machine Vision and Applications Journal* (2003-present)

### **Editorial Board Member**

- *Pattern Recognition Journal* (2004-2007)
- *International Journal on Artificial Intelligence Tools* (2003-present)

### **Guest Editor**

- *IEEE Multimedia Magazine* (special issue on Digital Multimedia on Demand, January-March 2004).
- *International Journal on Artificial Intelligence Tools* (special issue on Applications of Computer Vision, June 2000).

### **Reviewer**

- *Computer Vision and Image Understanding* (CVIU)
- *Pattern Recognition* (PR)
- *Image and Vision Computing* (IVC)
- *IEEE Transactions on Pattern Analysis and Machine Intelligence* (PAMI)
- *Machine Vision and Applications* (MVA)
- *International Conference on Computer Vision* (ICCV)
- *Computer Vision and Pattern Recognition Conference* (CVPR)

### **Program Chair/co-Chair**

- *First International Symposium on Visual Computing* (ISVC05), December 5-7, 2005, Lake Tahoe, Nevada.
- *IEEE International Symposium on Bio-Informatics & Biomedical Engineering*, November 2000, Washington DC.
- *IEEE Symposium on Image, Speech, and Natural Language Systems*, November 1999, Maryland.

### **Area Chair**

- *9th SIAM International Conference on Data Mining*, Reno, NV, April 30 - May 2, 2009.
- *IEEE International Conference on Advanced Video and Signal Based Surveillance* (AVSS08), September 1-3, 2008, Santa Fe, New Mexico.
- *Visual Information Engineering*, (N. America Area Chair) July 25-27, 2007, London, UK.

### **Organizer/co-Organizer**

- *ACM SIG 2003 Multimedia Biometrics Methods and Applications Workshop*, (in conjunction with ACM Multimedia 03), Berkeley, November 8, 2003 (co-organizer).
- *IEEE Workshop on Combined Research-Curriculum Development in Computer Vision*, (in conjunction with CVPR01), Kauai, Hawaii, December 11-13, 2001 (organizer).

### **Steering Committee Chair**

- *7th International Symposium on Visual Computing (ISVC11)*, Sept 26 - 28, 2011, Las Vegas, Nevada.
- *6th International Symposium on Visual Computing (ISVC10)*, November 29 - December 1, 2010, Las Vegas, Nevada.
- *5th International Symposium on Visual Computing (ISVC09)*, November 30 - December 2, 2009, Las Vegas, Nevada.
- *4th International Symposium on Visual Computing (ISVC08)*, December 1-3, 2008, Las Vegas, Nevada.
- *3rd International Symposium on Visual Computing (ISVC07)*, November 26-28, 2007, Lake Tahoe, Nevada.
- *2nd International Symposium on Visual Computing (ISVC06)*, November 6-8, 2006, Lake Tahoe, Nevada.

### **Program Committee Member**

- *Computational Modeling of Objects Presented in Images: Fundamentals, Methods and Applications*, Rome, Italy, September 6-7, 2012.
- *Computational Modeling of Objects Presented in Images: Fundamentals, Methods and Applications*, Rome, Italy, September 6-7, 2012.
- *International Conference on Cyberworlds*, Banff, AB, Canada, October 4-6, 2011.
- *International Workshop on Combinatorial Image Analysis (IWCA11)*, Madrid, Spain, May 23-25, 2011.
- *7th International Conference on New Horizons in Industry, Business and Education*, Chios island, Greece, August 25-26, 2011.
- *IEEE International Conference on Advanced Video and Signal Based Surveillance*, Klagenfurt University, Austria, August 30 - September 2, 2011.
- *17th International Conference on Digital Signal Processing*, Corfu, Greece, July 6-8, 2011.
- *SPIE Defense, Security and Sensing Symposium (Biometric Technology for Human Identification VII)*, April 25-29, 2011, Orlando, Florida.
- *IEEE Symposium on Computational Intelligence in Vehicles and Transportation Systems (CIVTS)*, Paris, France, April 11-15, 2011.
- *17th International Conference on Digital Signal Processing*, Corfu, Greece, July 6-8, 2011.
- *SPIE Defense, Security and Sensing Symposium (Biometric Technology for Human Identification VII)*, April 25-29, 2011, Orlando, Florida.

