George Wolberg

Office Address
Department of Computer Science
The City College of New York
138th St. at Convent Ave.
New York, NY 10031
212-650-6160 (Tel)
212-650-6248 (Fax)
wolberg@cs.ccny.cuny.edu
http://www-cs.ccny.cuny.edu/~wolberg

Home Address
111 Woodmere Blvd South
Woodmere, NY 11598
516-668-1393 (Cell)

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Research Interests

- Image Processing, computer vision, computer graphics:
  warping, morphing, interpolation, registration, filtering, 3D modeling, visual effects.

Education

- Columbia University, Ph.D. in Computer Science, October 1990
  Ph.D. Thesis: *Separable Image Warping: Implications and Techniques.* Advisor: T.E. Boult
- Cooper Union, M.E. in Electrical Engineering, November 1985. GPA: 3.8/4.0
  Masters Thesis: *An Omni-Font Character Recognition System.* Advisor: Y.Z. Efe
- Cooper Union, B.E. in Electrical Engineering, May 1985. GPA in major: 3.8/4.0
- Queens College, 18 Accounting credits (summers '81-'83), May 1985. GPA: 3.8/4.0
- Stuyvesant H.S., Academic Diploma, June 1981.

Honors

- CUNY Certificate of Recognition "Salute to Scholars" Awards, 2000-2011
- Mayor's Award for Excellence in Science and Technology, NYC, 1999/2000
- Citation in "Who's Who in Science and Engineering," 2000-present
- Citation in "Who's Who Among America's Teachers," 1998-present
- NASA Faculty Award for Research, 1998-2001
- CCNY Outstanding Teaching Award, 1997
- NSF Presidential Young Investigator Award, 1991-1996
- NSF Fellow in the 1990 Summer Institute in Japan Program
- NSF Graduate Fellowship, 1985-1988
- Four Year Merit Scholarship to the Cooper Union, 1981-1985
- Member of Tau Beta Pi National Engineering Honor Society, 1984
- Member of Eta Kappa Nu National Electrical Engineering Honor Society, 1984

Positions Held

- **PROFESSOR, DEPARTMENT OF COMPUTER SCIENCE**
  THE CITY COLLEGE OF NEW YORK / CUNY
  Assistant Professor (1990-1994), Associate Professor (1994-1998), Full Professor (1998-present). Teach courses in image processing, computer graphics, software design, digital logic, computer architecture, and C++ programming. Conduct research and supervise students in image processing, computer graphics, and computer vision. 1990-present.
- **ADJUNCT PROFESSOR, DEPARTMENT OF COMPUTER SCIENCE**
  COLUMBIA UNIVERSITY
  Teach Computational Techniques in Image Processing (W4165). 1990-2005.

- **SOFTWARE CONSULTANT**
  APPLE COMPUTER
  Implemented the image warping and morphing modules for Shake 3.5, the industry's leading digital effects compositing system. High-profile Shake customers include Weta Digital, Esc Entertainment, and Industrial Light and Magic. Since 1997, Shake has been used by the industry's top studios to generate mesmerizing Oscar-winning visual effects for such movies as the Matrix and the Lord of the Rings trilogies. 2003-2004.
- **LEGAL CONSULTANT**
  Served as expert witness in several patent invalidity and infringement cases. Prepared trial exhibits, testified before a jury, and invalidated a patent to successfully represent defendants. Clients include: Paramount Pictures (Pennie and Edmonds, 1995); Nedgraphics (Warner Norcross & Judd, 1998); Nvidia (Cooley Godward, 1999-2000); Universal Pictures (Sheldon and Mak, 2000); Adobe (Fish and Richardson, 2011); and Valeo (Osha Liang, 2013).

