

CURRICULUM VITAE

GREGORY J. WARD

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EDUCATION

- 1985 Master of Science in Computer Science from San Francisco State University, SF, CA.
- 1983 Bachelor of Arts in Physics from University of California at Berkeley, CA.

EMPLOYMENT

- October 2002-present **Consultant.** Anywhere Software, Berkeley, CA.
Software development and support for high dynamic-range HDR imaging, human perception, lighting simulation, display hardware, and graphics software. Patented new technology for high dynamic range display in collaboration with the Structured Physics Lab at the Univ. of British Columbia, which subsequently spun off Brightside Technologies, purchased by Dolby Laboratories in 2007. Implemented new HDR merge and ghost removal function under contract with Adobe. Developed custom rendering environment for DecorMagic, Inc. Invented new techniques to improve mobile displays for color deficient and elderly individuals for IRYSTec. Developed custom relighting and rendering methods for Depix. Short-term contracts with Microsoft, Optical Research Associates, Visarc, and NASA. Continuing development, enhancement and support of *Radiance* rendering package under contract with the Berkeley National Laboratory. Created advanced Photosphere browser application for standard and high dynamic-range images.
- April 2011-October 2023 **Sr. Member Technical Staff-Research.** Dolby Laboratories, Inc.
Create and develop new capture, representation, and transmission methods for high dynamic range (HDR) imaging and virtual reality (VR).
- July 2001-September 2002 **Managing Scientist.** Human Factors Practice, Exponent - Failure Analysis Assoc., Menlo Park, CA.
Expert in lighting simulation, color, and visibility. Measured, analyzed and simulated visibility in roadway accidents for the purpose of courtroom reconstruction and testimony. Analyzed color and appearance for product development. Developed software and algorithms for high dynamic-range photography, display, and analysis. Conducted research and authored various reports on risks related to head-mounted displays, laser range-finders, and manufacturing.
- June 1999-April 2001 **Member of Technical Staff.** Lab Research and Development, Shutterfly.com, Redwood City, CA.
Image processing algorithm development for digital photography. Designed and developed C++ library for digital lab image processing. Developed comprehensive model for digital photoprinter calibration and incorporated into proprietary color management system. Designed and implemented automatic white-balancing, gamut-constrained brightening, contrast enhancement, and artifact-free JPEG decompression algorithms.
- May 1997-June 1999 **Member of Technical Staff.** Applied Graphics Research, Engineering Division, Silicon Graphics, Inc., Mountain View, CA.
Developed new techniques and algorithms for physically-based rendering and interactive techniques for virtual reality applications. Created new TIFF standard for high dynamic-range image representation and tone-mapping algorithm to mimic human visual response. Developed holographic rendering technique using physically accurate ray tracing.

- January 1989-
April 1997 **Staff Scientist II.** Lighting Systems Research, Energy and Environment Division, Lawrence Berkeley National Laboratory, Berkeley, CA.
Head of Computer Imaging Project. Manage investigation of new illumination and reflection models and validation of simulation techniques. Invent and develop measurement devices and techniques as required. Supervise and coordinate the development of simulation software, databases and software links necessary to transfer lighting simulation technology to design practitioners. Publish research in archival journals.
- March-
November
1991 **Professor.** Solar Energy Research Group, Physics Department, Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland.
Simulation researcher in Swiss LUMEN project. Created and implemented efficient algorithms for simulating advanced daylighting systems. Developed programs for evaluating daylighted spaces for visual comfort and energy savings. Integrated work with architectural modeling and database software. Documented and published research.
- October 1983-
December
1989 **Research Associate.** Lighting Systems Research, Applied Science Division, Lawrence Berkeley Laboratory, Berkeley, CA.
Chief researcher in Image Generation with Ray Tracing Project. Computer graphics specialist. Created advanced lighting simulation for complicated environments with diffuse and specular surfaces. Experimented in Photocell Placement and Controls Project. Designed control hardware and software used in experiments. Developed package for data reduction and visualization. Supervised summer students. Published research.