- *IEEE Symposium on Computational Intelligence in Vehicles and Transportation Systems (CIVTS)*, Paris, France, April 11-15, 2011.
- *International Conference on Cyberwolds*, Singapore, October 20-22, 2010.
- *1st ACM International Workshop on Analysis and Retrieval of Tracked Events and Motion in Imagery Streams (ARTEMIS2010)*, Firenze, Italy, October 29 2010.
- *4th IEEE International Conference on Biometrics: Theory, Applications and Systems (BTAS 2010)*, Washington DC, Sept 27 - 29, 2010.
- *Computational Modeling of Objects Represented in Images: Fundamentals, Methods and Applications (CompIMAGE'2010)*, Buffalo, NY, May 5-7, 2010.
- *3rd IEEE International Conference on Biometrics: Theory, Applications and Systems*, Washington DC, Sept 28 - 30, 2009.
- *6th IEEE Workshop on Object Tracking and Classification in and Beyond the Visible Spectrum*, Miami, Florida, June 20, 2009
- *16th International Conference on Digital Signal Processing*, Santorini, Greece, July 5-7, 2009.
- *International Conference on Imaging Theory and Applications*, Lisboa, Portugal, February 5-8, 2009.
- *IEEE International Conference on Information Reuse and Integration*, Las Vegas, August 10-12, 2009.
- *Joint IAPR International Workshops on Structural and Syntactic Pattern Recognition (SSPR 2008) and Statistical Techniques in Pattern Recognition (SPR 2008)*, Orlando, Florida, December 4-6, 2008.
- *SPIE Defense and Security Symposium (DS108: Biometric Technology for Human Identification VI)*, April 13-17, 2009, Orlando, Florida.
- *IEEE Symposium on Computational Intelligence in Vehicles and Vehicular Systems*, Nashville, Tennessee, Mar 30-Apr 2, 2009.
- *IEEE/IAPR International Conference on Biometrics*, Alghero in Sardinia Island, Italy, June 2-5, 2009.
- *International Conference on Pattern Recognition (ICPR08) (Biometrics)*, Tampa, FL, December 8-11, 2008.
- *16th European Signal Processing Conference (EUSIPCO 2008)*, Lausanne, Switzerland, August 25-29, 2008.
- *IEEE Workshop on Online Learning for Classification*, Anchorage, Alaska, June 27, 2008
- *2nd IEEE International Conference on Biometrics: Theory, Applications and Systems*, Washington DC, Sept 29 - Oct 1, 2008.

- *5th IEEE Workshop on Object Tracking and Classification in and Beyond the Visible Spectrum*, Anchorage, Alaska, June 27, 2008
- *IEEE International Conference on Information Reuse and Integration, Las Vegas, July 13-15, 2008.*
- *International Conference on Cyberwolds*, Hangzhou, China, September 22-24 2008.
- *SPIE Defense and Security Symposium (DS26: Biometric Technology for Human Identification V)*, March 16-20, 2008, Orlando, Florida.
- *IEEE International Conference on Advanced Video and Signal Based Surveillance (AVSS07)*, September 5-7, 2007, London, UK.
- *International Workshop on Combinatorial Image Analysis (IWCA08)*, April 7-9, 2008, Buffalo, NY, USA.
- *International Conference on Signal-Image Technology and Internet-Based Systems (SITIS07)*, December 16-19, 2007, China.
- *IEEE International Conference on Information Reuse and Integration* August 13-15, 2007, Las Vegas, Nevada.
- *4th IEEE Workshop on Object Tracking and Classification in and Beyond the Visible Spectrum*, Minneapolis, MN, USA, Friday, June 22, 2007.
- *5th International Conference on New Horizons in Industry, Business and Education*, August 30-31, 2007, Rhodes island, Greece.
- *International Conference on Cyberwolds*, Hannover, Germany, Oct 24-26, 2007.
- *Visual Information Engineering*, July 25-27, 2007, London, UK.
- *International Conference on Sciences of Electronic, Technology of Information and Telecommunications (SETIT07)*, March 25-29, 2007, Hammamet, Tunisia.
- *IEEE International Conference on Advanced Video and Signal Based Surveillance (AVSS06)*, November 22-24, 2006, Sydney, Australia.
- *International Conference on Cyberwolds*, Ecole Polytechnique Fdrale de Lausanne (EPFL), Switzerland, Nov 28-30, 2006.
- *IEE Conference on Crime and Security: Imaging for Crime Detection and Prevention*, London, UK, 13-15 June 2006.
- *18th IEEE International Conference on Tools with Artificial Intelligence*, 2006.
- *Third IEEE Workshop on Object Tracking and Classification in and Beyond the Visible Spectrum*, (in conjunction with CVPR06), New York, NY, June 22, 2006.
- *International Conference on Computer Games Development*, Las Vegas, NV, June 26-29, 2006.
- *IEEE International Conference on Information Reuse and Integration*, Sep 16-18, 2006,