Pending Grants

- **Department of Energy**
  Principal Investigator on *3D Photography Algorithms for Computational Forensics*. This proposed 3-year grant (1/1/14-12/31/16) is to provide a total of $832,000 for developing a comprehensive feature-based 3D photography toolkit for computational forensics. The objectives are to compute photorealistic models from unordered collections of images, perform robust feature extraction in cluttered spaces and feature-limited environments, perform feature tracking among ordered as well as unordered image collections, and compute log-polar image registration to georeference reconstructed models onto Google Earth maps and other available high-resolution nadir (downward-looking) images.
- **National Science Foundation**
  Principal Investigator on *Curvature Scale-Space 3D for Feature Extraction and Shape Matching*. This proposed 3-year grant (9/1/14-9/1/17) is to provide a total of $497,836 for developing a new multiscale surface representation based on scale-space theory that specifically targets 3D shape matching applications. The proposed representation is stable against surface noise, and can be used to form discriminative feature vectors useful for establishing correspondences between regions on 3D surfaces.
- **National Science Foundation**
  Principal Investigator on *Flash LIDAR 3D Photography Photography System*. This proposed 3-year grant (9/1/14-9/1/17) is to provide a total of $497,836 for developing a 3D photography system that will fuse a stream of flash LIDAR depth data with calibrated RGB video to acquire phototextured 3D geometry of dynamic scenes at real-time rates. The underpinnings of this project lies in our recent work on 3D scale-invariant feature transforms (3D SIFT) to extract the salient features from each frame that may be registered together to produce the phototextured 3D models.

Grants

- **Artaic Inc.**
  Principal Invesigator on *SBIR Phase IIa: Computer-Aided Mosaic Design and Construction.* This is a 1-year $90,000 subcontract from Artaic (10/1/13-10/1/14) for research on the use of the log-polar image registration algorithm developed by the PI to design and render fractal mosaics, a new class of photomosaics. A fast GPU-based implementation will be developed and integrated into the graphical user interface that will be implemented to generate fractal mosaic images and to control their parameters.
- **Department of Energy**
  Principal Investigator on *Multi-Scale Image-to-Image Geo-registration and 3D Reconstruction*. This is a 10-month $93,000 contract (3/1/12-12/31/12) to assess the utility of log-polar transformations for rapid multi-scale multi-temporal registration among DOE-supplied hyperspectral images. The purpose of this work is to investigate ground anomaly sites for nuclear non-proliferation applications.

- **City Seeds Award (CCNY)**
  Co-PI on *Computer-Aided Mosaic Design and Rendering* with Prof. Annette Weintraub (Art Dept, CCNY). This is a 1-year grant (1/1/11 - 12/31/11) that provides a total of $50,000 for research and development of precision tiling and editing tools for designing and rendering digital images of tiled mosaics in the classic Greco-Roman style. We leveraged this work to collaborate with Artaic (Boston, MA) to design custom mosaics that can be manufactured by robots. An iPad mosaic design app is currently being implemented for a targeted mid-2012 release date. RF-93348-0601.
- **Department of Energy**
  Principal Investigator on *Feature-Based Data Fusion for 3D Photography*. This is a 2-year extension (9/15/09-9/15/11) to the DOE grant cited below. This extension provides $525,000 for research on feature-based data fusion algorithms for massive 3D photography datasets. DE-FG52-06NA27503-A006. RF-47814-00-04.
- **Securics Inc.**
  Principal Invesigator on *STTR Phase IIa: Improving Privacy and Security in Biometrics.* This is a 1-year $104,109 subcontract from Securics (10/1/09-10/1/10) for research on the use of multi-scale 3D feature extraction/matching to improve the robustness of the Biotope secure revocable transform for biometric data applied to face recognition and verification. RF-75989-0001.
- **Department of Energy**
  Principal Investigator on *Feature-Based Data Fusion for 3D Photography*. This is a 3-year grant (9/15/06-9/15/09) that provides a total of $556,694 for research on feature-based data fusion algorithms for massive 3D photography datasets. DE-FG52-06NA27503. RF-47814-00-01.
- **Google Research Award**
  Co-PI with Prof. Ioannis Stamos (Hunter College) on *Automated Texture Mapping and Model Fitting for SketchUp Models*. This is a 1-year grant (9/1/07 - 9/1/08) that provides a total of $50,000 for research on algorithms to automatically texture map photos onto SketchUp models. City College 21st Century Foundation.
- **CUNY Collaborative Research Grant**
  Co-PI with Prof. Ioannis Stamos (Hunter College). This is a one-year grant (9/1/2006 - 9/1/2007) that provides $40,000 for research on a visualization toolkit for 3D photography. RF-80209-01-13.
- **NSF Computing Research Infrastructure** Co-PI on "PRISM: Center for Perceptual Robotics, Intelligent Sensors, and Machines," with J. Xiao (EE), Z. Zhu (CS), and M. Lee (EE). This is a 3-year grant (3/15/2006 - 3/15/2009) that provides $310,000 from the NSF for funding the PRISM center at CCNY.
- **AFRL RASER Program**
  Co-PI on *Dynamic Pushbroom Stereo Mosaics for 3D and Moving Target Extraction* with Prof. Zhigang Zhu. This is a 4.5-year grant (3/7/2005 - 9/7/2009) that provides a total of $225,336 for research on a new geometric approach for recovering 3D objects and target extraction in dense urban scenes. FA8650-05-1-1853.
- **ONR HBCU/MI Research and Education Program Grant**
  Principal Investigator on *Log-Polar Transforms for Optical Image Processing and Target Recognition*. This is a 3.5-year grant (3/1/2003 -10/1/2006) that provides a total of $600,000 for research on log-polar transforms for target recognition and DSA technology. N000140310511. RF-47487-00-01.
- **CUNY Research Equipment Grant**
  Co-PI on *Integration of Laser Vibrometry, Infrared and Video for Multimodal Human Detection* with Prof. Zhigang Zhu. The grant provides $50,000 during 2/19/2004 - 2/18/2005 for the purchase of a laser doppler vibrometer and infrared camera.

