

Duncan Moore – CV 2019
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DUNCAN T. MOORE

Curriculum Vitae

**The Institute of Optics
University of Rochester
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Professional Experience

Rudolf and Hilda Kingslake Professor of Optical Engineering, University of Rochester, 1993-present

Vice Provost for Entrepreneurship, University of Rochester, 2007-present

Director for Entrepreneurship Activities, University of Rochester, 2006-2007

Professor of Business Administration, University of Rochester (William E. Simon Graduate School of Business Administration), 2005-present

Distinguished Guest Professor (Global), Graduate School of System Design and Management, Keio University, Tokyo Japan, 2013-2018

President, International Commission on Optics, 2012 - 2015

Area Coordinator for Entrepreneurship, 2008-present

Senior Fellow, Greater Rochester Enterprise, 2005-2007

Consulting Professor, Center for Longevity, Stanford University, 2005-2009

President and Chief Executive Officer, Infotonics Technology Center Inc., Canandaigua, NY, 2002-2004

Professor of Biomedical Engineering, University of Rochester, 2001-present

Special Assistant to the President of the University of Rochester and Executive Director of the University, Industry, and Government Partnership for Advanced Photonics, 2001-2002

Senior Science Advisor, Optical Society of America, Washington, DC, 2001-2003

Special Advisor to the Director, White House Office of Science and Technology Policy, Executive Office of the President, December, 2000 – May, 2001

Associate Director for Technology, White House Office of Science and Technology Policy, Executive Office of the President, December 1997 –December 2000

Dean, School of Engineering and Applied Sciences, University of Rochester, 1995-1997

American Physical Society Congressional Science Fellow:
Science, Technology and Space Fellow in the office of Senator John D. Rockefeller IV, West Virginia, 1993-1994

Professor, The Institute of Optics, University of Rochester, 1986-present

Associate Professor, The Institute of Optics, University of Rochester, 1978-1986

Assistant Professor, The Institute of Optics, University of Rochester, 1974-1978

Director, The Institute of Optics, University of Rochester, 1987-1993

Director, New York State Center for Advanced Optical Technology, University of Rochester, 1987-1994

Editor, Applied Optics, Optical Technology Division; published monthly by the Optical Society of America, 1990-1992

Visiting Scientist, Nippon Schlumberger K. K., Tokyo, Japan, 1983. Responsible for establishing Optics Department specializing in optical sensors for oil well logging and in optical data storage.

President and Founder, Gradient Lens Corporation, Rochester, NY, 1980-1997. Performing consulting and design services in gradient-index lenses, conventional lens design, and optical systems analysis.

Research Staff, Western Electric Engineering Research Center, Princeton, NJ, 1969-1971.
Responsible for design and fabrication of specialized lens systems.

Education

Ph. D., Optics, University of Rochester, Rochester, NY, 1971-1974
Thesis: "Gradient-Index Optics: Aspects of Design, Testing and Tolerancing"
Advisor: Dr. Philip W. Baumeister

M. S., Optics, University of Rochester, Rochester, NY, 1969-1970
Thesis: "Aberration Correction using Index Gradients"
Advisor: Dr. Peter J. Sands

B. A., Physics, University of Maine, Orono, ME, 1965-1969

Honors

- 1992 Science and Technology Award, Greater Rochester Metro Chamber of Commerce, 27th Annual Civic Awards Ceremony
- 1993 21st Annual Distinguished Inventor of the Year Award, Rochester Intellectual Property Law Association
- 1993 Japanese Applied Physics Society MOC/GRIN '93 Gradient-Index Award
- 1995 Honorary Doctor of Science, University of Maine
- 1996 Honorary Membership, Golden Key National Honor Society
- 1998 Election to the National Academy of Engineering
- 1999 Engineer of the Year, Rochester Engineering Society
- 1999 National Engineering Award, American Association of Engineering Societies
- 2001 Optical Society of America Leadership Award (to strengthen the link between the optics community and the public)
- 2002 Edward Orton, Jr. Memorial Lecturer, The American Ceramic Society
- 2002 ASM/TMS Distinguished Lecturer, ASM International
- 2003 50 Over Fifty Honoree, Rochester Business Journal
- 2005 Honorary Member, Optical Society of America, Rochester Chapter

- 2006 Gold Medal, The International Society for Optical Engineering (SPIE)
- 2009 Edwin H. Land Medal, The Society for Imaging Science and Technology and the Optical Society of America (OSA)
- 2012 University of Rochester – Hajim School’s 2012 Lifetime Achievement Award
- 2015 Rochester Regional Photonics Cluster – Leadership Award
- 2016 Rochester Museum & Science Center – Catalyst Award – Recognized for developing and encouraging an environment that promotes innovation in science and technology to form a lasting impact on the Greater Rochester Region
- 2016 Doctoral Commencement William Riker Award for Lifetime Achievement in Graduate Education at the University of Rochester
- 2017 Albert Nelson Marquis Lifetime Achievement Award
- 2017 Edward T. Bryand Distinguished Engineer Award, The University of Maine
- 2018 IEEE-USA Entrepreneur Achievement Award for Leadership in Entrepreneurial Spirit

American Men and Women of Science

Who's Who In Technology

Who's Who in America

Who’s Who in the World

Who’s Who in the 21st Century

Who’s Who in the East

Who’s Who in American Education

Who’s Who in Science & Technology

Who’s Who in Medicine & Healthcare

Marquis Who’s Who

Who’s Who in Business Education

Professional Society Fellows

Society of Photo-Optical Instrumentation Engineers

Fellow, 1981

Optical Society of America

Fellow, 1983

National Academy of Engineering, 1998

American Association for the Advancement of Science

Fellow, 2005

IEEE

Fellow, 2008

American Institute for Medical and Biological Engineering

Fellow, 2011

Publications

- "Design of Singlets with Continuously Varying Indices of Refraction", J. Opt. Soc. Am., 61, (7) 886-94 (1971)
- "Third-Order Aberrations of Inhomogeneous Lenses with Cylindrical Index Distributions" (with P.J.Sands), J.Opt.Soc.Am., 61,(9), 1195-1201(1971)
- "Lens Designs for Inhomogeneous Glass," Western Electric Technical Notes,5,(1)(1971)
- "Raytracing in Gradient-Index Media", J. Opt. Soc. Am., 65, (4) 451-55 (1975)
- "Raytracing in Tilted, Decentered, Displaced Gradient-Index Optical Systems", J. Opt. Soc. Am., 66,(8)789-95(1976)
- "Design of High Speed Optical Production Line," (with J.J.Bohache and G.H.Chen) Opt. Eng.,15,(5)416-23(1976)
- "Laser Fusion Microballoon Wall-Thickness Measurements: A Comparative Study" (with G.M.Halpern et al.), J.Appl.Phys.,48,(3)1223 -28(1977)
- "Design and Construction of a Phase-Locked Interference Microscope" (with G.W.Johnson), Proc.Syst.Integration & Opt.Design II - Another Look,SPIE, 103,76-85(1977)
- "Catadioptric System with a Gradient-Index Corrector Plate", J.Opt.Soc.Am.,67,(9)1143-46(1977).
- "Design of a Single Element Gradient-Index Collimator", J. Opt. Soc. Am.,67, (9) 1134-37(1977).
- "Gradient-Index Optical Lenses" (with D.P.Ryan), The Physics Teacher, 15, (7) 409-13(1977).
- "Phase-Locked Interferometry" (with G.W.Johnson and D.C.Leiner), Clever Opt.- Innovat. Appli. of Opt.,SPIE,126,152-60(1977).
- "Phase-Lock Interference Microscopy" (with D.C.Leiner), Proc. EOSD Symp., 726-31(1977).
- "Measurement of the Optical Properties of Gradient-Index Materials" (with D.P.Ryan), J.Opt.Soc.Am., 68,(9)1157-66(1978).
- "Real-Time Phase Microscopy using a Phase-Lock Interferometer" (with D.C.Leiner), Rev.Sci.Inst.,49,(12)1702-05(1978).
- "Large Aperture A.C.Interferometer for Optical Testing" (with R.Murray and F.B.Neves), Appl. Opt.,17,(24)3959-63(1978)

- "Aspherical Surface Polishing with a Ring Polisher" (with G.H.Chen), *Appl. Opt.*, 18,(4) 559-62(1979).
- "Phase-Locked Interferometry" (with G.W.Johnson and D.C.Leiner), *Opt. Eng.*,18,(1) 46-52(1979).
- "Interferometric Measurement of the Optical Phase Distribution for Fresnel Diffraction by a Straightedge" (with R.W.Boyd), *Appl. Opt.*, 18,(12) 2013-16(1979).
- "Phase-Locked Moire' Fringe Analysis for Automated Contouring of Diffuse Surfaces" (with B. E.Truax), *Appl.Opt.*,18,(1)91-96(1979).
- "Review of Gradient-Index Optics" (with S.D.Fantone), *Phys.Prop.of Op. Mat.*,SPIE,204, 38-43(1979).
- "Gradient-Index Optics: A Review", *Appl. Opt.*,19,(7)1035-38(1980).
- "Chromatic Variation of Index of Refraction Gradients. Part 1" (with L.Gregorka), *Appl. Opt.*,19,(7)1096-1100(1980).
- "Radial Gradient-Index Lenses with Zero Petzval Aberration" (with R.T.Salvage), *Appl. Opt.*, 19,(7)1081-86(1980).
- "Design of a Gradient-Index Binocular Objective" (with P.O.McLaughlin et al.), *Proc. OSA 1980 Intern. Lens Des. Conf.*, SPIE,237,369-79(1980).
- "Gradient-Index Optics: A Review", *Proc. OSA 1980 Intern. Lens Des. Conf.*, SPIE,237, 364-68(1980).
- "Phase-Locked Moire' Fringe Analysis for Scoliosis Detection", in *Moire' Fringe Topography and Spinal Deformity*, ed. M. S. Moreland, Pergamon Press, 48-65 (1981).
- "Design of a Gradient-Index Photographic Objective" (with L. G. Atkinson et al.), *Appl. Opt.*, 21,(6)993-98(1982).
- "Measurement of the Chromatic Variation of Index of Refraction Gradients" (with D.P.Ryan), *Appl. Opt.*,21,(6)1042-51(1982).
- "Imaging Capabilities of a Long Gradient-Index Rod", (with L.G.Atkinson and N. J. Sullo) *Appl. Opt.*, 21,(6)1004-8(1982).
- "Ray Tracing in Anamorphic Gradient-Index Media" (with J.M.Stagaman), *Appl. Opt.*,21, (6)999-1003(1982).
- "Gradient-Index Optical Materials", *Proc. 2nd Intern. Otto-Schott- Kolloquium*, 193-203 (1982).

- "Optical Surfacing Center using Computer Numerical Control Machinery" (with L.G. Atkinson), Proc. 1982 Electr. Mini-Symp., 72-90(1982).
- "Gradient-Index Eyepiece Design" (with J.F. Forer et al.), Appl. Opt., 22,(3)407- 12(1983).
- "Rectangular Luneburg-Type Lenses for Integrated Optics" (with V.E. Wood et al.), Opt. Ltrs.,8, (4)226-28(1983).
- "Gradient-Index Wide Angle Photographic Objective Design" (with L.G. Atkinson et al.), Appl. Opt., 23,(11)1735-41(1984).
- "GRIN IV: gradient-index optical imaging systems", Appl. Opt., 23, 1699, (1984)
- "Laser Diode to Fiber-Coupling using Anamorphic Gradient-Index Lenses" (with J.M. Stagaman), Appl. Opt.,23, (11)1730-34(1984).
- "Measurement of Absolute Gradient-Index Profiles using Modulation Ellipsometry" (with N.J. Sullo), Appl. Opt., 23, (11) 1765-73 (1984).
- "Gradient-Index Components", Proc. Nat. Sci. Found. Grantees Mtng (1984).
- "Gradient-Index in the Year 2004", J. Non-Crys. Solids,73,285-86 (1985).
- "Unusual Optical Forms," Geometrical Optics, SPIE 531, 256-63 (1985).
- "Gradient-Index Profile Control by Field-Assisted Ion Exchange in Glass" (with S.N. Houde-Walter), Appl. Opt., 24, (24) 4288-96 (1985).
- "Measurement of the Differential Thermal Expansion and Temperature Dependence of Refractive Index in Gradient-Index Glass" (with P.O. McLaughlin), Appl. Opt., 24, (24)4334-41 (1985).
- "Models for the Thermal Expansion Coefficient and Temperature Coefficient of the Refractive Index in Gradient-Index Glass" (with P.O. McLaughlin), Appl. Opt.,24, (24)4342-48 (1985).
- "Model for the Chromatic Properties of Gradient-Index Glass" (with D.P. Ryan-Howard), Appl. Opt.,24,(24)4356-66 (1985).
- "Photocopy Reduction Arrays: Design and Analysis" (with J.F. Goldenberg and J.J. Miceli), Appl. Opt.,24,(24)4288-96 (1985).
- "Application of Gradient-Index Lens Design Techniques to Lenses for Integrated Optics", Procs. Internatl. Lens Design Conference, SPIE 554, 319-26 (1985).
- "Preparation of Gradient-Index Glass Rods by the Sol-Gel Process" (with M. Yamane and J.B. Caldwell), Ltr. Ed., J. Non-Cryst. Solids, 85, 244-46 (1986).

- "Image Analysis of Curved Gradient-Index Rods" (with M.J. Nadeau and J.J. Miceli), *Appl. Opt.*, 25,(11)1780-90 (1986).
- "Design of Gradient-Index Lens Systems for Disc Format Cameras" (with J.B. Caldwell), *Appl. Opt.*, 25,(18)3351-55 (1986).
- "Gradient Infrared Optical Material Prepared by a Chemical Vapor Deposition Process" (with M.A.Pickering and R.L.Taylor), *Appl. Opt.*, 25,(19)3364-72 (1986).
- "Gradient-Index Binocular Objective Design" (with J.B. Caldwell, et al.), *Appl. Opt.*, 25,(19)3345-50 (1986).
- "Delta-n Control in GRIN Glass by Additives in AgCl Diffusion Baths" (with S.N. Houde-Walter), *Appl. Opt.*, 25,(19)3373-78 (1986).
- "Current Materials for Gradient-Index Optics," Proc.30th Ann.Intern. Tech.Symp-Opt.& Optoelect.Engin., SPIE 679, 2-6 (1986).
- "CAM Optical Fabrication System" (with L.G. Atkinson), *Proc. SPIE*, 676, 55-58 (1986).
- "Design, Fabrication, and Testing of a Gradient-Index Binocular Objective" (with D.S. Kindred), Proc.SPIE-Int. Soc. Opt. Eng., SPIE 766, 108-110 (1987).
- "Gradient-Index Optics" (with L. Pugliese), *Photonics Spectra*, March, 71-76 (1987).
- "Development of Concentration at Glass/Salt Interface in Diffusing GRIN Glass" (with S.N.Houde-Walter), *J. of Non-Crystalline Solids*, (99) 104-112 (1988).
- "Design, fabrication, and testing of a GRIN binocular objective" (with Douglas S. Kindred), *Appl. Opt.*, 27,(3)492-495 (1988).
- "Measurement of the refractive-index profile in polycrystalline germanium-silicon alloy GRIN crystals" (with Denis P. Naughton, and Joseph J. Miceli, Jr.), *App. Opt.*, 27(3) 505-507 (1988).
- "Real-time index profile measurement during GRIN glass fabrication" (with Susan Houde-Walter), *App. Opt.*, 27,(3)508-515 (1988).
- "Infrared Gradient-Index Design" (with J.R. Zinter), *Photonics Spectra*, July, 117-122 (1988).
- "Radial Gradient-Index Eyepiece Design" (with J.P. Bowen, J.B. Caldwell, L.R. Gardner, N. Haun, M. Houk, D. Kindred, M. Shiba and D. Wang), *Appl. Opt.*, Volume 27, August 1988.
- "Gradient-Index Lenses: Technology Derived from Nature", *Ceramic Bulletin*, Vol. 68, No. 11, 1941-1945 (1989)