Waikoloa, Hawaii.

- *International Conference on Sciences of Electronic, Technology of Information and Telecommunications (SETIT 2007)*, March 25-29, 2007, Hammamet, Tunisia.
- *International Conference on Computer Vision Theory and Applications (VISAPP)*, February 22-25, 2006, Setubal, Portugal.
- *IEEE International Conference on Advanced Video and Signal Based Surveillance (AVSS05)*, September 15-16, 2005, Como, Italy.
- *IEEE International Conference on Image Processing (ICIP05)*, September 11-14, 2005, Genova, Italy.
- *Second IEEE Workshop on Object Tracking and Classification in and Beyond the Visible Spectrum*, (in conjunction with CVPR05), San Diego, CA, June 20, 2005.
- *IEEE Workshop on Machine Vision for Intelligent Vehicles*, (in conjunction with CVPR05), San Diego, CA, June 21, 2005.
- *IEEE International Conference on Information Reuse and Integration*, Las Vegas, August 15-17, 2005.
- *17th IEEE International Conference on Tools with Artificial Intelligence*, 2005.
- *Genetic and Evolutionary Computing Conference (GECCO 2005)*, Washington, DC, June 25-29, 2005.
- *Fourth International Conference on New Horizons in Industry, Business and Education*, 25-26 August 2005, Corfu, Greece.
- *Signal, Image Technology and Internet-Based Systems (SITIS2005)*, November 27 - December 2, 2005, Cameroon.
- *International Conference on Cyberworlds (CW2005)*, November 23-25, 2005, Singapore.
- *Third International Conference on Sciences of Electronic, Technology of Information and Telecommunications*, March 27-31, 2005, Susa, Tunisia.
- *IEEE Workshop on Object Tracking and Classification Beyond the Visible Spectrum*, (in conjunction with CVPR04), Washington, DC, June 28, 2004.
- *International Joint Conference on Neural Networks (IJCNN04)*, Budapest, Hungary, July 25-29, 2004.
- *15th IEEE International Conference on Tools with Artificial Intelligence*, Sacramento, November 3-5, 2003.
- *IEEE International Symposium on Bio-Informatics and Biomedical Engineering*, Bethesda, March 10-12, 2003.
- *IEEE International Conference on Advanced Video and Signal Based Surveillance*, July 21-22, 2003 Miami, FL.

- *Third International Conference on New Horizons in Industry and Education*, 28-29 August 2003, Santorini, Greece.
- *14th IEEE International Conference on Tools with Artificial Intelligence*, November 4-6, 2002, Washington D.C.
- *INNS-IEEE International Joint Conference on Neural Networks (IJCNN02)*, Honolulu, Hawaii, May 12-17 2002.
- *IEEE International Symposium on Bio-Informatics and Biomedical Engineering*, November 2001, Washington DC.
- *IEEE Workshop on Models versus Exemplars in Computer Vision*, (in conjunction with CVPR01), Kauai, Hawaii, December 11-13, 2001.
- *IEEE Workshop on Computer Vision Beyond the Visible Spectrum: Methods and Applications*, (in conjunction with CVPR01), Kauai, Hawaii, December 14, 2001.
- *INNS-IEEE International Joint Conference on Neural Networks (IJCNN01)*, Washington DC, July 14-19, 2001.
- *Neural Networks and Expert Systems in Medicine and Health Care*, Milos Island, Greece, 20-22 June 2001.
- *IEEE Workshop on Computer Vision Beyond the Visible Spectrum: Methods and Applications* (in conjunction with CVPR00), June 2000, Hilton Head Island, SC.
- *IEEE International Conference on Information, Intelligence, and Systems*, November 1999, Maryland.
- *International Conference on Imaging Science, Systems, and Technology*, July 6-9, 1998, Las Vegas, Nevada, USA.
- *11th International Conference on Computer Applications in Industry and Engineering*, November 11-13, 1998, Las Vegas, Nevada, USA.