HONORS AND AWARDS

- 2023 Society for Information Display Otto Schade Prize
- 2018 SIGGRAPH Academy
- 2018 Daylight Award for Daylight Research
- 2012 International Building Performance Simulation Association (IBPSA-USA) Achievement Award
- 2010 Society for Information Display (SID) Special Recognition Award
- 2007 ACM SIGGRAPH Computer Graphics Achievement Award
- 1991 LBL Technology Transfer Award for the development and distribution of *Radiance*.
- 1990 Award of Merit from the Federal Laboratory Consortium for Technology Transfer for *Radiance*.
- “Winter Solstice” and “Tridimensional Chess” chosen for national juried exhibit, *Art of the Computer*, held during April 1988 at the Euphrat Gallery in Cupertino, CA.

Awarded over 120 U.S. and international patents (first author).

CITIZENSHIP

Born U.S. Citizen.

PUBLICATIONS

Refereed Journals

Ward, Gregory J., Bruno Bueno, David Geisler-Moroder, Lars O. Grobe, Jacob C. Jonsson, Eleanor S. Lee, Taoning Wang, Helen Rose Wilson, "Daylight Simulation Workflows Incorporating Measured Bidirectional Scattering Distribution Functions," *Energy & Buildings*, Vol. 259, No. 111890, 2022.

Wang, Taoning, Gregory Ward, Eleanor Lee, "Efficient modeling of optically-complex, non-coplanar exterior shading: Validation of matrix algebraic methods," *Energy & Buildings*, vol. 174, pp. 464-83, Sept. 2018.

Lee, Eleanor S., David Geisler-Moroder, Gregory Ward, "Modeling the direct sun component in buildings using matrix algebraic approaches: Methods and validation," *Solar Energy*, vol. 160, 15 January 2018, pp 380-395.

Narain, Rahul, Rachel A. Albert, Abdullah Bulbul, Gregory J. Ward, Marty Banks, James F. O'Brien, "Optimal Presentation of Imagery with Focus Cues on Multi-Plane Displays," *SIGGRAPH 2015*.

Banks, Martin, Abdullah Bulbul, Rachel Albert, Rahul Narain, James F. O'Brien, Gregory Ward, "The Perception of Surface Material from Disparity and Focus Cues," *VSS 2014*.

McNeil, A., C.J. Jonsson, D. Appelfeld, G. Ward, E.S. Lee, "A validation of a ray-tracing tool used to generate bidirectional scattering distribution functions for complex fenestration systems," *Solar Energy*, 98, 404-14, November 2013.

Ward, G., R. Mistrick, E.S. Lee, A. McNeil, J. Jonsson, "Simulating the Daylight Performance of Complex Fenestration Systems Using Bidirectional Scattering Distribution Functions within Radiance," *Leukos*, 7(4), April 2011.

Melendez, Francho, M. Glencross, G.J. Ward, R. Hubbard, "Relightable Buildings from Images," *EUROGRAPHICS 2011*.

Glencross, Mashhuda, G. Ward, C. Jay, J. Liu, F. Melendez, R. Hubbard, "A Perceptually Validated Model for Surface Depth Hallucination," *ACM Trans. Graph. (special issue SIGGRAPH 2008)*, August 2008.

Trentacoste, Matthew, W. Heidrich, L. Whitehead, H. Seetzen, G. Ward, "Photometric Image Processing for High Dynamic Range Displays," *Journal of Visual Communication and Image Representation*, Special Issue on High Dynamic Range Imaging, 2007.

Rempel, Allan G., M. Trentacoste, H. Seetzen, D. Young, W. Heidrich, L. Whitehead, G. Ward, "Ldr2Hdr: On-the-fly Reverse Tone Mapping of Legacy Video and Photographs," *ACM Trans. Graph. (special issue SIGGRAPH 2007)*, August 2007.

Seetzen, H., W. Heidrich, W. Stuezliger, G. Ward, L. Whitehead, M. Trentacoste, A. Ghosh, A. Vorozcovs, "High Dynamic Range Display Systems," *ACM Trans. Graph. (special issue SIGGRAPH 2004)*, August 2004.

Cater, K., A. Chalmers, G. Ward, "Detail to Attention: Exploiting Visual Tasks for Selective Rendering," *Eurographics Symposium on Rendering*, June 2003.

Ward, G., "Fast, robust image registration for compositing high dynamic range photographs from hand-held exposures," *Journal of Graphics Tools*, 8(2): 17-30, 2003. (Reprinted in *Graphics Tools, The JGT Editor's Choice*, A K Peters Ltd., 2005.)

Ward, G., Elena Eydelberg-Vileshin, "Picture Perfect RGB Rendering Using Spectral Prefiltering and Sharp Color Primaries," 13th Eurographics Workshop on Rendering, P. Debevec and S. Gibson (Editors), June 2002.