- "Gradient-Index Laser Scanning Analysis" (with Leland G. Atkinson, Debra S. Seitz, J. Robert Zinter), SPIE, Vol. 1079, 453-460 (1989)
- "Systematic Approach to the Design of Axial Gradient Lenses" (with David Y.H. Wang), OSA International Lens Design Conference, Monterey, California, June 1990.
- "Gradient-Index Profile Control from Mixed Molten Salt Baths" (with Joan E. Samuels), Appl. Opt., 29(28):4042-4050 (1990).
- "Design and Tolerancing of Aspherical and Gradient-Index Germanium Singlets of Equal Performance" (with Nathalie M. Renaud), Appl. Opt., Vol. 29, October 1990.
- "Axial and Radial Gradient-Index Titania Flint Glasses" (with Douglas S. Kindred and Julie Bentley), Appl. Opt., 29(28):4036-4041 (1990).
- "Index Profile Control Using Li⁺ for Na⁺ Exchange in Alumino-Silicate Glasses" (with Niels Haun and Douglas Kindred), Appl. Opt., Vol. 29, October 1990.
- "Third-Order Aberration Theory for Weak Gradient-Index Lenses" (with David Y. H. Wang), Appl. Opt., Vol. 29, October 1990.
- "Effects of Axial and Radial Gradients on Cooke Triplets" (with C. Gary Blough, John P. Bowen, Niels Haun, Douglas S. Kindred, R. John Koshel, Daniel M. Krill, Christopher Saxer, and David Y.H. Wang), Appl. Opt., Vol. 29, October 1990.
- "Computer-Based Program for Fabricating Precision Optics Integrates Design, Engineering, Manufacturing Processes, and Quality Control" (with Harvey Pollicove), Laser Focus World, Vol. 27, No. 3, March 1991.
- "Center for Optics Manufacturing" (with Harvey Pollicove), Photonics Spectra, March 1992.
- "COM: Working to Move The Optics Industry into the 21st Century" (with Harvey Pollicove), Photonics Spectra, May 1992.
- "Control of the radial gradient-index profile by leaching of a gel" (with Niels Haun), Appl. Opt., 31(25):5225-5229 (1992).
- "Gradient Index Optics: What's the Hold-up in Applications?", Optics & Photonics News, Vol. 3, No. 1, November 1992, Part I.
- "Gradient Index Optics: What's the Hold-up in Applications?", Optics & Photonics News, Vol. 3, No. 12, December 1992, Part II.
- "Reconstruction of Surface Profiles Using Optical Differentiation and Confocal Microscopy", published in Proceedings Soc. Photo-Opt. Instrum. Eng., Vol. 2184.

- "Quantitative Phase Imaging in Confocal Microscopy by Optical Differentiation" (with A. Kulawiec), *Appl. Opt.*, Vol. 33, No. 28, October 1, 1994.
- "Roundtable: Whither Now Our Research Universities?" (with R.L. Byer, P.M. Eisenberger, K. Gottfried, L.H. Greene, D.N. Langenberg, E.J. Moniz, S.C. Solomon), *Physics Today*, March 1995.
- "Rigid Endoscopic Relay Systems: A Comparative Study" (with T.H. Tomkinson, J.L. Bentley, M.K. Crawford, C.J. Harkrider, J.L. Rouke), *Appl. Opt.*, 35:6674-6683 (1996).
- "Design of Three-Element Night-Vision Goggle Objectives" (with J.L. Rouke, M.K. Crawford, D.J. Fischer, C.J. Harkrider, and T.H. Tomkinson), *Appl. Opt.*, 37:622-626 (1998).
- "Time Varying Boundary Condition Diffusion for Gradient-Index Design" (with C. Harkrider), International Optical Design Conference Proceedings, SPIE, 3482 (1998).
- "Birefringence Measurements in Gradient-Index Rod Lenses" (with J.L. Rouke), *Appl. Opt.*, 38:6574-6580 (1999).
- "Birefringence in Gradient-Index Rod Lenses: A Direct Measurement Method and Interferometric Polarization Effects" (with J.L. Rouke), *Appl. Opt.*, 40:4971-4980 (2001).
- "An Intra-Chip Free-Space Optical Interconnect" (with J. Xue, A. Garg, B. Ciftcioglu, Jian Zhang, J. Hu, S. Wang, I. Savidis, M. Jain, R. Berman, Zach Darling, P. Liu, M. Huang, H. Wu, E. Friedman, G. Wicks), 37th International Symposium on Computer Architecture (ISCA 2010).
- "Compact Spectrum Splitting Photovoltaic Module with High Efficiency" (with James D. McCambridge, Myles A. Steiner, Blair L. Unger, Keith A. Emery, Eric L. Christensen, Mark W. Wanlass, Allen L. Gray, Laszlo Tackacs, Roger Buelow, Timothy A. McCollum, James W. Ashmead, Greg R. Schmidt, Alex W. Haas, John R. Wilcox, James Van Meter, Jeffrey L. Gray, Allen M. Barnett and Richard J. Schwartz), accepted by *Progress in Photovoltaics: Research and Applications* (2010) published online in Wiley Interscience (2010)
- "A 3-D Integrated Intrachip Free-Space Optical Interconnect for Many-Core Chips" (with J. Xue, A. Garg, B. Ciftcioglu, Jian Zhang, J. Hu, S. Wang, I. Savidis, M. Jain, R. Berman, Zach Darling, M. Huang, H. Wu, E. Friedman, G. Wicks and H. Wu), *IEEE Photonics Technology Letters*, Vol. 23, No. 3, February 1, 2011
- "Eyepiece Designs with Radial and Spherical Polymer Gradient-Index Optical Elements" (Anthony J. Visconti, James A. Corsetti, Keija Fang, Peter McCarthy, Duncan T. Moore, and Greg R. Schmidt), *Opt. Eng* 52(11), 112102 (August, 2013); doi: 10.1117/1.OE.52.11.112102
- "Athermalization of Polymer Radial Gradient-Index Singlets" (James A. Corsetti, Leo Gardner, Greg Smith, Duncan T. Moore), *Opt. Eng* 52(11), 112104 (July 25, 2013); doi: 10.1117/1.OE.52.11.112104

- “Design and Fabrication of a Polymer Gradient-Index Optical Element for a High-Performance Eyepiece” (Anthony J. Visconti, Keija Fang, James A. Corsetti, Peter McCarthy, Duncan T. Moore, and Greg R Schmidt), *Opt. Eng* 52 (11), 112107 (August 2013); doi: 10.1117/1.OE.52.11.112107
- “Color Correction in the Infrared Using Gradient-Index Materials” (James A. Corsetti, Peter McCarthy and Duncan T. Moore), *Opt Eng.* 52(11), 112109 (July 2013); doi: 10.1117/1.OE.52.11.112109
- “Design and tolerance analysis of an axial gradient-index singlet broadband laser collimator” (Peter McCarthy and Duncan T. Moore), *Opt. Eng* 52(11), 112110 (August 2013; doi: 10.1117/1.OE.52.11.112110
- “All plastic high performance eyepiece design utilizing a spherical gradient-index lens” (Visconti, A., Fang, K., Schmidt, G., and Moore, D.T.), *Proc. SPIE 9293, International Optical Design Conference, 2014*
- “Optical Design Study in the 1-5 μ Spectral Band with Gradient-Index Materials”, (McCarthy, P., Berman, R. Williams, D. J. L., Yee, A., and Moore, D.T.), *Proc. SPIE, International Optical Design Conference (2014)*
- “Modeling Mid-Spatial Frequency Wavefront Error in Gradient-Index ALON Fabricated by Layered Diffusion”, (McCarthy, P, Nag, N., Moore, D. T.) *International Optical Design Conference (Optical Society of America, 2014)*
- “ Absolute Thickness Metrology with High Precision Using Low Coherence Interferometry”, (Zhao, Y., Schmidt, G., Moore, D.T., Ellis, J.D.) *Proceedings of the 29th ASPE Annual Meeting, 9-14 Nov. 2014, Boston*
- “New Tools for Finding First Order Zoom Lens Solutions and the Analysis of Zoom Lenses During the Design Process”, (Yee, Anthony J., Williams, Daniel J.L., Gandara-Montano, Gustavo, McCarthy, Pete, Bentley, Julie, Moore, Duncan),
- “Chromatic Correction for a VIS-SWIR Zoom Lens Using Optical Glasses”, (Zhao, Yang, Williams, Daniel J.L., McCarthy, Peter, Visconti, Anthony J., Bentley, Julie L., Moore, Duncan T.)
- “Optical Design Study of a VIS-SWIR 3X Zoom Lens”, (Berman, Rebecca, Corsetti, James A., Fang, Keija, Fennig, Eryn, McCarthy, Peter, Schmidt, Greg R., Visconti, Anthony J., Williams, Daniel J.L., Yee, Anthony J., Zhao, Yang, Bentley, Julie, Moore, Duncan T., Olson, Craig
- "The First Order Solutions for Two Configurations of Discrete Zoom Lenses" (Anthony J. Yee, Anthony J., Zhao, Yang; Steven, Samuel J., Berman, Rebecca, Fennig, Eryn A., Petropavlovskiy, Dmitry, Bentley, Julie, Moore, Duncan T., Olson, Craig; *Proc. SPIE*

9822, Advanced Optics for Defense Applications: UV through LWIR, 982215 (May 18, 2016).

“ALON GRIN optics for visible-MWIR applications” (Nagendra Nag, Santosh Jha, Suri Sastri, Lee M. Goldman, Surmet Corp. (United States); Peter McCarthy, Greg R. Schmidt, Julie L. Bentley, Duncan T. Moore, The Institute of Optics, Univ. of Rochester (United States) Published in Proceedings Volume 9822: Advanced Optics for Defense Applications: UV through LWIR July 2016

"Free-space infrared Mach-Zehnder interferometer for relative index of refraction measurement of gradient index optics," Anthony J. Yee, Duncan T. Moore, *Opt. Eng.* **56**(11), 111707 (2017), doi: 10.1117/1.OE.56.11.111707

“Optical design study in the 3-12 μm spectral band with gradient-index materials”, (Anthony Yee, Duncan Moore) *Proc. SPIE.* 10590 (2017), International Optical Design Conference; doi: 10.1117/12.2293375

“Dual FOV afocal zoom system with stationary pupils using single moving group” (Yang Zhao, Julie Bentley, Duncan Moore) *Proc. SPIE.* 10590, (2017) International Optical Design Conference 2017; doi: 10.117/12.2295388

“Design of planar light guide concentrators for building integrated photovoltaics” (Eryn Fennig, Greg Schmidt, Duncan Moore). *Proc. SPIE* 10590 (2017), International Optical Design Conference 2017; doi: 10.117/12.2293583

“Optimal Power distribution for minimizing pupil walk in a 7.5X afocal zoom lens (Wanyue Song, Yang Zhao, Rebecca Berman, S. Yvonne Bodell, Eryn Fennig, Yunhui Ni, Jonathan C. Papa, Tianyi Yang, Anthony J. Yee, Duncan T. Moore, Julie L. Bentley; *Proc. SPIE.* 10590 (2017), International Optical Design Conference; doi: 10.117/12.2292268

“Free space infrared Mach-Zehnder interferometer or relative index of refraction measurement of gradient index optics” (Anthony J. Yee, Duncan T. Moore); *Optical Engineering*, 56(11), 111707 (2017). Doi: 10.1117/1.OE.56.11.111707

“Design of a High Temperature (1350°C) Solar Receiver Based on a Liquid Metal Heat Transfer Fluid: Sensitivity Analysis” (F. DeAngelis, HR. Seyf, R. Berman, G. Schmidt, D. Moore and A. Henry, *Solar Energy*, (2018), 164, 200-209

"Design of a Freeform Gradient-Index Prism for Mixed Reality Head Mounted Display," (Anthony J. Yee, Wanyue Song, Nick Takaki, Tianyi Yang, Yang Zhao, Yunhui Ni, S. Yvonne Bodell, Jannick P. Rolland, Julie L. Bentley, Duncan T. Moore); *Proc. SPIE* 10676, Digital Optics for Immersive Displays, 106760S (21 May 2018);

"Design of a spatially multiplexed light field display on curved surfaces for VR HMD applications , " (Tianyi Yang, Nicholas S. Kochan, Samuel J. Steven, Greg Schmidt, Julie L. Bentley, Duncan T. Moore); *Proc. SPIE* 10676, Digital Optics for Immersive Displays, 106760Y (21 May 2018);

"Over-designed and under-performing: design and analysis of a freeform prism via careful use of orthogonal surface descriptions," (Nicholas Takaki, Wanyue Song, Anthony J. Yee, Julie Bentley, Duncan Moore, Jannick P. Rolland); Proc. (21 May 2018);

"Augmented reality display system for smart glasses with streamlined form factor," (Samuel Steven, Yang Zhao, Greg Schmidt, Julie Bentley, Duncan Moore); Proc. SPIE 10676, Digital Optics for Immersive Displays, 106761I (21 May 2018);

"Melt property variation in GeSe₂-As₂Se₃-PbSe glass ceramics for infrared gradient refractive index (GRIN) applications," (Anupama Yadav, Andrew Buff, Myungkoo Kang, Laura Sisken, Charmayne Smith, Jason Lonergan, Cesar Blanco, Michael Antia, Megan Driggers, Andrew Kirk, Clara Rivero-Baleine, Theresa Mayer - Virginia Tech, Andrew Swisher, Alexej Pogrebnyakov, AR Hilton, Greg Whaley - Amorphous Materials Inc., Thomas J. Loretz, Anthony Yee, Greg Schmidt, Duncan T. Moore, Kathleen A. Richardson); International Journal of Applied Glass Science, 2018; <https://doi.org/10.1111/ijag.12618>

Other Publications

Automatic Computer Design Program for Systems Containing Gradient-Index Optical Components, Program 14000 lines of code, 140-page manual, 1978.

Applied Optics (Gradient-Index Issues) Topical Editor, 19(7) and 23(11), April 1980 and June 1984.

"Evaluation of the Optical Engineering Program at Zhejiang University, Hangzhou, PRC," for the International Advisory Panel, Chinese University Development Project, The World Bank, 1984.

"Final Report -- Hubble Independent Optical Review Panel," this publication determine the correction for the Hubble Space Telescope. P-442-0078, Goddard Space Flight Center, Greenbelt, MD 20771, 1993.

"Entrepreneurship Education Comes of Age on Campus: The Challenges and Rewards of Bringing Entrepreneurship to Higher Education" (August 2013). Ewing Marion Kauffman Research Paper. Available at SSRN: <http://ssrn.com//abstract=2307987>.

Books

Proceedings-1985 International Lens Design Conference, Editor (with W. H. Taylor), SPIE 554 1986.

Tutorials in Optics, Editor, (Optical Society of America, Washington, D.C.) Annual Meeting, Rochester, NY, 1987.

Selected Papers on Gradient-Index Optics, Editor, SPIE Milestone Series, Volume MS 67, 1993.

Gradient-Index Optics, Editor, Optical Society of America Handbook of Optics, 1994.

Gradient-Index Materials, Editor, CRC Handbook of Laser Science and Technology,
Supplement 2: Optical Materials, 1994.

World Book Encyclopedia, Contributor in reviewing the article Optics, 2008.