### **Session Chair**

- *13th International Conference on Parallel and Distributed Computing Systems* Las Vegas, August 8-10, 2000 (Digital Video II).
- *Signal and Image Processing Conference*, Las Vegas, Nevada, October, 1998 (Object Recognition).
- *IEEE International Conference on Systems, Man, and Cybernetics*, Orlando, Florida, October, 1997 (Applications of Neural Networks in Computer Vision).

## **Editorials**

- [1] N. Bourbakis and G. Bebis, "Digital Multimedia on Demand", **IEEE Multimedia**, January-March 2004.

## Books Edited

- [6] G. Bebis et. al (eds) *Advances in Visual Computing*, Lecture Notes in Computer Science (LNCS), Vols 6453, 6454, 6455, 6th International Symposium, ISVC 2010, Las Vegas, NV, USA, November 29 - December 1, 2010.
- [5] G. Bebis et. al (eds) *Advances in Visual Computing*, Lecture Notes in Computer Science (LNCS), Vols 5875, 5876, 5th International Symposium, ISVC 2009, Las Vegas, NV, USA, November 30 - December 2, 2009.
- [4] G. Bebis et. al (eds) *Advances in Visual Computing*, Lecture Notes in Computer Science (LNCS), Vols 5358, 5359, 4th International Symposium, ISVC 2008, Las Vegas, NV, USA, December 1-3, 2008.
- [3] G. Bebis et. al (eds) *Advances in Visual Computing*, Lecture Notes in Computer Science (LNCS), Vols 4841, 4842, 3rd International Symposium, ISVC 2007, Lake Tahoe, NV, USA, November 26-28, 2007.
- [2] G. Bebis et. al (eds) *Advances in Visual Computing*, Lecture Notes in Computer Science (LNCS), Vols 4291, 4292, 2nd International Symposium, ISVC 2006, Lake Tahoe, NV, USA, November 6-8, 2006.
- [1] G. Bebis, R. Boyle, B. Parvin, and D. Koracin (eds) *Advances in Visual Computing*, Lecture Notes in Computer Science (LNCS), Vol. 3804, 1st International Symposium, ISVC 2005, Lake Tahoe, NV, USA, December 5-7, 2005.

## Book Chapters

- [2] G. Bebis, "Fingerprint Indexing", **Biometrics Encyclopedia**, Springer-Verlag, 2009 (ISBN: 978-0-387-73003-5).
- [1] G. Bebis, "Face Recognition in the Thermal Spectrum", **Biometrics Encyclopedia**, Springer-Verlag, 2009 (ISBN: 978-0-387-73003-5).

## Journal Publications

- [38] Tom Patten, Wenjing Li, George Bebis, and Muhammad Hussain, "Assessing Insect Growth Using Image Analysis", **International Journal of Artificial Intelligence Tools**, 2011 (in press).
- [37] U. Rajanna, A. Erol, and G. Bebis, "A Comparative Study on Feature Extraction for Fingerprint Classification and Performance Improvements Using Rank-Level Fusion", **Pattern Analysis and Applications**, vol. 13, no. 3, pp. 263-272, 2010.