- **CUNY Collaborative Research Grant**
  Co-PI with Prof. George Chaikin (Lehman College). This is a 2-year grant (11/1/2001 - 11/1/2003) that provides $15,840/year for research on log-polar transforms for image registration. RF-92919-00-08.
- **NASA Faculty Award for Research**
  Principal Investigator on *Robust Algorithms for Image Registration*. This is a 3-year award (1998-2001) that provides a total of $300,000/year for the development of robust image registration algorithms. NAG5-7129, RF-449588.
- **NASA PAIR Award**
  Associate Faculty Investigator on *Integration of Research and Education in Remote Sensing and Environmental/Climate Studies*. This is a 5-year award (1998-2003) that provides $500,000/year for revamping the curriculum of various courses with an enhanced research component. The courses targeted by this grant include image processing, remote sensing, and environmental/climate studies. NCC5-344, RF-449598.
- **NASA MU-SPIN Grant**
  Co-PI with Prof. Michael Vulis. This is a one-year grant (9/1997-9/1998) that provides $50,000 towards the development and implementation of a new model for the dissemination of online technical documentation and the evaluation of its impact on courseware. The grant is administered through the Minority University Research and Education Division (MURED). RF-449557.
- **NSF Presidential Young Investigator Award**
  Principal Investigator on *Algorithms for Image Manipulation*. This is a 5-year award (9/1/1991 - 9/1/1996) that provides $25,000/year plus matching of industrial support up to $37,500/year, for a total of up to $100,000/year. Industrial support from Xerox, SUN, Stardent, MicroPress, Korea Advanced Institute of Science and Technology, and Pacific Coast Software. IRI-9157260, RF-440665.
- **NSF Minority Institution Infrastructure Grant**
  Co-PI on *Center for Minorities in Information Processing Systems*. This is a 5-year grant (9/1/1991 - 9/1/1996) that provides $1,336,546 for the purpose of increasing the representation of minorities in academic research. RF-440674.
- **Xerox Foundation**
  Principal Investigator on *Algorithms for Image Restoration*. This is a 5-year grant (9/1/1992 - 9/1/1997) that provides $50,000 for the development of algorithms for restoring images scanned in the presence of vibrations. Several publications and a U.S. patent have been generated from this work. RF-776462.
- **CUNY Collaborative Research Grant**
  Co-PI with Profs. Theodore Raphan (Brooklyn College) and Ari Gross (Queens College). This is a 2-year grant (9/1/1994 - 9/1/1996) that provides $24,000 for research on pattern identification and visualization in the presence of noise. RF-992162.
- **PSC-CUNY Grants**
  Principal Investigator on various grants, including *Digital Image Warping*, *Digital Image Registration*, *Omnidirectional Imaging*, *3D Photography*, and *Mosaic Rendering*. Provided $12000 for 2012-2013 (RF-65773-00-43), $2860 for 2010-2011 (RF-62170-00-41), $4300 for 2009-2010 (RF-62170-00-40), $2805 for 2005-2006 (RF-67191-00-36), $3495 for 2004-2005 (RF-66454-00-35), $3297 for 2003-2004 (RF-65411-00-34), $3352 for 2002-2003 (RF-64417-00-33), $3314 for 2001-2002 (RF-63394-00-32), $3374 for 1999-2000 (RF-61408-00-30), $3632 for 1998-1999 (RF-69374-00-29), $3909 for 1997-1998 (RF-668373), $3432 for 1996-1997 (RF-667351), $3519 for 1995-1996 (RF-666338), $3899 for 1994-1995 (RF-665313), $2519 for 1993-1994 (RF-664314), $2286 for 1992-1993 (RF-663297), and $1000 for 1991-1992 (RF-662489).
- **New York State Center for Advanced Technologies Program**
  Co-PI on *Applications of Image Reconstruction and Image Warping on Entertainment and Medical Diagnosis*. Provided $20,342 for 1990.