Presentations

- "Design of Singlets with Continuously Varying Indices of Refraction," OSA Ann. Mtng., Miami, FL, Sept. 1970 (J.Opt.Soc.Am.60 1557).
- "Design of Corrector Plates with Gradient-Index Glasses," OSA Ann. Mtng., Denver, CO, March 1973 (J.Opt.Soc.Am.63 496).
- "Practical Aspects of A.C.Moire' Fringe Interferometry," (with J.M. Eastman) OSA Ann. Mtng., Houston, TX, Oct. 1974 (J.Opt. Soc.Am.64 1369).
- "Fabrication and Testing of Gradient-Index Components," OSA Ann. Mtng., Houston, TX, Oct. 1974 (J.Opt.Soc.Am.64 1376).
- "Current Status of Gradient-Index Optics," (Invited Paper) Intern. Lens Des. Mtng., Haverford, PA, June 1975.
- "Chromatic Dispersion in Gradient-Index Materials," (with D.P.Ryan) Am.Ceram.Soc.Mtng. (Glass Div.) Bedford Springs, MD, Oct. 1976.
- "Modeling and Fabrication of Gradient-Index Glass," (with S.D.Fantone and D.P.Ryan) OSA Ann. Mtng., Tucson, AZ, Oct. 1976 (J. Opt. Soc. Am.66 1111).
- "Optical Properties of Gradient-Index Materials," (with S.D.Fantone and D.P.Ryan) OSA Ann.Mtng., Tucson, AZ, Oct.1976 (J. Opt. Soc. Am. 66 1119).
- "Laser Fusion Microballoon Wall Thickness Measurements: A Comparative Study," (with G.Halpern et al.)Am. Phys. Soc. Mtng., San Francisco, CA, Nov. 1976 (J.Appl.Phys.,48 1223).
- "Design and Construction of a Phase-Locked Interference Microscope," (with G.W.Johnson), SPIE Mtng., Reston, VA, April 1977(Proc. Syst. I nteg. & Opt. Des. II - Another Look, SPIE, 103 76).
- "Phase-Locked Interferometry," (Invited Paper with G.W.Johnson) Symp. for Innovation in Measure. Science, Geneva, NY, July 1977.
- "Phase-Locked Interferometry," (Invited Paper with G.W. Johnson and D. C. Leiner) SPIE Ann. Mtng., San Diego, CA, Aug. 1977 (Clever Opt.-Innovat. Appl. of Opt., SPIE 126 152).
- "A.C.Moire' Fringe Analysis," (with B.E.Truax) OSA Ann. Mtng., Toronto, Canada, Oct. 1977 (J.Opt.Soc.Am.67 1365).
- "A Large Aperture A.C.Interferometer for Optical Testing," (with R.Murray and F.B.Neves) OSA Ann. Mtng., Toronto, Canada, Oct. 1977 (J. Opt. Soc.Am.67 1385).

- "Computer Simulation of the Optical Polishing Process," (with J.J.Bohache) OSA Annual Mtng., Toronto, Canada, Oct. 1977 (J.Opt.Soc.Am.67 1378).
- "Dispersion Measurements in Gradient-Index Glass using A Schlieren Method," (with L.Gregorka) OSA Ann. Mtng., Toronto, Canada, Oct. 1977 (J. Opt.Soc.Am.67 1442).
- "Evaluating Gradient-Index Fibers using Transverse Illumination," (with G.W.Johnson) OSA Ann. Mtng., Toronto, Canada, Oct. 1977 (J.Opt. Soc.Am.67 1373).
- "High-Speed Fabrication of Aspheric Surfaces," (with G.H.Chen) OSA Ann. Mtng., Toronto, Canada, Oct. 1977 (J.Opt.Soc.Am.67 1378).
- "Laser Fusion Microballoon Characterization using a Single Pass A.C. Interference Microscope," (with P.O.McLaughlin) OSA Ann. Mtng., Toronto, Canada, Oct. 1977 (J.Opt.Soc.Am.67 1386).
- "Lens Design using Spherical Gradients," (with S.D.Fantone), OSA Ann. Mtng., Toronto, Canada, Oct. 1977 (J.Opt.Soc.Am.67 1428).
- "Recent Developments in Gradient-Index Materials," (Invited Paper with S.D.Fantone) Electro Opt. 1977 Mat. Section, Anaheim, CA, Oct. 1977.
- "Refraction Index and Spectral Modeling of Gradient-Index Materials," (with S.D.Fantone) OSA Annual Meeting, San Francisco, CA, Oct. 1978 (J. Opt. Soc.Am.68 1396).
- "Phase-Lock Interference Microscopy," (with D.C.Leiner), Electro Opt. 1977 Mat. Section, Anaheim, CA, Oct. 1977.
- "Measurement of the Optical Phase Distribution for Fresnel Diffraction by a Straightedge," (with R.W.Boyd) OSA Ann.Mtng., San Francisco, CA, Oct. 1978 (J.Opt.Soc.Am. 68 1406).
- "Automated Surface Contouring using Phase-Locked Moire' Fringe Analysis," (with B.E.Truax) OSA Ann.Mtng.,San Francisco, CA, Oct. 1978 (J. Opt.Soc.Am.68 1415).
- "Comparative Study of Fiber and Wood Lens Imaging Systems," (with P.O. McLaughlin et al.) OSA Top. Mtng. Gradient-Index Opt. Imgng. Sys., Rochester, NY, May 1979.
- "Current Status of Gradient-Index Optical Systems," (Invited Paper) OSA Top. Mtng. Gradient-Index Opt. Imgng. Sys., Rochester, NY, May 1979.
- "Third-Order Aberrations of Zero Petzval Radial Gradient-Index Lenses," (with R.T.Salvage) OSA Top. Mtng. Gradient-Index Opt. Imgng. Sys., Rochester, NY, May 1979.
- "Review of Gradient-Index Systems," (With S.D.Fantone) SPIE Ann. Mtng., San Diego, CA, August 1979(Phys. Prop of Opt. Mat.,SPIE, 204 38).

- "Bulk Properties of Gradient-Index Materials," Basic Opt. Prop. of Mat., Nat. Bur. Standards (NBS574) Gaithersburg, MD, May 1980.
- "Chromatic Properties of Gradient-Index Glass," Amer. Ceram. Soc., Chicago, IL, April 1980.
- "Design of a Gradient-Index Binocular Objective," 1980 Intern. Lens Des. Conf., Mills College, Oakland, CA, May 1980(Proc OSA 1980 Intern.Lens Des. Conf., SPIE, 237 369).
- "Gradient-Index Optics - A Review," (Invited Paper) 1980 Intern. Lens Des. Conf., Mills College, Oakland, CA, May 1980 (Proc OSA 1980 Intern. Lens Des. Conf., SPIE, 237 364).
- "Phase-Locked Moire' Fringe Analysis for Scoliosis Detection," A Moire' Contourography of Scoliosis, Univ. Vermont, Burlington, VT, Sept. 1980 (Moire' Fringe Topog. and Spinal Deform., ed. M.S.Moreland, Pergamon Press, 48).
- "Design of Gradient-Index Optical Systems," (Invited Paper) Top. Mtng. Gradient-Index Opt. Imgng. Systs., Honolulu, HA, May 1981.
- "Design of a Gradient-Index Photographic Objective," (with L.G.Atkinson et al.) Top. Mtng. Gradient-Index Opt. Imgng. Systs., Honolulu, HA, May 1981(Appl.Opt.,21 993).
- "Imaging Capabilities of a Long Gradient-Index Rod," (with L.G.Atkinson and N.J.Sullo)Top. Mtng. Gradient-Index Opt. Imgng Systs., Honolulu, HA, May 1981(Appl.Opt.,21 1004).
- "Ray Tracing in Anamorphic Gradient-Index Media," (with J.M.Stagaman) Top. Mtng. Gradient-Index Opt. Imgng. Systs., Honolulu, HA, May 1981 (Appl. Opt.,21 999).
- "Aberration Correction using Index Gradients," (Invited Paper) Spec. Sem. Micro-Opt. Systs., Tokyo, Japan, May 1981.
- "Pit Growth on Scuffed Bearing Surfaces," (with J.L.Lauer and S. Fung) Mtng. Amer. Phys. Soc., Dallas, TX, March 1982.
- "Comparison of Predicted and Experimental Values of Refractive-Index and Chromatic Properties of Gradient-Index Materials," (with D.P.Ryan) Gradient-Index Opt. Imgng. Systs., Spring Conf. Appl. Opt., Rochester, NY, May 1982.
- "Gradient-Index Eyepiece Design," (with J.D.Forer et al.) Gradient-Index Opt. Imgng. Systs., Spring Conf. Appl. Opt., Rochester, NY, May 1982(Appl. Opt.,22 407).
- "Gradient-Index Optical Materials," (Invited Paper), Otto Schott Kolloquium, Jena, GDR, July 1982(Proc.OttoSchott Kolloquium, Fried.-Schiller-Univ. Jena,GDR,193).
- "Interferometer for the Measurement of Infrared Gradient-Index Materials," (with J.J.Miceli) OSA Ann. Mtng., Tucson, AZ, Oct. 1982.

- "Optical Surfacing Center using Computer Numerical Control Machinery," (with L.G. Atkinson) 14th Annual Tri-Service Conf. on Manf. Tech., Phoenix, AZ, Oct. 1982.
- "Gradient-Index Optical Systems," (Invited Paper) Opt. Soc. Southern Calif. Ann. Mtng., Hawthorne, CA, Dec. 1982.
- "Gradient-Index, Fiber, and Integrated Optics," (Invited Paper) OSA Workshop. Opt. Fab. and Test., Palo Alto, CA, Dec. 1982.
- "Bulk Gradient-Index Materials," (Invited Paper) Appl. Phys. Soc. of Japan, Kansai Chapt., Osaka, Japan, May 1983.
- "Chromatic Properties of Waveguide Lenses," (with C.B. Wooley), JSAP, OSA & ICO, 4th Top. Mtng. Gradient-Index Opt. Imgng. Systs., Kobe, Japan, July 1983.
- "Gradient-Index Field-Assisted Ion Exchange in Glass for Gradient-Index Imaging Optics," (with S.N. Houde-Walter) JSAP, OSA & ICO, 4th Top. Mtng. Gradient-Index Opt. Imgng. Systs., Kobe, Japan, July 1983.
- "Gradient-Index Wide Angle Photographic Objective Design," (with L. G. Atkinson et al.) JSAP, OSA, & ICO, 4th Top. Mtng. Gradient-Index Opt. Imgng. Systs., Kobe, Japan, July 1983 (Appl. Opt., 23 1735).
- "Imaging through Curved Gradient-Index Rods," (with M.J. Nadeau and J.J. Miceli) JSAP, OSA & ICO, 4th Top. Mtng. Gradient-Index Opt. Imgng. Systs., Kobe, Japan, July 1983.
- "Laser Diode to Fiber Coupling using Anamorphic Gradient-Index Lenses," (with J.M. Stagaman) JSAP, OSA & ICO, 4th Top. Mtng. Gradient-Index Opt. Imgng. Systs., Kobe, Japan, July 1983 (Appl. Opt., 23 1730).
- "Third Order Aberration Analysis of Gradient-Index Arrays," (with J.D. Forer and J.J. Miceli) JSAP, OSA & ICO, 4th Top. Mtng. Gradient-Index Opt. Imgng. Systs., Kobe, Japan, July 1983.
- "Gradient-Index Optical Design," Minicourse, Xian Institute of Optics and Precision Mechanics, Xian, PRC, Sept. 1983.
- "A Year in the Japanese Optics Industry," (Invited Paper), Rochester Chapt., OSA, March 1984.
- "Gradient-Index - A Historical Perspective," (Invited Paper), 5th Top. Mtng. Gradient-Index Opt. Imgng. Systs., Monterey, CA, April 1984.
- "Optical Surfacing Center using Computer Control Machinery," (Invited Paper with L.G. Atkinson) Workshop on Opt. Fab. and Test., Monterey, CA, April 1984.
- "Radial Gradient Curved Surface for Optical Data Pickup," 5th Top. Meeting Gradient-Index Optical Imaging Systems, Monterey, CA, April 1984.

"A.C. Interferometric Techniques," Minicourse, Zhejiang Univ. Hangzhou, PRC, May 1984.

"Gradient-Index Optical Design," Minicourse, Zhejiang Univ., Hangzhou, PRC, May 1984.

"Optical Education in the United States and Japan," (Invited Paper) Zhejiang Univ., Hangzhou, PRC, May 1984.

"Gradient-Index Optical Systems," (Invited Paper) Quinghua Univ., Beijing, PRC, May 1984; Appl. Phys. Soc. of Japan - Tokyo Chapter, May 1984; Hokkaido Univ., Sapporo, Japan, May 1984.

"Unusual Optical Forms,"(Invited Paper) Los Angeles Tech.Symp.Opt. and Electro-Opt. Eng., SPIE, January 1985 (Geomet. Opt.,SPIE, 531, 256).

"Application of Gradient-Index Lens Design Techniques to Lenses for Integrated Optics," (with C.B.Wooley) Intern. Lens Des. Conf., Cherry Hill, NJ, June 1985 (1985 Intern. Lens Des. Conf., SPIE, 554, 319).

"Athermalization: A Theoretical Study of Radial GRIN Lenses using Glassy Polymers," (with L.R.Gardner) 6th Top. Mtng., Gradient-Index Optical Imaging Systems, AEEI, JSAP & OSA, Palermo, Italy, Sept. 1985 (Grin '85 Tech. Digest,AEEI,J2).

"Delta-n Control in GRIN Glass by Additives in AgCl Diffusion Baths," (with S.N.Houde-Walter) 6th Top. Meeting, Gradient-Index Optical Imaging Systems, AEEI, JSAP & OSA, Palermo, Italy, Sept. 1985 (Grin '85 Tech. Digest, AEEI, B2).

"Design of an Axial Gradient-Index Binocular Objective," (with J.B.Caldwell et al.) 6th Top. Meeting Gradient-Index Optical Imaging Systems, AEEI, JSAP & OSA, Palermo, Italy, Sept. 1985 (Grin '85, Tech.Digest, AEEI, F4).

"Design of Optical Elements for the Ultraviolet using Radial Gradients," (with M. T. Houk) 6th Top. Meeting Gradient Index Optical Imaging Systems AEEI, JSAP & OSA, Palermo, Italy, Sept. 1985 (Grin '85 Tech. Digest, AEEI, J3).

"Fabrication of Infrared Transmitting Gradient-Index Materials using Germanium/Silicon Alloys," (Invited Paper with J. J. Miceli and D. P. Naughton) 6th Top. Mtng.

"Gradient-Index Optical Imaging Systems," AEEI, JSAP & OSA, Palermo, Italy, Sept. 1985 (Grin '85 Tech.Digest, AEEI, J1).

"Luneburg Type Waveguide Lenses in a Three-Layer Waveguide," (with C.B.Wooley) 6th Top. Mtng. Gradient Index Optical Imaging Systems, AEEI, JSAP & OSA, Palermo, Italy, Sept. 1985 (Grin '85 Tech.Digest, AEEI, I3).