- [36] J. Wang, G. Bebis, Mircea Nicolescu, Monica Nicolescu, and R. Miller, "Improving Target Detection by Coupling It with Tracking", **Machine Vision and Applications**, vol. 20, no. 4, pp. 205-223, 2009.
- [35] T. Uz, G. Bebis, A. Erol, and S. Prabhakar, "Minutiae-Based Template Synthesis and Matching for Fingerprint Authentication", **Computer Vision and Image Understanding (CVIU)**, vol 113, pp. 979-992, 2009.
- [34] A. Amayeh, G. Bebis, and M. Nicolescu, "Hand-based Verification and Identification Using Palm-Finger Segmentation and Fusion", **Computer Vision and Image Understanding Journal (CVIU)**, vol 113, pp. 477-501, 2009.
- [33] J. Martinez, A. Erol, G. Bebis, R. Boyle, and X. Twombly, "Integrating Perceptual Level of Detail with Head Pose Estimates and their Uncertainty", **Machine Vision and Applications**, vol 21, no. 1, pp. 69-83, 2009.
- [32] L. Loss, G. Bebis, M. Nicolescu, and A. Skurikhin, "An Iterative Multi-Scale Tensor Voting Scheme for Perceptual Grouping of Natural Shapes in Cluttered Backgrounds", **Computer Vision and Image Understanding (CVIU)**, vol. 113, no. 1, pp. 126-149, 2009.
- [31] J. Usabiaga, A. Erol, G. Bebis, R. Boyle, and X. Towmbly, "Global Hand-Pose Estimation by Multiple Camera Ellipse Tracking", **Machine Vision and Applications**, vol 21, no. 1, pp. 1-15, 2009.
- [30] A. Tavakkoli, Mircea Nicolescu, G. Bebis, and Monica Nicolescu, "Non-parametric Statistical Background Modeling for Efficient Foreground Region Detection", **Machine Vision and Applications**, vol 20, no 6, pp. 395-409, 2009.
- [29] U. Rajanna, A. Erol, and G. Bebis, "A Comparative Study on Feature Extraction for Fingerprint Classification and Performance Improvements Using Rank-Level Fusion", **Pattern Analysis and Applications**, (to appear) 2010.
- [28] R. Kelley, C. King, A. Tavakkoli, Mircea Nicolescu, Monica Nicolescu, and G. Bebis, "An architecture for understanding intent using novel hidden Markov formulation", **International Journal of Humanoid Robotics**, (special issue on "Cognitive Humanoid Robots"), vol. 5, no. 2, pp. 243-264, 2008.
- [27] W. Li, G. Bebis, and N. Bourbakis, "3D Object Recognition Using 2D Views", **IEEE Transactions on Image Processing**, vol. 17, no. 11, pp. 2236-2255, 2008.
- [26] A. Tavakkoli, Mircea Nicolescu, G. Bebis, and Monica Nicolescu, "A Support Vector Data Description Approach for Background Modeling in Videos with Quasi-Stationary Backgrounds", **International Journal of Artificial Intelligence Tools**, vol. 17, no. 4, pp. 635-658, 2008.
- [25] A. Erol, G. Bebis, M. Nicolescu, R. Boyle, X. Twombly, "Vision-Based Hand Pose Estimation: A Review", **Computer Vision and Image Understanding** (special issue on Vision for Human-Computer Interaction), October/November 2007.
- [24] G. Bebis, A. Gyaourova, S. Singh, and I. Pavlidis, "Face Recognition by Fusing Thermal Infrared and Visible Imagery", **Image and Vision Computing**, vol. 24, no. 7, pp.

727-742, 2006.