Patents

1. "Page Turner with Moving Page Retaining Arms and Method of Operation," A. Sadegh and G. Wolberg U.S. Patent No. 7,939,739. Issue Date: May 10, 2011.
2. "System and Related Methods for Automatically Aligning 2D Images of a Scene to a 3D Model of the Scene," G. Wolberg, L. Liu, I. Stamos, G. Yu, and S. Zokai, U.S. Prov. Patent Appl. No. 12/157,595, December 18, 2008.
3. "Domain of Definition in Warper/Morpher," D. Candela, M. Middler, R. Brinkmann, and G. Wolberg, U.S. Patent No. 7,418,156. Issue Date: August 26, 2008.
4. "Automatic Page Turner with Turnstile Element," G. Wolberg and A. Sadegh, U.S. Patent No. 7,019,203. Issue Date: March 28, 2006.
5. "Automatic Page Turner with Belt Drive Element," A. Sadegh and G. Wolberg, U.S. Patent No. 6,935,058. Issue Date: August 30, 2005.
6. "Method for Processing Data and Method for Generating Digital Output Data," G. Wolberg and R. Loce, Japanese Patent No. JP8237476A2. Issue Date: September 13, 1996.
7. "Method for Restoring Images Scanned in the Presence of Vibrations," G. Wolberg and R. Loce, U.S. Patent No. 5,537,226. Issue Date: July 16, 1996.
8. "Separable Image Warping Methods and Systems Using Spatial Lookup Tables", G. Wolberg and T.E. Boult, U.S. Patent No. 5,204,944. Issue Date: April 20, 1993.

Monograph

- *Digital Image Warping*, G. Wolberg, IEEE Computer Society Press, Los Alamitos, CA, 1990. Also appears in its entirety in *Essential Books in Graphics Programming*, a Dr. Dobb's Journal CD-ROM, 1995.

Book Chapters

1. "Dynamic Pushbroom Stereo Vision for Surveillance and Inspection," Z. Zhu, G. Wolberg, J.R. Layne, Chapter 8 in *3D Imaging for Safety and Security*," Edited by A. Koschan, M. Pollefeys, and M. Abidi, Kluwer/Springer, August 2007, pp. 173-200.
2. "LDV Sensing and Processing for Remote Hearing in a Multimodal Surveillance System," Z. Zhu, W. Li, E. Molina, G. Wolberg, Chapter 4 in *Multimodal Surveillance: Sensors, Algorithms, and Systems*," Edited by Z. Zhu and T.S. Huang, Artech House Publisher, July 2007, pp. 59-90
3. "Sampling, Reconstruction, and Antialiasing," *CRC Handbook of Computer Science*, 2nd Edition, Ed. by A.B. Tucker, Chapman & Hall / CRC Press, 2004.
4. "Image Manipulation," *Encyclopedia of Electrical and Electronics Engineering*, Ed. by J.G. Webster, Wiley, 1999.
5. "Sampling, Reconstruction, and Antialiasing," *CRC Handbook of Computer Science and Engineering*, Ed. by A.B. Tucker, CRC Press, 1997.
6. "Fast Convolution With Packed Lookup Tables," G. Wolberg and H. Massalin, *Graphics Gems IV*, Ed. by P. Heckbert, Academic Press, 1994.
7. "A Fast Algorithm for Digital Image Scaling," G. Wolberg and H. Massalin, *Communicating With Virtual Worlds*, Ed. by N.M. Thalmann and D. Thalmann, Springer-Verlag, 1993.
8. "Image Warping Among Arbitrary Planar Shapes," *New Trends in Computer Graphics*, Ed. by N.M. Thalmann and D. Thalmann, Springer-Verlag, 1988, pp. 209-218.

Journal Publications

Available at
`http://www-cs.ccny.cuny.edu/~wolberg/publications.html`

1. "Lightweight 3D Modeling of Urban Buildings from Point Clouds," W. Li, G. Wolberg, and S. Zokai, *IEEE Trans. of Visualization and Computer Graphics*, submitted for publication, 2013.

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