- "The Design of Gradient-Index Lens Systems for Disc Format Cameras," (with J.B.Caldwell) 6th Top. Mtng. Gradient-Index Optical Imaging Systems, AEEI, JSAP & OSA, Palermo, Italy, Sept. 1985 (Grin '85 Tech.Digest, AEEI, F2).
- "A Year in Japan - The Worlds of Education in Business," Amer. Inst. Phys., Corp. Assoc. Mtng., Rochester, NY, Oct. 1985.
- "Preparation of Gradient-Index Glass Rods by the Sol-Gel Process," (with M. Yamane and J.B.Caldwell) Mat. Res. Soc. 1986 Spring Mtng., Palo Alto, CA, April 1986.
- "Current Materials for Gradient-Index Optics," (Invited Paper) 30th Ann. Intern. Tech. Symp.-Opt.& Optoelect. Eng., SPIE, August 1986, San Diego, CA (SPIE, Current Developments in Optical Engineering and Diffraction Phenomena, 679, 2-6).
- "Design, Fabrication, and Testing of a Gradient-Index Binocular Objective," (with D.S. Kindred) Optoelect.& Laser Appl. '87, SPIE, January, 1987, Los Angeles, CA
- "Fabrication of Polymer Radial-Index Gradients Utilizing a New Cross-Linking Polymer," (with L.R. Gardner), 7th Top. Mtng. Gradient-Index Optical Imngng. Systems, Reno, Nevada, January 1987 (Grin '87 Tech. Digest, ThD2).
- "Large Diameter Radial Gradient-Index Glass," (with J. B. Caldwell and D.S. Kindred), 7th Top. Mtng. Gradient-Index Optical Imngng. Systems, Reno, Nevada, January 1987 (Grin '87 Tech. Digest, ThD3).
- "Real-Time Index Profile Measurement during GRIN Glass Fabrication,"(with S.N. Houde-Walter), 7th Top. Mtng. Gradient Index Optical Imaging Systems, Reno, Nevada, January 1987 (Grin '87 Tech. Digest, FA2).
- "Ray Tracing in Gradient-Index Materials," (Invited Paper) American Association of Physics Teachers, January 1987, San Francisco, CA.
- "Fabrication and Testing of a Gradient-Index Binocular Objective," (with D.S. Kindred), 7th Top. Mtng. Gradient Index Optical Imaging Systems Reno, Nevada, January 1987 (Grin '87 Tech. Digest, FB1).
- "Three-Dimensional Superimposition Array," (with J.R. Zinter), 7th Top. Mtng. Gradient Index Optical Imaging Systems, Reno, Nevada, January 1987 (Grin '87 Tech. Digest, FB2).
- "Gradient Index Optics," (Invited Paper) Optics ECOOSA 88, March 1988, Birmingham, England.
- "Gradient Index Optics," (Invited Paper) SPIE, April 6, 1988, Orlando, Florida.
- "Gradient Index Optics," (Invited Paper) OSA Southern Connecticut Chapter, May 1988, Norwalk, CT.

"Interaction for Academics in the Industrial World: the U.S. and Japan," (Invited Paper) OSA, August 15, 1988, San Diego, CA.

"Infrared Gradient Index Design and Materials," (Invited Paper) OPTCON '88, November 1988, Santa Clara, CA.

"Practical F/1 Infrared Gradient Index Objective," (with J.R. Zinter) OPTCON '88, November 1988, Santa Clara, CA.

"Effective Research and Development in Electro-Optics," (Invited Paper) University of North Carolina at Charlotte, September 1988, Charlotte, NC.

"Effects of Axial and Radial Gradients on Cooke Triplets," (with C. G. Blough, J. P Bowen, J. B. Caldwell, S. Chuang, L. R. Gardner, N. Haun, M. T. Houk, D.S. Kindred, R. J. Koshel, D. Krill, N. M. Renaud, C. E. Saxer, and D.Y. H. Wang) MOC/GRIN '89 Tokyo Conference.

"Index Profile Control Using Li^+ for Na^+ Exchange in Alumina Silicate Glasses," (with N. Haun, D. Kindred, and L. Surovick) MOC/GRIN '89 Tokyo Conference.

"Third Order Aberrations of Weak Gradient-Index Lenses," (with D.Y.H. Wang) MOC/GRIN '89 Tokyo Conference.

"Radial Gradient TiO_2 Flint Glass Li^+ - Na^+ Exchange and Na^+ - Li^+ Exchange," (with D.S. Kindred) MOC/GRIN '89 Tokyo Conference.

"Use of Microoptical Lenses Fabricated by Chemical Vapor Deposition," (with J.P. Bowen) MOC/GRIN '89 Tokyo Conference.

"Measurement of Chromatic Properties of Gradient Index Glasses: Method and Results," (with C. E. Saxer) MOC/GRIN '89 Tokyo Conference.

"Gradient Index Optics" (Invited paper), ESSILOR - Paris, France, November 1989.

"Technical Optical Entrepreneurship" (Invited Paper), Copenhagen, Denmark, November 1989.

"Gradient Index Optics" (Invited Paper), Rolls Royce - London, England, November 1989.

"Sol-Gel Performance" (Invited Paper), Gorham Advanced Materials Institute, Marco Island, Florida, December 1989.

"Gradient-Index Lenses: Technology Derived from Nature," (Ceramic Bulletin, Vol. 68, No. 11, 1989).

"Gradient-Index Laser Scanning Lens Analysis," (with L.G. Atkinson, D. Seitz, and J.R. Zinter) SPIE, Vol. 1079, Hard Copy Output, 1989.

"Practical Infrared Gradient Index Optics," (with J.R. Zinter, L.G. Atkinson, and K. A. Mitchell) 1989.

"Gradient-Index Optics & Equivalence to Other Areas of Physics," (Invited Paper) Optical Society of Southern California, May 1990.

"Journées Nationales d'Optique Guidée," (Invited Paper), Transinnova, Bihorel, France, October 1990.

"Gradient Index Materials in Manufacturing," (Invited Paper) OSA Ann. Mtg., Boston, MA, November 1990.

"Control of the Radial Gradient-Index Profile Using the Sol-Gel Process," (with Niels Haun) 9th Top. Mtng., Gradient-Index Optical Systems, Monterey, CA, April 1991.

"Design and Fabrication of a Gradient Index Compact Disk Objective," (with Julie L. Bentley and Douglas S. Kindred) 9th Top. Mtng., Gradient-Index Optical Systems, Monterey, CA, April 1991.

"Paraxial Chromatic Aberrations of Weak Axial Gradient Index Lenses," (with David Y.H. Wang) 9th Top. Mtng., Gradient-Index Optical Systems, Monterey, CA, April 1991.

"Hubble Space Telescope - Cure," (Invited Paper) Optical Society of America, Washington, DC, May 1991.

"Gradient-Index Optics," (Invited Talk) Korean Academy of Industrial Technology (KAITECH), Seoul, Korea, May 1991.

"Process Science Development at the Center for Optics Manufacturing," (with Harvey M. Pollicove and Donald Golini), SPIE, San Diego, CA July 1991.

"Technology Development at the Center for Optics Manufacturing," (with Harvey M. Pollicove), SPIE, San Diego, CA, July 1991.

"Optics in Nature: Interesting Students In Optics," (Invited Talk) St. Petersburg, U.S.S.R., October 1991.

"Findings of the Hubble Independent Optical Review Panel," University of Rochester, Laser Laboratory for Energetics (Invited Talk), October 1991.

"Control of the Radial Gradient-Index Profile by Leaching of a Gel," (with Niels Haun) SPIE, San Diego, CA, July 1992.

"Novel Gradient Index Glasses," Gordon Research Conference, "Optical Phenomena in Glass," (Invited Talk) Tilton, New Hampshire, July 1992.

"Technology Development at the Center for Optics Manufacturing," (with Harvey M. Pollicove) SPIE, San Diego, CA, July 1992.

"New Interferometer for Measuring Chromatic Dispersion of Gradient-index Materials," (with Christopher E. Saxer) Tenth Topical Meeting on Gradient-index Optical Systems, Santiago, Spain, October 1992.

"Harmonic Phase Shifting Interferometry," (with Christopher E. Saxer) OSA Optical Fabrication and Testing Workshop, Boston, MA, November 1992.

"Reality in Gradient Index Optics," (Optics & Photonics News, Vol. 3, No. 12, December 1992).

"Introduction to Gradient-Index Optics - Use in Nature and Optical Systems," (Invited Talk) American Chemical Society, 205th ACS National meeting, Denver, CO, March 1993.

"Technical Advances in Process Science Research at the Center for Optics Manufacturing," (with S.D. Jacobs, A. Lindquist, M.J. Cumbo, B. Puchebner, A. Feltz, W. Czajkowski, D. Golini, J. Greivenkamp, and H.M. Pollicove) Submitted to the Seventh International Precision Engineering Seminar to be held in Kobe, Japan, May 1993.

"Phase Imaging in Confocal Microscopy by Optical Differentiation," (with Andrew Kulawiec) OSA Ann. Mtg. Toronto, Canada, October 1993.

"Design of Optical Systems with Negative Gradient-Index Dispersion," MOC/GRIN '93 Eleventh Topical Meeting on Gradient-Index Optical Systems, Tokyo, Japan, October 1993

"Reconstruction of Surface Profiles Using Optical Differentiation and Confocal Microscopy," (with Andrew Kulawiec) SPIE, San Jose, CA, February 1994.

"Zoom Lens Design Using Gradient-Index Lenses," (with Masaharu Deguchi) SPIE, San Jose, CA, February 1994.

"A Year in Washington, DC," LEOMA Executive Seminar, Washington, DC February 1994.

"Li⁺ for Na⁺ and Na⁺ for Li⁺ Ion Exchange in Alumina Borate Glasses," (with Julie L. Bentley, Jennifer L. Rouke, Douglas S. Kindred) OSA Gradient Index Optical Systems Topical Meeting, Rochester, NY, June 1994.

"Twenty-five years of GRIN Optics," Invited talk GRIN '94, June 1994.

Invited talk, "Congress, Science, and Engineering Funding," at Emerging Priorities: The Needs, Scope and Future of the New York State Glass Industry, Corning, NY, September 1994.

"Washington Experiences of a Scientist," Invited Talk, OSA Corporate Associates, October 1994.

"Gradient Index Optical Manufacturing, " Invited Talk, 55th Conference on Glass Problems, Columbus, Ohio, Sponsored by the Departments of Materials Science and Engineering, The Ohio State University and The University of Illinois at Urbana-Champaign, November 1994.

"The Making of Science Policy in a Senate Office," American Physical Society meeting, San Jose, CA, March 1995.

"Science, Technology and the U.S. Congress: Is There Any Connection?", Optical Society of America, Los Alamos, NM, March 1995.

"Science, Technology and the U.S. Congress: Is There Any Connection?", Optical Society of America, Albuquerque, NM, March 1995.

"Gradient Index Optics", Physics Department, New Mexico State University, Los Cruces, NM, March 1995.

"Science, Technology and the U.S. Congress: Is There Any Connection?", Optical Society of America, Los Cruces, NM, March 1995.

"Science, Technology and the U.S. Congress: Is There Any Connection?", Optical Society of America, Huntsville, AL, May 1995.

"Science, Technology and the U.S. Congress: Is There Any Connection?", Optical Society of America, Boulder, CO, May 1995.

"Rigid Endoscopic Relay Systems: A Comparative Study" (with Todd Tomkinson), Optical Society of America annual meeting, Portland, OR, September 1995.

"Tolerances in Axial Gradient-Index Lenses" (with Mary Kate Crawford), Optical Society of America annual meeting, Portland, OR, September 1995.

"Design of Gradient-Index Lens Systems using Manufacturing Parameters" (with Julie Bentley), Optical Society of America annual meeting, Portland, OR, September 1995.

"Modeling Li^+ for Na^+ Ion Exchange in Aluminosilicate Glasses Using a Modified Quasi-Chemical Diffusion Coefficient" (with Julie Bentley), Optical Society of America Annual Meeting, Portland, OR, September 1995.

"Science, Technology and the U.S. Congress: Is There Any Connection?", Rochester Section of the Optical Society of America and the Rochester Chapter of the Society for Imaging Science and Technology, Rochester, NY, October 1995.

"Gradient Index Optics -- Natural and Manmade", Southwestern Ontario Section of the Optical Society of America, Waterloo, Ontario, October 1995.

- “Science, Technology and the U.S. Congress: Is There Any Connection?”, New England Section of the Optical Society of America, Boston, MA, November 1995.
- “Gradient Index Optics”, Workshop on Research and Education in Optical Science and Engineering, sponsored by the NCR Committee on Optical Science and Engineering, Irvine, CA, January 1996.
- “Gradient Index Lens Systems with Negative Dispersion”, First Meeting of the Tokyo Section of the Optical Society of America, Tokyo, Japan, April 1996.
- “Gradient Index and Endoscopy”, Urologic Scientific Symposium: Festschrift for Dr. Abraham T.K. Cockett, University of Rochester School of Medicine & Dentistry, Rochester, NY, May 1996.
- “Trends and Directions in Federal Funding” (panel discussion), University of Connecticut, Storrs, CT, May 1996.
- “Graded Index Optical Materials”, International Symposium on Optical Science, Engineering, and Instrumentation, Annual Meeting of SPIE, The International Society for Optical Engineering, Denver, CO, August 1996.
- “Current State of the Art in Gradient Index Optics”, Carl Zeiss, Oberkochen, Germany, September 1996.
- “Gradient-Index Optics”, St. Petersburg Institute of Fine Mechanics and Optics, Technical University, St. Petersburg, Russia, September 1996.
- “Gradient-Index Profile Modification” (with Curtis Harkrider), Optical Society of America Annual Meeting, Rochester, NY, October 1996.
- “Design of Night Vision Goggle Objectives Using Aspheres, Holographic Optical Elements, and Gradient-Index Materials” (with Jennifer Rouke), Optical Society of America Annual Meeting, Rochester, NY, October 1996.
- “Design and Manufacture of Gradient Index Optical Systems”, Instituto Nacional de Astrofisica Optica y Electronica, 25th Anniversary Celebration, Puebla, Mexico, November 1996.
- “GRIN Optics”, Industrial Technology Research Institute, Chutung Hsinchu, Taiwan, January 1997.
- “What Went Wrong with the Hubble Telescope?”, Rochester Section of The Optical Society of America and the Society of Physics Students, Rochester, NY, February 1997.

- “Gradient Index Optics”, National Capital Section of The Optical Society of America, McLean, VA, April 1997.
- “University-Industry Collaboration: Problems and Opportunities”, Round Table on High-Level Innovation, Ministry of Research and Information Technology, Copenhagen, Denmark, May 1997.
- “Gradient Index Optical Manufacturing”, Southwestern Connecticut Section of The Optical Society of America, Danbury, CT, May 1997.
- “Gradient Index Optical Manufacturing”, Quebec Section of The Optical Society of America, Quebec City, Canada, June 1997.
- “Gradient Index Design-for-Manufacturing Using Time Varying Boundary Condition Diffusion” (with C.J. Harkrider), The Optical Society of America, Annual Meeting, Long Beach, CA, October 1997.
- “Time Varying Boundary Condition Diffusion for GRIN Lens Profile Control” (with C.J. Harkrider), MOC/GRIN ‘97, Tokyo, Japan, October 1997.
- “Progress in GRIN Optics and Related Technology”, plenary talk, MOC-GRIN ‘97, Tokyo, Japan, October 1997.
- “High-Quality - Low-Cost Endoscopes”, Rochester Engineering Society, Rochester, NY, November 1997.
- “Planning Public Policy in Science and Technology: A UR Professor Goes to Washington”, Downtown Community Forum, Rochester, NY, April 1998.
- University of Rochester’s 148th Commencement Address, Rochester, NY, May 1998.
- "Time Varying Boundary Condition Diffusion for Gradient-Index Design" (with C. Harkrider), International Optical Design Conference, Kona, Hawaii, June 1998.
- "Time Varying Boundary Condition Diffusion for Manufacturable Gradient-Index Lens Design" (with C. Harkrider), Optical Society of America Annual Meeting, Baltimore, MD, October 1998.
- "Birefringence Measurements in Gradient-Index Rod Lenses" (with J.L. Rouke), Optical Society of America Annual Meeting, Baltimore, MD, October 1998.
- "Design and Manufacture of a Gradient Index Axicon" (with D.J. Fischer and C.J. Harkrider), Optical Society of America Annual Meeting, Santa Clara, CA, October 1999.
- “How Investment Should be Made in Science and Technology – A Case Study of Nanotechnology”, plenary address, Japan Society for Precision Engineering, Tokyo, Japan, March 2001.