- [23] Z. Sun, G. Bebis, and R. Miller, "On-road Vehicle Detection: A review", **IEEE Transactions on Pattern Analysis and Machine Intelligence**, vol. 28, no. 5, pp. 694-711, 2006.
- [22] Z. Sun, G. Bebis, and R. Miller, "Monocular Pre-crash Vehicle Detection: Features and Classifiers", **IEEE Transactions on Image Processing**, vol. 15, no. 7, pp. 2019-2034, July 2006.
- [21] Z. Sun, G. Bebis, and R. Miller, "On-Road Vehicle Detection Using Evolutionary Gabor Filter Optimization", **IEEE Transactions on Intelligent Transportation Systems**, vol. 6, no. 2, pp. 125-137, 2005.
- [20] Z. Sun, G. Bebis, and R. Miller, "Boosting Object Detection Using Feature Selection", **Pattern Recognition**, vol. 37, pp. 2165-2176, 2004.
- [19] N. Bourbakis, J. Gattiker, and G. Bebis "A Synergistic Model for Interpreting Human Activities and Events from Video", **International Journal on Artificial Intelligence Tools** , vol. 12, no. 1, 2003.
- [18] J. Dowdall, I. Pavlidis, and G. Bebis, "Face Detection Using Multi-Band Fusion", **Image and Vision Computing**, vol 21, no. 7, pp. 565-578, 2003.
- [17] G. Bebis. D. Egbert, and M. Shah, "Review of Computer Vision Education", **IEEE Transactions on Education**, vol. 46, no. 1, pp. 2-21, 2003.
- [16] G. Bebis, S. Louis, Y. Varol, and A. Yfantis, "Genetic Object Recognition Using Combinations of Views", **IEEE Transactions on Evolutionary Computing**, vol 6, no. 2, pp. 132-146, April 2002.
- [15] G. Bebis, S. Uthiram, and M. Georgiopoulos, "Face Detection and Verification Using Genetic Search", **International Journal on Artificial Intelligence Tools**, vol 9, no 2, pp. 225-246, 2000.
- [14] E.Yfantis, T. Lazarakis, G. Bebis, and M. Gallitano, " An Algorithm for Cancer Recognition of Ultrasound Images", **International Journal on Artificial Intelligence Tools**, vol 9, no 2, pp. 265-276, 2000.
- [13] M. Georgiopoulos, I. Dagher, G. Heilman, and G. Bebis, "Properties of Learning of a Fuzzy ART Variant", **Neural Networks**, vol. 12, No. 6, pp. 837-850, 1999.
- [12] G. Bebis, M. Georgiopoulos, N. La Vitoria Lobo, and M. Shah, "Recognition by Learning Affine Transformations", **Pattern Recognition**, Vol. 32, No. 10, pp. 1783-1799, 1999.
- [11] G. Bebis, G. Papadourakis and S. Orphanoudakis, "Curvature Scale Space Driven Object Recognition with an Indexing Scheme based on Artificial Neural Networks", **Pattern Recognition**, Vol. 32, No. 7, pp. 1175-1201, 1999.
- [10] I. Dagher, M. Georgiopoulos, G. Heilman, and G. Bebis, "An Ordering Algorithm for Pattern Presentation in Fuzzy ARTMAP That Tends to Improve Generalization

- Performance", **IEEE Transactions on Neural Networks**, Vol. 10, No. 4, pp. 768-778, 1999.
- [9] G. Bebis, M. Georgiopoulos, M. Shah, and N. La Vitoria Lobo, "Indexing based on algebraic functions of views", **Computer Vision and Image Understanding**, vol. 72, no. 3, pp. 360-378, 1998.
- [8] G. Bebis, M. Georgiopoulos and N. La Vitoria Lobo, "Using Self-Organizing Maps to Learn Geometric Hashing Functions for Model-Based Object Recognition", **IEEE Transactions on Neural Networks**, Vol 9, No. 3, pp. 560-570, 1998.
- [7] G. Bebis, M. Georgiopoulos, and T. Kasparis "Coupling weight elimination with genetic algorithms to reduce network size and preserve generalization" **Neurocomputing**, Vol. 17, No. 3&4, pp. 167-194, 1997.
- [6] M. Georgiopoulos, H. Fernlund, G. Bebis, and G. Heileman, "Order of Search in Fuzzy ART and Fuzzy ARTMAP: Effect of the Choice Parameter", **Neural Networks**, vol. 9, no. 9, pp. 1541-1559, 1996.
- [5] G. Bebis and M. Georgiopoulos, "Feed-forward neural networks: why network size is so important", **IEEE Potentials**, pp. 27-31, October/November 1994.
- [4] G. Bebis and G. Papadourakis, "Object Recognition Using Invariant Object Boundary Contour Representations and Neural Network Models", **Pattern Recognition**, Vol. 25, No. 1, pp. 25-44, January 1992.
- [3] G. Papadourakis and G. Bebis, "Artificial Neural Networks I", **Scientific Journal of the Technical Chamber of Greece**, Vol. 11, No. 3, pp. 57-73, 1991.
- [2] G. Papadourakis and G. Bebis, "Artificial Neural Networks II", **Scientific Journal of the Technical Chamber of Greece**, Vol. 12, No. 1, pp. 107-131, 1992.
- [1] G. Bebis, G. Papadourakis and M. Georgiopoulos, "Back Propagation: Increasing Rate of Convergence by Predictable Pattern Loading", **Intelligent Systems Review**, Vol. 1, No. 3, pp. 14-30, 1989.