Ward, G. and M. Simmons, "The Holodeck Ray Cache: An Interactive Rendering System for Global Illumination in Nondiffuse Environments," *ACM Transactions on Graphics*, 18(4):361-98, October 1999.

Larson, G.W., "The LogLuv Encoding for Full Gamut, High Dynamic Range Images," *Journal of Graphics Tools*, 3(1), April 1999.

Larson, G.W., H. Rushmeier, C. Piatko, "A Visibility Matching Tone Reproduction Operator for High Dynamic Range Scenes," *IEEE Transactions on Visualization and Computer Graphics*, 3(4), 291-306, December 1997.

Ward, G., "Making Global Illumination User Friendly," *Sixth Eurographics Workshop on Rendering*, proceedings to be published by Springer-Verlag, Dublin, Ireland, June 1995.

Rushmeier, H., G. Ward, C. Piatko, P. Sanders, B. Rust, "Comparing Real and Synthetic Images: Some Ideas about Metrics," *Sixth Eurographics Workshop on Rendering*, proceedings to be published by Springer-Verlag, Dublin, Ireland, June 1995.

Ward, G., "The RADIANCE Lighting Simulation and Rendering System," *Computer Graphics*, July 1994.

Rushmeier, H., G. Ward, "Energy Preserving Non-Linear Filters," *Computer Graphics*, July 1994.

Ward, G., "Applications of RADIANCE to Architecture and Lighting Design," *Proceedings of the 1994 IES National Conference*, August 1994.

Ward, G., "Measuring and Modeling Anisotropic Reflection," *Computer Graphics*, Vol. 26, No. 2, July 1992.

Ward, G., P. Heckbert, "Irradiance Gradients," *Third Annual Eurographics Workshop on Rendering*, to be published by Springer-Verlag, May 1992.

Ward, G., "Adaptive Shadow Testing for Ray Tracing," *Second Annual Eurographics Workshop on Rendering*, to be published by Springer-Verlag, May 1991.

Ward, G., "Visualization," *Lighting Design and Application*, Vol. 20, No. 6, June 1990.

Ward, G., F. Rubinstein, R. Clear, "A Ray Tracing Solution for Diffuse Interreflection," *Computer Graphics*, Vol. 22, No. 4, August 1988.

Ward, G., F. Rubinstein, "A New Technique for Computer Simulation of Illuminated Spaces," *Journal of the Illuminating Engineering Society*, Vol. 17, No. 1, Winter 1988.

Rubinstein, F., G. Ward, R. Verderber, "Improving the Performance of Photo-Electrically Controlled Lighting Systems," *Journal of the Illuminating Engineering Society*, Vol. 18, No. 1, Winter 1989.

Papamichael, K.M., F. Rubinstein, S. Selkowitz, G. Ward Larson, "The Integration of Operable Shading Systems and Electric Lighting Controls," *Technical Proceedings of the 1986 International Daylighting Conference*, American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Atlanta, GA, 1988.

Rubinstein, F., G. Ward Larson, R.R. Verderber, "The Effect of Control Algorithm and Photosensor Response on the Performance of Daylight-Following Lighting Systems," *Technical Proceedings of the 1986 International Daylighting Conference*, American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Atlanta, GA, 1988.

Conference Proceedings

David Geisler-Moroder, Gregory J Ward, Taoning Wang, Eleanor S Lee, "Peak extraction in daylight simulations using BSDF data," *IBPSA Building Simulation*, 2021.

Ward, Greg, Murat Kurt, and Nicolas Bonneel, "Reducing Anisotropic BSDF Measurement to Common Practice," *Workshop on Material Appearance Modeling*, 2014.

Ward, G., M. Glencross, "A Case Study Evaluation: Perceptually Accurate Textured Surface Models," *Proceedings of the Symposium on Applied Graphics in Perception and Visualization (APGV)*, September 2009.

Ward, G., "Defining Dynamic Range," Proceedings of the 2008 Society of Information Display Symposium, May 2008.

Ward, G., "The Hopeful Future of High Dynamic Range Imaging," Proceedings of the 2007 Society of Information Display Symposium, May 2007.

Ward, G. "A General Approach to Backwards-Compatible Delivery of High Dynamic Range Images and Video," Proceedings of the Fourteenth Color Imaging Conference, November 2006.