“Establishing Priorities in Science and Technology”, The 2001 Melvin R. Lohmann Lecture, College of Engineering, Architecture and Technology, Oklahoma State University, Stillwater, OK, April 2001.

“Science Policy in the Clinton Administration”, Intellectual Property in the Veterans Administration Conference, Arlington, VA, April 2001.

“Challenges to Innovation in the U.S.”, Photonics in the Forest – The Fitzpatrick Center for Photonics and Communication Systems Convocation, Duke University, April 2001.

“Industrial R&D and Federal Science and Technology Policies”, American Association for the Advancement of Science Colloquium on Science & Technology Policy, Washington, DC, May 2001.

“Perspective from Washington”, Rochester Intellectual Property Law Association, Rochester, NY, May 2001.

“Perspective from Washington”, Association of University Anesthesiologists Annual Meeting, Rochester, NY, May 2001.

“Federal S&T Policy – The Bush and Clinton Years” (panel moderator), Office of Science and Technology Policy 25th Anniversary Symposium, Massachusetts Institute of Technology, Cambridge, MA, May 2001.

“U.S. Science Policy”, Workshop on the Interface of Science and Government – How Scientific Information is used by Government Policymakers, sponsored by the AAAS Science and Technology Policy Fellowship Programs and the Swiss government, June 2001.

“Biomedical Engineering and Federal Policy”, Biomedical Engineering Research Conference of The Whitaker Foundation, LaJolla, CA, August 2001.

"The Current Status of Photonics in the USA", International Photonics Technology Conference 2001, organized by the Optical Society of Korea and the Korea Association for Photonics Industry Development, Kwangju, Korea, September 2001.

"Establishing Federal Priorities in Science and Technology", U.S. Department of Veterans Affairs National Research and Development Meeting, Keystone, CO, October 2001.

"Science and Technology Policy in the U.S.", Mentor Training Seminar, Center for Innovation Policy Research and Education for Central and Eastern Europe, Budapest, Hungary, November 2001.

"Federal Priorities in Science and Technology", Rotary Club, Perry, NY, November 2001.

"Center of Excellence in Photonics and Microsystems, Rochester, NY", The Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology", Oslo, Norway, January 2002.

"S&T Policies: Challenges of Globalization", Confederation of Norwegian Business and Industry (NHO) Annual Conference, Oslo, Norway, January 2002.

"Center of Excellence for Infotonics", High Technology of Rochester Board of Directors, Rochester, NY, February 2002.

"Twenty-First Century Science and Technology Policy and the Relevance of K-12 Education", CTY Conference for Educators, Johns Hopkins University Center for Talented Youth, Ellicott City, MD, March 2002.

"Twenty-First Century Science and Technology Policy", University of Maine, Orono, ME, April 2002.

"Center of Excellence for Infotonics", Department of Electrical Engineering Seminar Series, University at Buffalo, Buffalo, NY, April 2002.

"National Initiatives in Nanoscience and Technology: Challenges to Innovation in the U.S.", Edward Orton, Jr. Memorial Lecture, American Ceramic Society Annual Meeting, St. Louis, MO, April 2002.

"Establishing Federal Priorities in Science and Technology", Optical Fabrication and Testing Topical Meeting, The Optical Society of America, Tucson, AR, June 2002.

"Design Methods for Gradient-Index Progressive Addition Lenses" (with David Fischer), International Optical Design Conference (IODC), Tucson, AR, June 2002.

"Industry/Academia/Government Partnerships: The Center of Excellence for Infotonics", NY-Nanotech 2002, UNY-VAC – Upstate New York Chapter of the American Vacuum Society, Troy, NY, August 2002.

"U.S. Initiatives for Improving the Quality of Life Using Optics", Ninth Congress of the International Commission for Optics: Optics for the Quality of Life, Florence, Italy, August 2002.

"Impact of the National Initiative on Optics and Photonics and its Relevance to Workforce Issues", Stanford Photonics Research Center Annual Meeting, Palo Alto, CA, September 2002.

"Continued Economic Growth and its Barriers", ASM/TMS Distinguished Lecture in Materials and Society, ASM Annual Event, Columbus, OH, October 2002.

"Future Trends in Technology and the Workforce", Future Vision: The Next Generation Optoelectronics Technologies and Markets, Optoelectronics Industry Development Association, Fairport, NY, October 2002.

"An Academic in Washington: The Best of Both Worlds Establishing Federal Priorities in Science and Technology", Manhattan College Sesquicentennial Jubilee, Riverdale, NY, November 2002.

"The Making of Federal Science and Technology Policy", Rochester Chapter of the Optical Society of America, Rochester, NY, November 2002.

"Infotonics", Digital Rochester: Knowledge Upgrade Series V.4, Rochester, NY, December 2002.

"Center of Excellence for Infotonics", Rochester Regional Advisory Board, Rochester, NY, December 2002.

"The Future of Science is Not Along the Disciplinary Axis", American Association for the Advancement of Science Annual Meeting, Denver, CO, February 2003.

"Influencing Congress' Understanding of Science and Technology", American Association for the Advancement of Science Annual Meeting, Denver, CO, February 2003.

"Funding Opportunities", Forum on Optical Sensing for Homeland Security, Optical Society of America, Washington, DC, February 2003.

"Center of Excellence for Infotonics", Finger Lakes Workforce Investment Board, March 2003.

"Center of Excellence for Infotonics", High Technology Optics Division of The Thales Group, Rochester, NY, March 2003.

"National Initiatives in Nanoscience and Technology: Challenges to Innovation in the United States", State University of New York at Stony Brook, Stony Brook, NY, March 2003.

"Thirty Years of Congressional Fellows: Looking Back and Looking Forward", American Physical Society April Meeting, Philadelphia, PA, April 2003.

"Center of Excellence for Infotonics", Industrial Associates Meeting, The Institute of Optics, University of Rochester, Rochester, NY, April 2003.

"Establishing Federal Priorities in Science and Technology", Center for Optoelectronics and Optical Communications, University of North Carolina at Charlotte, Charlotte, NC, April 2003.

"Photonics Research in Rochester", NSF Workshop on Fundamental Research Needs in Photonic Materials Synthesis and Processing at the Interface", University of Rochester, Rochester, NY, April 2003.

"Center of Excellence for Infotonics", Finger Lakes Community College Board of Trustees, Canandaigua, NY, May 2003.

"Infotonics Technology Center: Center of Excellence in Photonics and Microsystems", Finger Lakes Community College Fall Professional Day, Canandaigua, NY, August 2003.

- “Infotonics Technology Center: Center of Excellence in Photonics and Microsystems”, Regional Industrial Development Association Meeting, Canandaigua, NY, October 2003.
- “Education and Technical Workforce” Panel Presenter at ‘Bridging the Gap Between Science and Technology: A Science and Technology Conference Honoring Neal Lane, Rice University, Houston, TX, November 2003.
- “Infotonics Technology Center: Center of Excellence in Photonics and Microsystems”, Strategic Planning Committee, Canandaigua National Bank, Canandaigua, NY, November 2003.
- “A Scientist Goes to Washington: Establishing Federal Priorities In Science and Technology”, Vanderbilt University, Nashville, TN, November 2003.
- “Infotonics Technology Center: Center of Excellence in Photonics and Microsystems”, Society for Imaging and Technology, Rochester, NY, November 2003.
- “How Companies are Succeeding with University Partners” (Panel), Rochester Business Alliance Economic Symposium, Rochester, NY, November 2003.
- “Infotonics Technology Center: Center of Excellence in Photonics and Microsystems”, 2004 Richard C. Shultz Distinguished Scholars Lecture Series, Rochester Museum & Science Center, Rochester, NY, January 2004.
- “Infotonics Technology Center: Center of Excellence in Photonics and Microsystems”, Joint Meeting of Canandaigua Rotary Club and Kiwanis Club, Rochester, NY, January 2004.
- “Trends in Optics”, Optical Society of America's (OSA) Photonics and Telecommunications Executive Forum, Los Angeles, CA, February 2004.
- “Infotonics Technology Center: Center of Excellence in Photonics and Microsystems”, Rochester Rotary Club, Rochester, NY, March 2004.
- “Workforce Issues and K-12 Education: Barriers to Continued Economic Growth”, Western New York Tech-Prep/Career and Technical Education Best Practices conference on The Business of Education, Batavia, NY, March 2004.
- “The Infotonics Technology Center and Opportunities”, Golisano School of Information Technology, Rochester Institute of Technology, Rochester, NY, March 2004.
- “The Infotonics Technology Center and Thompson Health”, F.F. Thompson Hospital, Canandaigua, NY, March 2004.
- “Clusters and Collaboration: The Regional Response” (Panel), EDA/Council on Competitiveness National Economic Development Conference, Washington, DC, June 2004.

- “Harnessing Light for America: Optics and Photonics for Medicine and More” (Workshop), co-sponsored by the Optical Society of America and SPIE—The International Society for Optical Engineering, in conjunction with the Congressional Research and Development Caucus, Washington, DC, October 2004.
- “On the Lighter Side”, 75th Anniversary Symposium of The Institute of Optics, University of Rochester, Rochester, NY, October 2004.
- “Computer Simulated Human Eye Modeling with GRIN Incorporated in the Crystalline Lens” {Abstract}, Huang, J.Y. & Moore, D. (2004) Journal of Vision, 4(11): 58, 58a, <http://journalofvision.org/4/11/58/>, doi: 10.1167/4.11.58.
- “What’s Out There? Careers in Chemistry” (Panel), Northeastern Regional Meeting of the American Chemical Society, Rochester, NY, November 2004.
- “NASA’s Role in R&D in Support of the Nation’s Future Air Transportation Management System and Aviation Safety” (Panel Moderator), Workshop on NASA’s Roles in Aeronautics Technologies, NAS Board on Science, Technology and Economic Policy, Washington, DC, January 2005.
- “Gradient-Index Optics in Nature and the Manmade World”, Optical Sciences Center of the University of Arizona, Tucson, AZ, February 2005.
- “Chemical and Biologic Technologies: US and Japanese Perspectives” (Panel Moderator), Conference on Sensors and Sensor Systems: A US-Japan Dialogue, Program on Development, Security and Cooperation in collaboration with the Science Council of Japan, sponsored by The National Academies, from the Series on Global Dialogues and Emerging Science and Technology, Tsukuba, Japan, February 2005.
- “Trends and Implications of Network Systems”, Conference on Sensors and Sensor Systems: A US-Japan Dialogue, Program on Development, Security and Cooperation in collaboration with the Science Council of Japan, sponsored by The National Academies, from the Series on Global Dialogues and Emerging Science and Technology, Tsukuba, Japan, March 2005.
- “Concluding Remarks”, Conference on Sensors and Sensor Systems: A US-Japan Dialogue, Program on Development, Security and Cooperation in collaboration with the Science Council of Japan, sponsored by The National Academies, from the Series on Global Dialogues and Emerging Science and Technology, Tsukuba, Japan, March 2005.
- “Gradient-Index Optics in Nature and the Manmade World”, Lawrence Livermore National Laboratory, Livermore, CA, May 2005.
- “Technology for an Aging Population”, Center on Longevity, Stanford University, Stanford, CA, May 2005.
- “ElderTech”, presentation before the IEEE-USA Medical Technology Policy Committee, Washington, DC, June 2005.

“Superman V: Warren Smith’s Identity Revealed”, SPIE International Symposium on Optics & Photonics, San Diego, CA, August 2005.

“Special Lens Requirements” (Panel Chair), A Tribute to Warren Smith, SPIE International Symposium on Optics & Photonics, San Diego, CA, August 2005.

Pilot Annual Portfolio Assessment Expert Review (facilitator), National Institute on Disability and Rehabilitation Research, Washington, DC, October 2005.

“Technology for an Aging Population”, U.S. Department of Veterans Affairs Rehabilitation Research and Development Centers of Excellence National Directors’ Meeting, Palo Alto, CA, October 2005.

“Establishing Priorities in Science and Technology in the U.S.”, Photonics Polymer Symposium sponsored by the Japan Science Technology Agency and ERATO Koike Photonics Polymer Project, Keio University, Tokyo, Japan, November 2005.

“Insect Eyes”, DARPA Electronic Eye Workshop, Atlanta, GA, January 2006.

“Gradient-Index Optics in Nature and the Manmade World”, Corning Tropol, Fairport, NY, February 2006.

“50% Efficient Solar Cell Architectures and Designs” (with Allen Barnett, Christiana Honsberg, Douglas Kirkpatrick, Sarah Kurtz, David Salzman, Richard Schwartz, Jeffrey Gray, Stuart Bowden, Keith Goossen, Michael Haney, Dan Aiken, Mark Wanlass, and Keith Emery), IEEE 4th World Conference on Photovoltaic Energy Conversion, Waikoloa, Hawaii, May 2006.

“Human Eye Modeling Using a Single Equation of Gradient Index Crystalline Lens for Relaxed and Accommodated States” (with Yanqiao Huang), International Optical Design Conference, Vancouver, BC, June 2006 (SPIE 6342(1): 63420D-1).

“Tapered Gradient Index Microlenses for Compound Lens Arrays” (with Greg R. Schmidt), International Optical Design Conference, Vancouver, BC, June 2006 (SPIE 6342(2): 63422X-1).

“Cross-University Collaborations: Do They Really Create More Successful Entrepreneurs?” (panel), National Consortium of Entrepreneurship Centers National Conference, Erlanger, KY, October 2006.

“Milestones Toward 50% Efficient Solar Cell Modules,” Presented at the 22nd European Photovoltaic Solar Energy Conference, Milan, Italy, 2007.

“The Future of the Information Superhighway and Changes in Demographics of the World” (Keynote Speech), NEDO Symposium, Tokyo, Japan, February 2007.

- “Gradient Index in Nature and High Efficiency Solar Cells and how science policy is made in the U.S.” APS/AAPT New York State Chapter, West Point, New York, April 2007.
- “Strategies for Obtaining Campus Buy In/Attracting & Developing Entrepreneurship Faculty” (panel). Howard University, Washington, D.C. - ELI Institute Faculty Conference on Entrepreneurship, June 2007.
- “The Future Direction of Research in the United States” EPSCoR/IDeA Conference, Baltimore, MD, June 2007.
- “The Role of the Entrepreneurship ‘Continuum’ in Regional Economic Development.” Workforce Innovations 2007. Kansas City, MO. July 2007.
- “GRIN (Gradient Index) Optics and Beyond.” Aerospace Corporation. El Segundo, CA. August 2007.
- “Emerging Technologies for an Aging Population.” International Longevity Center, Science in Society Conference. New York, NY. September 2007.
- “Strengthening National Defense with Laser Technology.” OSA R & D Caucus. Washington, DC. September 2007.
- “Innovative Strategies for Supporting Entrepreneurship.” APEC Conference, Manila, Philippines. September 2007.
- “Entrepreneurship and the University of Rochester.” Kodak/ITT Retiree Luncheon. Rochester, NY. October 2007.
- “Gradient-Index Materials Manufacturing in Nature and Manmade.” Centre for Ultra-high bandwidth Devices for Optical Systems Seminar, Canberra, Australia. July 2008.
- “Gradient-Index Materials Manufacturing in Nature and Manmade.” Technical Talk, Melbourne, Australia. July 2008.
- “Gradient-Index Materials Manufacturing in Nature and Manmade.” Technical Talk, Sydney, Australia. July 2008.
- “Gradient-Index Materials Manufacturing in Nature and Manmade.” Technical Talk, Shenyang, China. September 2008.
- “The School of Engineering and Applied Sciences 50th Anniversary – The Future of Innovation Symposium” - Keynote address. University of Rochester, Rochester, NY. October 2008.
- “Optics for Solar Cell for Portable Power” – OSA’s Frontiers in Optics 2008. Rochester

Riverside Convention Center, Rochester, NY. October 2008.