## Conference Publications

- [102] BingDong Li, Esra Erdin, Mehmet H. Gunes, George Bebis and Todd Shipley, "An Analysis of Anonymity Technology Usage", **3rd COST TMA International Workshop on Traffic Monitoring and Analysis**, Vienna, Austria, April 27, 2011.
- [101] Joshua Gleason, Ara V. Nefian, Xavier Bouysssonousse, Terry Fong and George Bebis, "Vehicle Detection from Aerial Imagery", **IEEE International Conference on Robotics and Automation (ICRA11)**, Shanghai, China, May 9-13, 2011.
- [100] A. Tavakkoli, M. Nicolescu, and G. Bebis, "A Spatio-Spectral Algorithm for Robust and Scalable Object Tracking in Videos", **6th International Symposium on Visual Computing**, Las Vegas, Nevada, Nov 29 - Dec 1, 2010.

- [99] G. Amayeh, G. Bebis, and M. Hussain, "A Comparative Study of Hand Recognition Systems", **Workshop on Emerging Techniques and Challenges for Hand-based Biometrics (in conjunction with ICPR 2010)**, Istanbul, Turkey, August 22, 2010.
- [98] M. El Ansari, S. Mousset, A. Bensrhair, and G. Bebis, "Temporal Consistent Fast Stereo Matching for Advanced Driver Assistance Systems (ADAS)", **IEEE Intelligent Vehicles Symposium (IV10)**, San Diego, CA, June 21-24, 2010.
- [97] G. Amayeh, A. Tavakkoli, and G. Bebis, "Accurate and Efficient Computation of Gabor Features in Real-Time Applications", **5th International Symposium on Visual Computing (ISVC09)**, Las Vegas, Nevada, USA, November 30 - December 2, 2009.
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- [63] A. Tavakkoli, M. Nicolescu, and G. Bebis, "Automatic Robust Background Modeling Using Multivariate Non-Parametric Kernel Density estimation for Visual Surveillance",

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## **Research Grants (serving as Principal Investigator (PI))**

**Agency:** Nevada NASA Space Grant Consortium  
**Investigators:** G. Bebis (PI) and K. Bekris (co-PI)  
**Title:** Workforce Training in Imaging and Robotics  
**Period of Proposed Funding:** August 2009 - December 2011  
**Amount Granted :** \$80,000

**Agency:** Nevada NASA EPSCoR  
**Investigators:** G. Bebis (PI)  
**Title:** High Resolution 3D Lunar Maps Using Subpixel Accuracy and AdaptiveWindow Search  
**Period of Proposed Funding:** July 2009 - June 2010  
**Amount Granted :** \$40,000

**Agency:** NSF  
**Investigators:** G. Bebis (PI)  
**Title:** Hand-Based Biometrics  
**Period of Proposed Funding:** July 2006 - December 2008  
**Amount Granted :** \$70,000

**Agency:** eTreppid Technologies, LLC  
**Investigators:** G. Bebis (PI)  
**Title:** Object Detection, Tracking, and Classification  
**Period of Proposed Funding:** June 2006 - December 2007  
**Amount Granted :** \$130,000

**Agency:** UtopiaCompression Inc.  
**Investigators:** G. Bebis (PI)  
**Title:** Visual Surveillance  
**Period of Proposed Funding:** May 2006 - December 2006  
**Amount Granted :** \$80,000

**Agency:** NASA  
**Investigators:** G. Bebis (PI), F. Harris, A. Yfantis, and M. Nicolescu  
**Title:** Computer Vision Technologies for Effective Human-Computer Interaction in Virtual Environments (2nd phase)  
**Period of Funding:** 1/2006 - 2/2008  
**Amount Granted :** \$780,000

**Agency:** NASA  
**Investigators:** G. Bebis (PI), F. Harris, A. Yfantis, and P. Stubberud  
**Title:** Computer Vision Technologies for Effective Human-Computer Interaction in Virtual Environments (1st phase)  
**Period of Funding:** 9/02 - 12/05  
**Amount Granted:** \$1,148,940

**Agency:** NSF  
**Investigators:** G. Bebis (PI), D. Egbert, E. Jacobson, and M. McIntosh

**Title:** Combined Research-Curriculum Development in Computer Vision  
**Period of Funding:** 1/1/2001 - 8/31/2004  
**Amount Granted:** \$650,243

**Agency:** NSF  
**Investigators:** G. Bebis (PI)  
**Title:** Request for Travel Grant for Undergraduate and Graduate Students  
**Period of Funding:** 6/1/2001 - 12/31/2001  
**Amount Granted:** \$8,831