Seetzen, Helge, H. Li, L. Ye, W. Heidrich, L. Whitehead, G. Ward, "Observations of Luminance, Contrast and Amplitude Resolution of Displays," The Society for Information Display International Symposium, May 2006.

Ward, G., M. Simmons, "JPEG-HDR: A Backwards-Compatible, High Dynamic Range Extension to JPEG," Proceedings of 13th Color Imaging Conference, Scottsdale, Arizona, November 2005.

Ward, G., M. Simmons, "Subband Encoding of High Dynamic Range Imagery," First Symposium on Applied Perception in Graphics and Visualization (APGV), Los Angeles, California, August 2004.

Seetzen, H., L. Whitehead, G. Ward, "High Dynamic Range Display Using Low and High Resolution Modulators," The Society for Information Display International Symposium, May 2003.

Ward, G. "A Wide Field, High Dynamic Range, Stereographic Viewer," Proceedings of PICS 2002, Portland, Oregon, April 2002.

Ward, G. "High Dynamic Range Imaging," Proceedings of the 9th Color Imaging Conference, Scottsdale, Arizona, November 2001.

Ward, G., "Overcoming Gamut and Dynamic Range Limitations in Digital Images," Proceedings of the Sixth Color Imaging Conference, November 1998.

Schuman, J., G. Ward, "The Practical Computer in Design," proceedings of the 1990 ICSRIC conference, Germany, August 1990.

Ward, G., F. Rubinstein, A. Grynberg, "Luminance in Computer-Aided Lighting Design," *Proceedings of Building Simulation '89*, Vancouver, June 1989.

Rubinstein, F., G. Ward, "The Control of Daylight-Linked Lighting Systems," *Conference Record of 1984 IEEE/IAS Annual Meeting*, October 1984. Submitted for publication in *IEEE Transactions on Industry Applications*.

Technical Reports

Grynberg, A., G. Ward, *A New Tool for Reflectometry*, July 1990.

Rubinstein, F., R. Verderber, G. Ward, *Photo-Electric Control of Daylight-Following Lighting Systems*, July 1987. Prepared for Electric Power Research Institute.

Rubinstein, F., R. Verderber, G. Ward, *Photocell Placement and Control*, March 1986. L-21302. Prepared for Electric Power Research Institute.

Other Publications and Reports

Reinhard, E., G. Ward, S. Pattanaik, P. Debevec, W. Heidrich, K. Myszkowski, *High Dynamic Range Imaging: Acquisition, Display, and Image-Based Lighting*, Second Edition, Morgan Kaufmann Publishers, San Francisco, 2010.

Reinhard, E., G. Ward, S. Pattanaik, P. Debevec, *High Dynamic Range Imaging: Acquisition, Display, and Image-Based Lighting*, Morgan Kaufmann Publishers, San Francisco, 2005.

Larson, G.W. and R. Shakespeare, *Rendering with Radiance: The Art and Science of Lighting Visualization*, Morgan

Kaufmann Publishers, San Francisco, CA, 1998.

Ward, G., "A Contrast-Based Scalefactor for Luminance Display," *Graphics Gems IV*, Edited by Paul Heckbert, Academic Press 1994.

Ward, G., "Towards More Practical Reflectance Measurements and Models," *Proceedings of Graphics Interface '92 Workshop on Local Illumination*, Vancouver, B.C., May 1992.

Ward, G., "Real Pixels," *Graphics Gems II*, Edited by James Arvo, Academic Press 1991, pp. 80-83.

Ward, G., "A Recursive Implementation of the Perlin Noise Function," *Graphics Gems II*, Edited by James Arvo, Academic Press 1991, pp. 396-401.

Ward, G., A. Grynberg, C. Ehrlich, F. Rubinstein, "Using CAD for Lighting Design Helps Predict the Unpredictable," *Electrical Systems Design*, April 1990.

Reviews by Others

Ashdown, I., "Lighting for Architects," *Computer Graphics World*, August 1996, pp. 38-46.

Novitski, B.J., "Energy Conservation Software," *Architecture*, May 1991, pp. 127-131.

Novitski, B.J., "Let the Sun Shine In," *Macintosh-Aided Design*, February 1991, pp. 35-40.

Lord, D., "Computer Aided Lighting," *Progressive Architecture*, November 1990, pp. 126-130.