“Science Public Policy in the Next Administration” – Keynote address. NYS Science & Technology Law Center @Syracuse College of Law. Skaneateles Falls, NY. November 2008.

“Gradient-Index Materials Manufacturing in Nature and Manmade.” Technical Talk. University of Maine, Orono, ME. April 2009.

“Optics for Solar Cell for Portable Power” – Rochester Chapter of IEEE-LEOS. RIT, Inn & Conference Center, Rochester, NY. April 2009.

“Technology for Successful Aging” – University of Rochester Panel for the 175th Anniversary of Rochester, Rivers Run Senior Living Center, Rochester, NY. May 2009

“Scientists and Engineers as Entrepreneurs” – South Africa Physics and Entrepreneurship Meeting, Cape Town, South Africa. November 2009

“Marketing Your Invention” – South Africa Physics and Entrepreneurship Meeting, Cape Town, South Africa. November 2009

“Cash is King” – Keio University, Yokohama, Japan. May 2010

“Gradient-Index Materials Manufacturing in Nature and Manmade.” Technical Talk. Keio University, Yokohama, Japan. May 2010

“Design, Assembly, and Testing of a Spectral Splitting Solar Concentrator Module” (with Eric Christensen, Greg Schmidt, Blair Unger) OSA June 2010.

“Dimpled Planar Lightguide Solar Concentrators” (with Blair Unger, Greg Schmidt) IODC June 2010

“Measurement and Characterization of Dimpled Planar Light Guide Prototypes” (with Michael Brown, Greg Schmidt, Blair Unger) IODC June 2010

“Stepped Planar Light Guide Solar Concentrator” (with Greg Schmidt, Blair Unger) IODC June 2010

“Masters of Science in Technical Entrepreneurship and Management” ASEE June 2010

“Gradient-Index Optics in Nature and Manmade World” Pontificia Universidad Catolica del Peru September 2010

“GRIN Optics in 2010” Pontificia Universidad Catolica del Peru September 2010

“Introduction to the enterprise creation and acceleration experiences” Entrepreneurship for Scientists and Knowledge Transfer Managers International Seminar, in conjunction with The Institute of Physics (London), Argentina September 2010

“Accessing the market and commercial potential” Entrepreneurship for Scientists and Knowledge Transfer Managers International Seminar, in conjunction with The Institute of Physics (London), Argentina September 2010

“Experiences of CEOs, founders, etc.” Entrepreneurship for Scientists and Knowledge Transfer Managers International Seminar, in conjunction with The Institute of Physics (London), Argentina September 2010

“Design, Assembly, and Testing of a Spectral Splitting Solar Concentrator Module” (with Eric Christensen, Greg Schmidt, Blair Unger) EOSAM, Paris, France October 2010.

“Dimpled Planar Lightguide Solar Concentrators” (with Blair Unger, Greg Schmidt) EOSAM, Paris, France October 2010

“Thin light weight optics for Concentrating Photovoltaic Systems” Energy for the 21st Century 2010, University of Rochester October 2010

“Special Remarks” 19th International Conference on Plastic Optical Fibers, Keio University, Yokohama, Japan October 2010

“Entrepreneurship for Scientists and Engineers” 2010 EOS Topical Meeting on Optics and Energy Paris, France October 2010

“Gradient-Index Optics in nature and man-made” Delaware State University, Dover, Delaware March 2011

“Teaching Entrepreneurship to Scientists and Engineers: Can we teach a person to be an entrepreneur or is it in the DNA” Delaware State University, Dover, Delaware March 2011

“Scientists and Engineers as Entrepreneurs” Royal Scientific Society, Amman, Jordan, March 2011

“Financing and VC Expectations for Business Startups” Royal Scientific Society, Amman, Jordan, March 2011

“Lessons from start-ups and spin-offs” EOS Annual Meeting Workshop on Entrepreneurship and Business Innovation in PhD Education, Galway, Ireland, June 2011

“Scientists and Engineers as Entrepreneurs” EOS Annual Meeting Workshop on Entrepreneurship and Business Innovation in PhD Education, Galway, Ireland, June 2011

“Financing and VC Expectations for Business Startups” EOS Annual Meeting Workshop on Entrepreneurship and Business Innovation in PhD Education, Galway, Ireland, June 2011

“Lessons from start-ups and spin-offs” EOS Annual Meeting Workshop on Entrepreneurship and Business Innovation in PhD Education, Galway, Ireland, June 2011

“Light Guiding Concentrating Photovoltaics Systems”, Frontiers in Optics, 2011, San Jose, CA, October, 2011

Scientists and Engineers as Entrepreneurs” Keio University, Tokyo, Japan, November, 2011

“Gradient-Index Optics and Concentrating Photovoltaics”, University of Rochester, Rochester, NY, November, 2011

“Financing and VC Expectations for Business Startups” Keio University, Tokyo, Japan, November, 2011

“Lessons from start-ups and spin-offs” Keio University, Tokyo, Japan, November, 2011

“Polymetric Photonics for Disaster Recovery”, 1st International Conference on Advanced Photonic Polymers, Yokohama, Japan, December 2011

“Lessons from start-ups and spin-offs”- Joint ICTP-TWAS for Physicists & Engineers – Workshop 2012 - Entrepreneurship for Physicists and Engineers from Developing Countries, Trieste Italy, April 2012

“New Gradient-index Materials and Designs with Polymers, Glass and ALON”, Imaging and Applied Optics: OSA Optics & Photonics Congress, June 2012

“Large Diameter Radial Gradient-Index Lenses Fabricated by Ion Exchange”, Imaging and Applied Optics: OSA Optics & Photonics Congress, June 2012

“Application of a Multiple Cavity Fabry-Perot Interferometer for Measuring the Thermal Expansion and Temperature Dependence of Refractive Index in New Gradient-Index Materials”, Imaging and Applied Optics: OSA Optics & Photonics Congress, June 2012

“Optical Design with Gradient-Index Elements Constrained to Real Material Properties”, Imaging and Applied Optics: OSA Optics & Photonics Congress, June 2012

“Lessons from start-ups and spin-offs”- ICTP, BATAN and IOP’s 2012 Workshop - Entrepreneurship for Physicists and Engineers from Far Eastern Developing Countries, Jakarta Indonesia, December 2012

“Gradient-Index Optics and Concentrating Photovoltaics”, MIT Lincoln Laboratories, April, 2013

“Gradient-Index Optics and Concentrating Photovoltaics”, MIT, April, 2013

“Design of a ZnS/ZnSe Radial Gradient-Index Objective Lens in the Mid-Wave Infrared: Imaging Systems and Applications/Imaging and Applied Optics Conference: OSA Optics and Photonics, Arlington, VA, June 2013

“Gradient-Index Optics and Concentrating Photovoltaics”, RIAO/OPTILAS’ 2013 Conference - Plenary, Porto, Portugal, July 2013

“Entrepreneurship for Scientists and Engineers, RIAO/OPTILAS’ 2013 Conference/SPIE – Plenary Lecture, Porto, Portugal, July 2013

“Entrepreneurship for Scientists and Engineers”, SDM Special Lecture, Keio University, Tokyo, Japan, October 2013

“Recent Developments in Gradient Index Optics”, Plenary Lecture, Micro Optics Conference 2013, Tokyo, Japan, October 2013

“Capacity Building, Innovation & Entrepreneurship, Panel Presentation, American Center for Physics, November 2013

“Commercializing Your Inventions – what does it take for a scientist or engineer to be an entrepreneur?” Scientist & Entrepreneurship Workshop, Chiapas, Mexico, December 2013

“Importance of Marketing”, Lecture, Scientist & Entrepreneurship Workshop, Chiapas, Mexico, December 2013

“Inventions to Startups – some best practices and what experiences can be translated to developing countries”, Lecture, Scientist & Entrepreneurship Workshop, Chiapas, Mexico, December 2013

“Grand Challenges in Optics and Photonics: Essential Technologies for Our Nation”, AAAS 2015 Annual Meeting, Chicago, IL, February, 2014

“Recent Developments in Gradient Index Optics”, New England Section of OSA, March 2014

“Skill Sets for Careers”; Reinventing the Physicist: Innovation and Entrepreneurship Education for the 21st Century, College Park, MD, June 2014

“Technical Entrepreneurship & Management – APS, Physics Innovation & Entrepreneurship Education for the 21st Century, June 2014

Rochester Science Café, Rochester, NY, September, 2015

“Musicians & Nurses are Entrepreneurs Too!”, Pecha Kucha Presentation, GCEC Conference, London, October 2014

“Innovation and Entrepreneurship in Industrial Physics”, American Physical Society – Workshop on Industrial Physics, Harbourtowne Conference Center, Maryland, October 2014

- “Grin Optics and Entrepreneurship” – Seminar at Centre for Optical & Laser Engineering (COLE), School of Mechanical & Aerospace Engineering, Nanyang Technological University, November 2014
- “Mirages, Malaysia Air Flight 370 and Other Interesting Optical Phenomena”; Latin America Optics & Photonics Conference, Cancun, Mexico, November 2014
- “Scientists and Engineers as Entrepreneurs”; Entrepreneurship Workshop for Scientists and Engineers, Kenya, December, 2014
- “Pitching for Cash: Equity Issues, Share Dilution, Valuation at Various Stages of Development, Funding Needs at Different Stages”; Entrepreneurship Workshop for Scientists and Engineers, Kenya, December, 2014
- “Pitching for Cash – Communication and Presentation Skills”; Entrepreneurship Workshop for Scientists and Engineers, Kenya, December, 2014
- “Entrepreneurship and Economic Development in a Changing Community”; Presentation at Universitatea Tehnica din XCluj-Napoca, Cluj, Romania, May 2018
- “Gradient-Index Optics and Concentrating Photovoltaics”; Optics & Photonics Days, University of Jyvaskyla , Jyvaskyla, Finland, May 2018
- “The Transition of Rochester From a Big Company City (Kodak, Xerox and Bausch and Lomb) to SEMs”, Institute of Photonics @ University of Eastern Finland, Joensuu, Finland, May 2018
- “Gradient-Index Optics and Concentrating Photovoltaics”; IWPP2018, Suwa City, Japan, Plenary Lecture, October 2018
- “Polymetric Lenses for Optical Systems”, IWPP2018, Suwa City, Japan, Plenary Lecture, October 2018

Patents

"Optical System Comprising a Singlet Element having a Continuously Varying Index of Refraction", U.S. Patent 3,729,253, April 24, 1973.

"Telecentric Lens System", U.S. Patent 3,773,404, November 20, 1973.

"Optical Disc Pickup Lens", Japanese Patent 58-122512, July 21, 1983.

"Spherical Gradient-Index Lens Designs for Video-Disk Pickup Lens or the Like", U.S. Patent 4,457,590, July 3, 1984.

"Method and Composition for Creating Gradient-Index Glass", U.S. Patent 4,756,733, July 12, 1988.

"Universal Lens Polishing Tool, Polishing Apparatus and Method of Polishing", U.S. Patent 4,768,308, September 6, 1988.

"Sol-Gel Method for Making Gradient-Index Glass", U.S. Patent, 4,797,376, February, 1989.

"Composite Gradient Index and Curved Surface Anamorphic Lens and Applications", U.S. Patent 4,900,138, February, 1990.

"Gradient Index Glass", U.S. Patent 4,902,650, February, 1990.

"Sol-Gel Method for Making Gradient-Index Optical Elements," U.S. Patent 5,068,208, November, 1991.

"Gradient-Index of Refraction Optical Data Storage Lens" (with Daniel M. Krill), U.S. Patent 5,161,063, November, 1992.

"Negative Abbe Number Radial Gradient Index Relay and Use of Same" (with Douglas Kindred), U. S. Patent 5,361,166, November, 1994.

"Riflescope Utilizing Gradient Index Lenses" (with Leland G. Atkinson and George Nadorff), U.S. Serial No. 983953, June, 1994.

"Negative Abbe Number Radial Gradient Index Relay, Method of Making, and Use of Same" (with Leland G. Atkinson et al), U.S. Patent 5,457,576, October 1995.

"Negative Abbe Number Radial Gradient Index Relay, Method of Making, and Use of Same" (with Douglas S. Kindred et al), EPO 00624209, 1997.

"Stepped light collection and concentration system, components thereof and methods" (with Greg Schmidt and Blair Unger), U.S. Patent 7,817,885, October 2010

“Light Collecting and Emitting Apparatus Application” (with Greg Schmidt, Blair Unger and Michael Brown), U.S. Patent 8,189,970, May 2012

“Dimpled Light Collection and Concentration System, Component” (with Greg Schmidt, Blair Unger and Michael Brown), U.S. Patent 8,498,505, July 30, 2013

“Light Collecting and Emitting Apparatus, Method and Applications” (with Greg R Schmidt, Blair L. Unger, Michael Brown), U.S. Patent 9,036,963, May 19, 2015

Advisees and Thesis Topics

Masters Candidates (completed)

Dennis C. Leiner (1977)

Phase-Lock Interference Microscopy

Fernando B. Neves (1977)

Large Aperture A. C. Interferometry

Mark Craig Gerchman (1978)

Production Methods for Fabricating Aspheric Optical Elements

Lisa Gregorka (1978)

Measurement of the Chromatic Dispersion of Gradient Refractive Index Glass using a Schlieren Technique

Bruce E. Truax (1978)

Phase-Locked Moire' Fringe Analysis for Automatic Contouring of Diffuse Surfaces

Robert P. Herloski (1979)

Measurement of Ultrasmall Displacement

Robert T. Salvage (1979)

Third Order Aberration Study of Radial Gradient Lenses with Zero Petzval Curvature and Spherical Gradient Lenses

Karen D. Jacobsen (1980)

Three-Dimensional Moire' Contouring using Phase-Locked Interferometry

Danette P. Ryan (1980)

Measurement of the Chromatic Dispersion of Gradient-Index Materials by Multiple Wavelength A. C. Interferometry

Susan N. Houde-Walter (1983)

Field-Assisted Ion Exchange in Glass

Thomas F. Powers (1983)

Interferometric Measurement of Transparent Solids

Ronald D. Stern (1982)

Three-Dimensional Contouring by Additive Moire Topography

Nancy J. Sullo (1982)

Measurement of Absolute Refractive Index Profiles in Gradient-Index Materials using Modulation Ellipsometry

- Jill D. Forer (1983)
Third Order Aberration Analysis of Gradient-Index Arrays
- Mary J. Nadeau (1984)
Aberration Analysis of Curved Gradient-Index Imaging Rods
- Denis P. Naughton (1986)
Fabrication and Testing of Infrared Gradient-Index Materials
- Robert J. Zinter (1987)
A Three Dimensional Super Position Array
- Joan Samuels (1989)
Influence of the Molten Salt Bath on Ion Exchange in Glass and The Gradient-Index Profile
- Daniel Krill (1990)
Axial and Radial Index Gradients Optical Data Storage Lenses
- Laurie Scheffel (1990)
Dispersion Measurement of Infrared Gradient Materials
- Mark Wittman (1991)
High-Precision Characterization of Inertial-Fusion Targets Using Scanning Fabry-Perot Interferometry
- Michael Hoppe (1992)
Design of Axial Gradient Singlets Utilizing a Fickian Diffusion Model
- Anchal Sharma (2016)
A Study of Homogeneous and Spherical Gradient-Index Ball Lenses