**Agency:** ONR  
**Investigators:** G. Bebis (PI) and G. Mauer  
**Title:** Automatic Target Recognition Using Algebraic Functions of Views  
**Period of Funding:** 4/1/2001 - 3/31/2005  
**Amount Granted :** \$587,887

**Agency:** Ford Motor Company  
**Investigators:** G. Bebis (PI) and D. Egbert  
**Title:** Vehicle Detection, Classification, Tracking, and Depth Estimation for Driver Assistance and Collision Avoidance as part of Vehicle Compatibility Big Bang  
**Period of Funding:** 1/1/2003-8/31/2005  
**Amount Granted :** \$80,000

**Agency:** University of Nevada (Applied Research Initiative)  
**Investigators:** G. Bebis (PI) and D. Egbert  
**Title:** Vehicle Detection, Classification, Tracking, and Depth Estimation  
**Period of Funding:** 1/1/2003-8/31/2005  
**Amount Granted :** \$80,000

**Agency:** UNR - Research Advisory Board  
**Investigators:** G. Bebis (PI)  
**Title:** Robotic Vision Systems  
**Period of Funding:** 7/1/98 - 6/30/99  
**Amount Granted:** \$8,000

## **Research Grants (serving as co Principal Investigator (co-PI))**

**Agency:** NIJ  
**Investigators:** M. Gunes (PI), G. Bebis (co-PI)  
**Title:** Forensic and Investigative tools and technologies to investigate criminal use of Internet Anonymizers  
**Period of Proposed Funding:** September 2010 - August 2011  
**Amount Granted :** \$107,792

**Agency:** NSF  
**Investigators:** E. Folmer (PI), G. Bebis (co-PI)

**Title:** TextSL: A Virtual World Interface for the Visually Impaired  
**Period of Proposed Funding:** August 2009 - July 2012  
**Amount Granted :** \$500,000

**Agency:** Nevada Dept of Transportation (NDoT)  
**Investigators:** T. Tan (PI), G. Bebis (PI)  
**Title:** Evaluation of Video Detection Systems and Development of Application Guidelines at Signalized Intersections  
**Period of Proposed Funding:** October 2007 - October 2009  
**Amount Granted :** \$165,000

**Agency:** NSF  
**Investigators:** S. Louis (PI), G. Bebis, et al.  
**Title:** Cognitive Information Processing Systems (part of "Research Infrastructure for Nevada's Growth - Targeting Research with Uniqueness and Excellence")  
**Period of Proposed Funding:** June 2005 - June 2008  
**Amount Granted :** \$1,200,000

**Agency:** Sanford Center for Aging  
**Investigators:** M. Webster (PI), G. Bebis, M. Wessinger, M. Crognale  
**Title:** Adaptation and Aging in the Human Visual System  
**Period of Proposed Funding:** 7/2005 - 12/2006  
**Amount Granted :** \$20,000

**Agency:**NASA  
**Investigators:** M. Webster (PI) and G. Bebis  
**Title:** Adaptation and Visual Exploration  
**Period of Proposed Funding:** 1/2005 - 12/2005  
**Amount Granted :** \$39,619

**Agency:** NSF  
**Investigators:** D. Koracin (PI), G. Bebis  
**Title:** Development of an Air-Sea Interaction Model with the Parameterization of the Ocean Surface Gravity Waves  
**Period of Proposed Funding:** 1/2006 - 12/2007  
**Amount Granted :** \$70,000

**Agency:** UNR - Instructional Enhancement Grant  
**Investigators:** D. Egbert (PI) and G. Bebis  
**Title:** Teaching Modules for Computer Vision Research  
**Period of Funding:** 1/1/2001 - 6/31/2001  
**Amount Granted:** \$2,400

**Agency:** Honda  
**Investigators:** Q. Ji (PI) and G. Bebis  
**Title:** A Multi-Sensory Vision System for Monitoring Driver's Vigilance  
**Period of Funding:** 11/1/98 - 10/31/99  
**Amount Granted:** \$25,000

**Agency:** UNR - Applied Research Initiative

**Investigators:** Q. Ji (PI) and G. Bebis

**Title:** A Multi-Sensory Vision System for Monitoring Driver's Vigilance

**Period of Funding:** 11/1/98 - 10/31/99

**Amount Granted:** \$25,000