Doctoral Candidates (completed)

- Gih-Horng Chen (1977)
High-Speed Fabrication of Aspherical Surfaces
- James J. Bohache (1978)
Study of the Optical Polishing Process
- Stephen D. Fantone (1979)
Design, Engineering, and Manufacturing Aspects of Gradient--Index Optical Components
- Glen W. Johnson (1979)
Measurement of Strongly Refracting Three-Dimensional Distributions

- David Lees (1979)
Frustrated Total Reflection Polarizing for the Infrared
- Joel L. Seligson (1981)
The Optical Field in the Focal Region of an Aberrated Lens
- Paul O. McLaughlin (1983)
Thermal Expansion and Temperature Dependence of the Refractive Index in Gradient Refractive Index Glasses
- Joseph J. Miceli (1983)
Infrared Gradient-Index Optics: Materials, Fabrication, and Testing
- Danette P. Ryan (1983)
Chromatic Properties of Index of Refraction Gradients in Glass
- Joan M. Stagaman (1985)
Anamorphic Gradient-Index Lens Systems
- Leland G. Atkinson III (1986)
High Speed Fabrication of Aspheric Surfaces
- Susan N. Houde-Walter (1987)
Profile Control in Gradient-Index Glasses
- C. Benjamin Wooley (1989)
Design and Fabrication of Luneburg-Type Waveguide Lenses
- J. Brian Caldwell (1989)
Sol-Gel Methods for Making Radial Gradient-Index Glass
- Leo R. Gardner (1989)
Studies in Gradient Index Polymer Materials
- Michael T. Houk (1990)
Fabrication & Testing of Index Gradients in Fluorite Materials
- Douglas S. Kindred (1991)
Development of New Gradient-Index Glasses for Optical Imaging Systems
- John P. Bowen (1991)
Radial Gradient Lenses for Single-Mode Optical Systems
- C. Gary Blough (1992)
Single Point Diamond Turning of Glass

- David Wang (1992)
Design Methods for Gradient Index Imaging Systems
- Niels Haun (1993)
Effect of Diffusion Chemistry on Gradient Index Profiles formed via Sol-Gel
- Andrew Kulawiec (1994)
Quantitative Phase Imaging in Scanning Optical Microscopy
- Julie Bentley (1995)
Integration of the Design and Manufacture of Gradient-Index Optical Systems
- Christopher Saxer (1997)
Interferometric Characterization of the Chromatic Dispersion of Gradient-Index Glasses
- Curtis Harkrider (1999)
Design-for-Manufacture of Gradient-Index Optical Systems Using Time-Varying Boundary Condition Diffusion
- Mary Kate Crawford (1999)
Tolerance Analysis of Axial Gradient-Index Lenses
- Jennifer Rouke (2000)
Birefringence in Gradient-Index Materials
- Paul Murphy (2000)
Interferometric Metrology of Aspheric Surfaces
- David Fischer (2002)
Gradient-Index Ophthalmic Lens Design and Polymer Material Studies
- Yanqiao (Joyce) Huang (2008)
Spatial Coherence Interferometry for Biometric Measurement of the Human Eye
- Greg Schmidt (2009)
Artificial Neural Superposition Compound Eyes and the Effect of Tapered Gradient Index Cones
- Blair Unger (2010)
Dimpled Planar Lightguide Solar Concentrators
- Eric Christensen (2012)
Spectral Splitting Solar Concentrating Systems and Variable Thickness Dielectric Coatings
- Xinye Lou (2012)
Spatial Coherence Interferometry and Its Applications

- Mick Brown (2013)
Advanced Light Guide Solar Concentrators
- Pete McCarthy (2015)
Gradient-Index Materials, Design, and Metrology for Broadband Imaging Applications
- Dan Williams (2016)
Window-Integrated Low Concentration Planar Light Guide Solar Concentrators
- Kejia Fang (2016)
Design, Fabrication and Characterization of Polymer Gradient-Index (GRIN) Material
- James Corsetti (2017)
Design of ZNS/ZNSE Gradient-Index Lenses in The Mid-Wave Infrared and Design, Fabrication, and Thermal Metrology of Polymer Radial Gradient-Index Lenses
- Rebecca Berman (2018)
Efficient Light Collection in Solar Concentrating Systems
- Yang Zhao (2018)
Low-Coherence Interferometer for Dimensional Metrology
- Anthony J. Yee (2018)
Mid-Wave and Long-Wave Infrared Gradient-Index Optics: Metrology, Design and Athermalization

Doctoral Candidates (in process)

Eryn Fennig

Tianyi Yang

Robert Chou

Nicholas Kochan

Principal Investigator on Grants and Contracts

"Rationalization of Manufacturing Methods in Optical Fabrication" Frankford Arsenal, Philadelphia, PA July 1974 - September 1975	\$ 39,900
"Gradient-Index Optical Glass Lenses" National Science Foundation, Washington, D. C. July 1974-December 1976	\$127,000
"A. C. Interference Microscope" Laboratory for Laser Energetics, Rochester, NY July 1975 - June 1977	\$ 37,620
"A. C. Interference Microscopy for Cystoscopy" American Cystoscope Makers, Inc, Stamford, CT July 1975 - June 1977	\$ 40,230
"Large Aperture A. C. Interferometer" Laboratory for Laser Energetics, Rochester, NY December 1975 - June 1977	\$ 76,492
"Engineering Aspects of Gradient-Index Optical Systems" National Science Foundation, Washington, D. C. July 1976 - December 1978	\$145,000
"Phase Lock Interference Microscope" subcontract to RIAS National Science Foundation, Washington, D. C. July 1977 - July 1978	\$ 20,000
"Program Concepts for Gradient-Index Optical Systems" Redstone Arsenal, Huntsville, AL May 1978 - September 1978	\$ 9,950
"Gradient-Index Optical Systems" National Science Foundation, Washington, D. C. July 1978 - December 1981	\$214,460
"Gradient-Index Lens Design" Redstone Arsenal, Huntsville, AL October 1978 - December 1979	\$ 54,825

"Gradient-Index Topical Meeting"	National Science Foundation, Washington, D. C. April 1979 - March 1980	\$ 3,500
"Independent Research Project"	General Dynamics Corporation, Pomona, CA	
	1979 - 80	\$ 42,000
	1980 - 81	\$ 32,000
	1981 - 82	\$ 34,650
	1982 - 83	\$ 20,345
"IR Properties of Gradient-Index Materials"	Redstone Arsenal, Huntsville, AL June 1980 - June 1981	\$ 59,960
"Optical Surfacing using a Computer Numerical Control Machine"	Picattiney Arsenal, Dover, NJ September 1980 - August 1983	\$333,011
"Gradient-Index Aerial Photographic Lens"	Jet Propulsion Laboratory, Pasadena, CA February 1981 - September 1981	\$ 6,500
"Gradient-Index Topical Meeting"	National Science Foundation, Washington, D. C. May 1981 - October 1981	\$ 3,500
"Gradient-Index Lens Research"	Redstone Arsenal, Huntsville, AL August 1981 - May 1982	\$ 66,925
"Gradient-Index Pilot Project"	Picatinny Arsenal, Dover, NJ September 1981 - August 1984	\$417,000
"Gradient-Index Optical Systems"	National Science Foundation, Washington, D. C. November 1981- December 1984	\$220,209
"Non-Interferometric Methods of Measuring Gradient-Index Profiles"	Xerox Corporation, Rochester, NY July 1982 - August 1982	\$ 8,000

"Study for Integrated Optics Spectrometer" Jet Propulsion Laboratory, Pasadena, CA December 1982 - September 1983	\$ 4,500
"Graded-Index and Multisegmented Optics Research" Redstone Arsenal, Huntsville, AL December 1982 - September 1983	\$176,216
"Optical System Engineering and Software at Jet Propulsion Laboratory" Jet Propulsion Laboratory, Pasadena, CA June 1984 - August 1984	\$ 19,000
"Center for Advanced Optical Technology" New York State Science and Technology Foundation September 1983 - present	\$ 75,000
"Gradient-Index Optical Systems" National Science Foundation, Washington, D. C. July 1985 - June 1986	\$ 55,000
"Gradient-Index Optical Systems" Army Research Office, Research Triangle Park, NC July 1985 - July 1988	\$515,894
"Studies in Gradient-Index Plastics" Dow Chemical Company, Midland, MI January 1986 - June 1989	\$ 93,713
"Gradient-Index Optical Systems" National Science Foundation, Washington, D. C. September 1986 - August 1989	\$266,932
"Opto-Electronic Systems Research" Army Research Office, Research Triangle Park, NC October 1986 - September 1988	\$161,291
"Design of Gradient-Index Eyepieces" Jet Propulsion Laboratory, Pasadena, CA December 1986 - October 1987	\$ 4,500
Director, New York State Center for Advanced Optical Technology Principal Investigator, July 1987 - 1994	\$1,800,000 /yr
Principal Investigator, Center for Optics Manufacturing	\$4,600,000
TLD/Laser Beam Thermal Interaction Project R0691, RG&E	\$ 7,500

"Research on Optical Manufacturing" July 1992 - June 1997	\$1,583,530
"Optimod" DOD/Army September 1992 - August 1995	\$1,100,000
"Optical Manufacturing Issues in Gradient & Diffractive Optics" September 1992 - November 1995	\$ 300,000
"Glass Micro-Optics" National Science Foundation (with Professor Susan Houde-Walter)	\$ 40,000
"Design and Characterization of an Infrared Endoscope" US-Mexico Foundation May 1995 - July 1997	\$ 70,000
"Design of Optical Systems and Metrology of Components for Projection Lithography" Semiconductor Research Corporation August 1996 - December 1997	\$ 290,000
"Kauffman Campus Initiatives" Program Kauffman Foundation March 2004 – June 2009	\$3,592,000
"Golden Horseshoe Business Plan Contest" Greater Rochester Enterprise September 2005 – December 2005	\$ 9,900
"Lateral Solar Cell Architecture" University of Delaware/DARPA October 2005 – September 2006	\$ 409,324
"Study of Wide Field of View Optical System Based on Animal Eyes" ARL August 2006 – July 2007	\$ 199,660
"Master of Science in Science and Technology Commercialization Program" US Department of Labor/ NYS Department of Labor June 2006 – May 2009	\$ 120,000
"Very High Efficiency Solar Cells" Dupont Engineering Research July 2007 – March 2009	\$ 583,800

<p>“Stanford Center on Longevity” University of Stanford July 2007 – June 2009</p>	<p>\$ 250,000</p>
<p>“Photo Voltaic Solar Cells for Utility Power” Abengoa Solucar Power December 2007 – May 2010</p>	<p>\$1,828,157</p>
<p>“3D-Integrated Intra-Chip Free-Space Optical Interconnect for Future Multi-Core SoCs” Total Funding - \$1,098,247 NSF July 2008 – June 2011</p>	<p>\$ 15,000</p>
<p>“Mechanisms of Monolayer Migration” NIH-Small Research Grant Program December 2008-November 2010</p>	<p>\$ 99,123</p>
<p>“Very High Efficiency Solar Cells (Phase 1 and 2)” Dupont Engineering Research/Energy Focus July 2006 – June 2009</p>	<p>\$ 500,000</p>
<p>“Manufacture, Design and Measurement of Gradient-Index Materials” SAIC/DARPA September 2009 – April 2010</p>	<p>\$ 50,000</p>
<p>“IGERT: Distributed Renewable Energy: From Science and Technology to Entrepreneurship and Policy” NSF – Co-Principal Investigator July 2010 – June 2015</p>	<p>\$3,200,000</p>
<p>“Very High Efficiency Solar Cells (Phase 3 and 4)” Energy Focus July 2009 – December 2011</p>	<p>\$ 878,121</p>
<p>“Manufacturable Gradient-Index Materials for DOD Visible and IR Systems” DARPA July 2010 – June 2016</p>	<p>\$5,642,466</p>
<p>“Project Genesee” Rambus LLC March 2012 – February 2013</p>	<p>\$ 270,881</p>
<p>“MGRIN Design and Metrology, ALON Materials” Surmet/Defense Advanced Research Projects Agency (DARPA) March 2012 – March 2013</p>	<p>\$ 201,318</p>

<p>“Light Guide Based Concentrators” Rambus International Ltd. April 2012 – April, 2013</p>	\$ 269,700
<p>“High Efficiency Solar Fuels Reactor Concept” Georgia Institute of Technology April, 2013 – April, 2015</p>	\$ 199,209
<p>“Manufacturable Gradient-Index for DoD Visible and IR Systems – Phase 2, Option 2 Surmet August, 2013 – June, 2015</p>	\$ 340,497
<p>“Visible and Short Wavelength Zoom Optical Systems” L-3 Sonoma July, 2014 – December, 2015</p>	\$ 84,455
<p>“Long Wave Length Thermal Interferometer” Rochester Regional Photonics Corporation December, 2014 – March, 2019</p>	\$1,048,106
<p>“I-Corps Site Catalyzing the Commercialization of Ground Breaking Innovations with Regional Entrepreneurial Expertise” I-Corp Site January, 2015 – December, 2017</p>	\$ 299,787
<p>“Planar Light Guide Concentrating Photo Voltaics” DOE/ARPA-E January, 2016 – September 2019</p>	\$3,215,758
<p>“EDA University Center Economic Development Program” EDA September, 2016 – August, 2021</p>	\$1,169,194
<p>“Corps Node: Upstate NY Alliance of Entrepreneurial Innovation” National Science Foundation October, 2016 – September 2021</p>	\$ 799,170
<p>“Romanian Professor Entrepreneurship Education and Networking Program” Council of International Educational Exchange (CIEE) July, 2016 – June, 2019</p>	\$ 400,000
<p>“Metrology of Homogeneous and GRIN materials” Lockheed Martin November, 2016 – December, 2018</p>	\$ 114,949

“Virtual Skylight” Hyperloop Transportation Technology, Inc. March, 2018 – February, 2019	\$ 156,326
“GRIN Optic Design & Metrology for Application in Ophthalmic Lenses” Carl Zeiss Vision International GmbH March, 2018 – February 2019	\$. 100,000

Administrative Responsibilities

The Institute of Optics (University of Rochester)

Graduate Committee	1974-1982, 1984, 1985
Chairman	1979-80
Ad Hoc Committee on Development	1975-77
Responsible for Departmental Computing Funds (\$12,000/year)	1975-82
Responsible for Optical Fabrication Facility Annual Budget (1977) \$120,000	1975-83
Space and Facilities Committee	1984
Masters Co-Op Program Coordinator	1981-82, 1984-85
Steering Committee	1984-86
Undergraduate Committee	1985-86
Hopkins Chair Search Committee	2001-02
Strategic Planning	2010-2011
Director Search Committee	2010-2011
Executive Committee	2012-2017
Director Search Committee	2017
Optics Advisory Committee	2017-2018
Graduate Committee	2019

College/School of Engineering and Applied Science (University of Rochester)

Research Facilities Committee	1975-79
Director Search Committee, Institute of Optics	1977-81
Graduate Committee	1979-83
Chairman	1982-83
Biomedical Engineering Executive Committee	1979-93
Faculty Secretary	1984-86
Forbes Award Committee	2003-04
William F. May Professorship in Engineering Search Committee	2004-05
Biomedical Engineering Senior Advisory Committee	2004-
Biomedical Engineering/Optics Committee	2004-
Kaufmann Entrepreneurial Year (E5) Program, Selection Committee	2012 – Present
Center for Earth & Environmental Sciences- Structure Committee	2014 – Present
AS&E Dean of the Faculty Search Committee	2017- Present

University of Rochester

Computer Center Advisory Committee	1977-80
Undergraduate Teaching Committee	1981-82
Review Committee - Laboratory for Laser Energetics	1980-82
Review Committee - Deanship of the	

College of Engineering	1980
Academic Computing Steering Committee	1984
Ad Hoc Committee on Parking	1984
Dean Search Committee, College of Engineering	1984-85
University Committee on Tenure and Privileges	1984-86
Faculty Senator	1985-92
Executive Committee	1986-87, 1990-92
Research Policy Committee	1986-87
Budget Committee	1991, 92
Strategic Planning Committee	2010-2011
Provost's Committee on Multidisciplinary Research	2007
Chair-SEAS Dean's Search Committee	2007-2008
Provost Committee on Interdisciplinary Research	2008
Board of Trustees Advisory Committee on Tech Transfer	2008 - Present
Member of the President's Cabinet	2009 - Present
Director Search Committee, Optics	2010 - 2011
Corporate Relations Strategy Committee	
Technology Commercialization Affiliates Committee	2011- Present
Technology Development Fund, Executive Committee	2011- Present
Board of Trustees Research and Innovation Committee	2014 - Present
One Rochester Leadership Council	2014 - Present

Monroe Community College

Optical Technology Advisory Committee	1994-95
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Professional Activities

Amarel Precision Instruments, Inc.

Board of Directors, 1996-97

Technical Advisory Committee, 1997

American Association for the Advancement of Science

Fellow, 2005

Committee on Science, Engineering, and Public Policy, 2005-11

William D. Carey Lectureship Selection Committee, 2006-09

Engineering Section

Chair-elect, 2009-2010

Chair, 2010-2011

Retiring Chair, 2011-2012

Program Committee, AAAS Forum on Science and Technology Policy, 2009

Fellows Selection Committee (Engineering) 2009-11

American Association of Engineering Societies

Board of Governors, 1995-97

American Ceramic Society (Glass Division), 1977-91

American Institute of Physics

Governing Board, 1994-98

Executive Committee of the Board, 1995-97

Committee for Public Policy, 1994-97

Committee on Committees, 1994-97

State Department Fellowship Selection Committee, 2001-02

Book reviewer, 2001-2009

ICTP-AIP Industrial Physics Forum Planning Committee, 2013 -2014

American Physical Society

Selection Committee for the Congressional Scientist Program, 1995, 2009

Panel on Public Affairs, 1995-96, 2006-10

Ethics; National Research Policy; and Steering Subcommittees):

Vice Chair, 2007-2008

Chair-Elect, 2008-2009

Chair, 2009-2010

Chair, Subcommittee to write commentary on the 2009 APS Climate Change

Statement, 2009-2010

Past Chair, 2010-2011

Forum on Physics and Society, 1996

Executive Committee, 1996-97

Physics Policy Committee, 2009

Member, APS Council, 2009

Development Advisory Committee, 2014-2016

American Society for Engineering Education, Engineering Deans Council
Public Policy Committee, 1995-97

American Society for Precision Engineering, 1989-present

Association of Engineering Colleges in New York State, 1995-97

Coalition for Photonics and Optics, Chair, 1996-97

Council of Scientific Society Presidents

Co-Chair, Government Affairs Committee, 1996-97

Alumni Network, 2003-

Council on Competitiveness

National Center for Regional Innovation, 2003

National Innovation Initiative, 2004

National Innovation Initiative Public Sector Innovation Working Group, 2004

German Society for Applied Optics DGaO

Program Committee for DGaO/ICO Conference 2016

Global Consortium of Entrepreneurship Centers

Executive Advisory Board, 2016 - Present

Gradient Lens Corporation

Board of Directors, 1980-Present

High Tech Rochester

Luminate Advisory Board Member, 2017-Present

Hillside Family of Agencies'

Board of Governors, 2014 – Present

Research Advisory Committee, 2014 – 2018

Future Watch Committee, 2015 - Present

Strategic Development Committee, 2016 – Present

Governance Committee, 2018 - Present

IEEE

Senior Member Grade, 2007

Fellow, 2008

USA Government Fellows Selection Committee, 2005-2010

Industrial Research Institute

Academic Advisory Council of the University Relations Committee, 2001-2004

Pre-College Education Subcommittee, 2001-2004

International Commission for Optics

Delegate, 1979-82
Program Committee, 1987 meeting
International Advisory Committee, 1998 meeting
International Advisory Committee, Fifth International Topical Meeting on Education and Training in Optics, 1997
International Commission for Optics, Elected Vice President, 2008-2011
United States Advisory Committee
Member-at-Large, 2008-2017
Ex-Officio Member, 2009-2011
Chair International Commission for Optics, 2011-2013
Chair of the Committee for the Regional Development of Optics, 2008-2011
President, August 2011 – 2014
Past President, Governing Board, 2014-2017

Maine Science and Technology Foundation

Board of Directors, 2002-2003

Materials Research Society, 1984-1990

The National Academies/ National Research Council

U.S. National Committee for the International Commission for Optics, 1988
Board of Physics and Astronomy, 1988
Committee on Optical Sciences and Engineering, 1995
Instrumentation and Laboratory Improvement Initiative, 1995
Board on Assessment of NIST Programs, 2001-9/05
Panel for Physics of the Board on Assessment of NIST Programs:
Vice Chair, 2001-2002
Chair, 2002-9/05
Steering Committee, Capitalizing on Science, Technology, and Innovation:
An Assessment of the Small Business Innovation Research Program, 2002-2008
Committee on Innovation Models for Aerospace Technologies, 2004-2005
Steering Committee for Sensors and Sensor Systems: A US-Japan Dialogue, Global Dialogues on Emerging Science and Technology, 2004-2005
U.S. Advisory Council/Committee for the International Commission on Optics, 2006-2013
Member at Large, 2008 – 2018
Ex-Officio Member, 2009 – 2011
Chair, 2011 - 2013
Committee on Science, Technology, and Law, 2006-2009
Member, Committee on Capitalizing on Science, Technology, and Innovation: An Assessment of the Small Business Innovation Research Program: Phase I, 2003-2008
Member, Committee on Capitalizing on Science, Technology, and Innovation: An Assessment of the Small Business Innovation Research Program: Phase II, 2009-2016

Member, Committee on Harnessing Light: Capitalizing on Optical Science Trends and Challenges for Future Research, 2011-2012
U.S. Liaison Committee for the International Union of Pure and Applied Physics (USLC/IUPAP)
Ex-Officio Member, 2012 – 2013
Member of the Panel on Materials Science and Engineering at the Army Research Laboratory, 2013 – 2017

National Aeronautics and Space Administration (NASA)

Hubble Space Telescope Independent Optical Review Panel, Chairman, 1990-91
Goddard Space Flight Center Engineering Visiting Committee, 2002-2006
Goddard Space Flight Center Applied Engineering and Technology Directorate Visiting Committee (Chairman), 2002-2006
James Webb Space Telescope Product Integrity Team, 2002-Present

National Science Foundation

Science and Technology Centers Blue Ribbon Panel – to select NSF Science and Technology Centers for 2010, 2009

The New York Photonics Development Corp.

Board of Directors, 1992

Optical Society of America

Gradient-Index Optical Imaging Systems Topical Meetings:
May 1979 - Rochester, NY (Co-Chairman)
May 1981 - Honolulu, HI (Chairman)
May 1982 - Rochester, NY (Program Committee)
July 1983 - Kobe, Japan (U. S. Chairman)
April 1984 - Monterey, CA (Program Committee)
September 1985 - Palermo, Italy (Program Committee)
January 1987 - Reno, Nevada (Program Committee)
July 1989 - Tokyo, Japan (Program Committee)
March 1991 - Monterey, CA (Chairman)
September 1992 - Spain (Program Committee)
September 1993 - Japan (Program Committee)
Science of Polishing Topical Meetings:
April 1984 - Monterey, CA (Chairman)
June 1990 - Monterey, CA (General Chairman)
International Lens Design Conferences:
June 1985 - Cherry Hill, NJ (Program Chairman)
June 1990 - Monterey, CA (Co-chairman)
Counselor, Rochester Section, 1978-79
Nominating Committee, 1979
Program Chairman, Rochester Section, 1981-82
Technical Chairman, Lens Design Group, 1981-82
Technical Program Committee, 1992
Fellow, 1983

Education Committee, 1984-87
Ad Hoc Committee on Society Objectives and Policy, 1985-86
Ad Hoc Committee on Accreditation of Optical Engineers, 1985-86
Ad Hoc Committee on Optical Engineering, 1985-86
Newport Research Award Committee, 1985
Annual Meeting Chairman, 1987
Technical Council, 1986-87
Member and Public Information Committee, 1993
Optical Society of America - Offices:
 President, 1996
 Vice President 1994
Board of Directors, Member-at-Large, 1987-89
Engineering Council, 1988-91
 Chair, 1992-93
 Vice-Chair, 1990-1992
Executive Committee of Board of Directors, 1988-89, 1992-97
Congressional Fellows Selection Committee, 1995-97
President's Advisory Council, 1997 - Present
Public Policy Committee, 1997, 2006-2009
 Advocate of Optics Selection Subcommittee, 2006-07 (Chair)
Senior Science Advisor, 2001-2002
2003 OSA Leadership Award/New Focus Prize Committee, 2002-2003
Advisory Committee, Forum on Optical Sensing for Homeland Security, 2002-2003
Advisory Council for Homeland Security, 2004-2006
Section Committee of the AAAS Section of Physics, 2012-2015

Optem (a Division of Thales)

Board of Directors, 2001-2002

Optical Society of Korea

Advisory Editor, 2005 – present

Optical Society of Japan

Advisory Board, 11th International Conference on Optics, “ODF ’18 Hiroshima, 2017-18

Optics and Photonics Society of Singapore

icOPEN2015-International Advisory Board Member

Photonics Spectra Magazine

Editorial Board, 1987-91

Rochester Angel Network, Inc.

Board of Directors, 2015 - Present

Rochester Angel Fund, LLC

Advisory Board, 2015 - Present

Rochester Museum and Science Center

Board of Trustees, 2003- 2013, 2017 – Present (Honorary Trustee)
Planetarium Task Force, 2003-2005
Innovation Place Task Force, 2003-2010
 Chair, 2005-2009
Strategic Planning Committee, 2003-2013
Task Force on Increasing Technical Community Involvement, 2004-2005
Science and Technology Committee, 2013
Education Committee, 2010- 2013
International Year of Light Committee, 2014-2015

Society of Photo-Optical Instrumentation Engineers, 1974-present

Gradient-Index Imaging Optics Meeting
 September-October, 1980 - Huntsville, AL (Co-Chairman)
Education Committee, 1980
Fellow, 1981
Awards Committee Chairman, 1985
Board of Governors, 1986-88
Technology Transfer Committee, 1987
Program Committee Member, SPIE Symposium, An Optical Believe It or Not: Key
Lessons Learned II, August 2009

Other Activities

Optical Technology Program Review Committee, Monroe Community College, Rochester, NY, 1982-93

University of Maine (Orono), Physics Department Review Committee, 1982-84
(Chairman, 1983)

International Advisory Committee, Microoptics Conference '87, Japan Society of Applied Physics, 1987

High Technology of Rochester, Advisory Board, 1988-93

Hubble Space Telescope Independent Optical Review Panel, Chairman, 1990-91

Overseas Advisory Committee, Third Microoptics Conference (MOC '91), Yokohama, Japan, October 1991

Review Panel, Ontario Laser and Lightwave Research Center, Toronto, Ontario, Canada, January, 1995

International Advisory Board, Optical Review, The Optical Society of Japan, 1995-97

Steering Committee, Greater Regional Industrial Technology Program, 1995-97

Overseas Advisory Committee, MOC/GRIN '97, 6th Microoptics Conference and 14th Topical Meeting on Gradient-Index Optical Systems, sponsored by the Japan Society of Applied Physics, 1996-97

Environmental and Energy Services Division Review Committee (Chair), Idaho National Engineering and Environmental Laboratory, 2001-2002

Advisory Committee, First International Workshop on Glass and the Photonics Revolution, 2001-2002

Advisory Board, Georgia Institute of Technology School of Public Policy, 2002-2005

Strategic Review Steering Committee, Ontario County (NY) Office of Economic Development, 2002-2004

International Editorial Board, Journal of the Optical Society of Korea, 2003

Board of Advisors, The Nanotechnology Policy Forum, 2003

International Advisory Board for icOPEN2015 – International Conference on Optical and Photonic Engineering, 2014/15

Other Activities (continued)

Advisory Board, What The Tech! Radio Magazine, WXXI (Rochester public television), 2003-2004

Steering Committee, Stanford University Center on Longevity, 2004-2009

Advisory Panel for Electronics and Optics, U.S. Air Force Research Laboratory, 2004-2007

Working Group to Review Science and Technology Projects, Japanese Ministry of Education, Culture, Sports, Science and Technology, 2005

Golden Horseshoe Business Plan Contest Committee, 2005-2008

Workforce on Innovation in Regional Economic Development (WIRED), funded by the U.S. Department of Labor:

Governing Board, 2005-2010

Steering Committee of the Governing Board, 2005-2010

Operations Committee, 2005-2010

Team Leaders Committee, 2005-2010

Subgroup on Entrepreneurship, 2005-2010

Scientific Advisory Board, NaturalNano, 2006-2008

Japan Science and Technology Agency (JST)

Super Centers of Excellence Program (one of 4 foreign reviewers), 2005-2010

International Conference on Optics-photonics Design & Fabrication, (ODF '10 Yokohama)

Member of Advisory Board, 2009-2010

International Conference on Advanced Photonic Polymers (Yokohama, Japan)

Member of Advisory Board, 2012

International Conference on Optics-photonics Design & Fabrication, (ODF '14 Itabashi Tokyo)

Member of Advisory Board, 2013-2014

Optical Society of Korea, Advisory Editor, 2013

Finger Lakes Regional Council

Optics Imaging & Photonics Committee, 2013 - Present

Entrepreneurship & Innovation Committee, 2013 - Present

Rochester Regional Optics, Photonics & Imaging Accelerator Advisory Board, 2013 - 2015

icOPEN2015- Singapore, Advisory Board Member, 2015

High Tech Rochester

Luminate Accelerator - Selection Panel, 2017 - present

11th Annual Optics, Design & Fabrication Conference , Hiroshima, Japan– Advisory Board, 2018

Teaching Duties

Optics 100	Introduction to Optics	Spring 2001
Optics 121	Fundamentals of Optics	Fall 1974
Optics 241	Geometrical Optics	Fall 1975, 1977, 1978, 1980, 1981, 1982, 1984, 1987, 1988, 1995
Optics 300	Current Optics and Optical Technology	Spring 2005
Optics 392	Engineering Clinics	Spring 1993
Optics 395	Topics in Geometrical Optics	Spring 1996
Optics 441	Geometrical Optics	Fall 2001, 2004
Optics 442	Instrumental Optics	Spring 1975, 1976, 1977, 1978, 1981, 1982, 1984, 1986, 1987, 2006
Optics 443	Fabrication and Testing	Fall 1976, 1979, 1986, Spring 1985
Optics 444	Lens Design	Spring 1989, 1990, 1991, 1992, 1993, 1995, 1997
Optics 456	Graduate Optics Laboratory	Spring 1979, 1980
Optics 481/ENT425	Technical Entrepreneurship	Spring 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014
Optics 492	Technical Entrepreneurship	Spring 2002, 2003, 2004, 2005
Optics 591	Optical Entrepreneurship	Spring 1988, 1989
Optics 592	Advanced Optical Design	Fall 1985
GBA 423	New Venture Management (Business and Entrepreneurship Administration)	Spring 2006, 2007
TEM 411	General Management of New Ventures	Spring 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019