

# O P T I C A L R E S E A R C H A S S O C I A T E S

## Professional Experience

2007 - Present Systems Engineer/Illumination, Optical Research Associates  
2003 – 2006 Senior Staff Engineer/Illumination, Optical Research Associates  
1999 – 2002 Research Assistant, University of Arizona  
1996 - 2002 Sole Proprietor (Davenport Optical Consulting), Optical Engineer Lighting Development Engineer, Prince Corporation, Holland, MI, Research/Teaching Assistant, John Carroll University

## Education

2002 Ph.D. Degree in Optical Sciences, University of Arizona  
2000 M.S. Degree in Optical Sciences, University of Arizona  
1995 M.S. Degree in Physics, John Carroll University  
1993 B.S. Degree in Physics, John Carroll University (Summa Cum Laude)

Since joining ORA in 2003 after completing his degree at the University of Arizona Optical Sciences Center (now the College of Optical Sciences), he has been involved in a diverse array of activities. Some of these include:

- LED head-mounted light and bike-light design
- LED illuminators for medical applications
- Specialized-distribution, wide-angle, fiber optic output lens design
- Optimization of smoothly-varying, reflector and coupler design work using *LightTools*<sup>®</sup>-SolidWorks<sup>®</sup> Link Module (LSM)
- Design of Fresnel lenses
- Design of concentrators for tracking solar collection systems
- Design/analysis of other innovative solar collector geometry for consumer and industrial markets
- Development of Solar Tracking Utility that ships that is part of the *LightTools*<sup>®</sup> Utility Library
- Flame detection system analysis and design
- Fundus camera illumination systems
- Projection display analysis
- Highly-successful, 3-year DARPA HED Light project to bring high efficiency distributed fiber optic lighting technology to fruition
- Remote, refrigeration-system luminaire design
- Shipboard lighting
- Brightness enhancing film design/analysis
- Arc source modeling using Abel inversion and other techniques
- Xenon source/system modeling and analysis
- Indicator light guides
- Machine vision illumination design
- Spectroscopic fluorescence system illuminator design
- Spatial and angularly mixing rippled light guides
- Paint pattern density design for signage and illuminator applications
- Telescope stray light analysis
- Other DARPA funded work

Prior to joining ORA, he obtained a Ph.D. in Optical Sciences from the University of Arizona. His research, and dissertation, sponsored by DARPA, was directed at enabling the use of Non-Uniform-B-Spline surfaces (NURBS) to create faceted reflectors that produce efficient uniform illuminance distributions. During this same period he formed Davenport Optical Consulting, a sole proprietorship. Much of the contract work he performed was with the Lighting Innovations Institute and Lighting Innovations Corporation, based in Cleveland, OH. Work there included diverse lighting applications such as: automotive tail light prototypes, medical illuminators, and fiber optic lighting applications.

Earlier, at John Carroll University, he earned his bachelor's and master's of science (physics) degrees studying martensitic phase transformations in NiAl alloys. Much of his work there was performed using acoustics and atomic force microscopy (AFM). After completing his MS degree at John Carroll University, he went on to Prince Corporation (now Johnson Controls), where he worked on interior automotive lighting applications as a lighting development engineer before applying successfully for the University of Arizona advanced degree program.

## **Patents**

U. S. 7,374,313 Luminaire with improved lateral illuminance control (Cassarly et al)

U. S. 7,330,632 Fiberoptic luminaire with scattering and specular side-light extractor patterns (Buelow et al)

U. S. 7,164,819 Side-light extraction by light pipe-surface alteration and light-extraction (Jenson et al)

U. S. 7,163,326 Efficient luminaire with directional side-light extraction (Cassarly et al)

## **Patents Pending**

U.S. 20070024971 Rippled mixers for uniformity and color mixing (Cassarly et al)

U.S. 2007/0247835A1 Lighted Display Case with Remote Light Source (Buelow et al)

## **Publications**

“Optimizing concentrating solar collection systems considering integrated performance over time band and location”, International Optical Design Conference Proceedings of SPIE Volume: 6652 (2007)

“Solar Tracking Simulation”, SAIC International Non Imaging Optics Workshop, 2007

“Ripple Structures Used for Optimizing Uniformity in an LED Light-piping System,” Optical Design and Fabrication Conference, (2007).

"Non-Rotationally Symmetric Mixing Rods," International Optical Design Conference, (2006).

"Optimizing Density Patterns to Achieve Desired Light Extraction for Displays," International Optical Design Conference, (2006).

“NURBS Topics” and “LightPipes”, Invited lectures, University of Arizona, College of Optical Sciences Illumination Seminar, (March 2006).

"Optimizing Angle-to-Area converting, light-piping systems using surface features," Proc. SPIE 5942, 29-38 (2005).

"Optimization for Illumination Systems: The Next Level of Design," Proc. SPIE 5456, 81-90, (2004).

"Optimization for Efficient Angle-to-Area Conversion in Illumination Systems," Proc. SPIE 5524, 93-100, (2004).

"Non-uniform-rational-B-splines (NURBS) in Illumination Design," Invited Paper, OSA Annual Meeting (2003).

"Creation of a Uniform Circular Illuminance Distribution Using Faceted Reflective NURBS Surfaces," Ph.D. Dissertation, University of Arizona, December, 2002.

"3D NURBS representation of surfaces for illumination," International Optical Design Conference, (2002).

"Automated Design of a Uniform Distribution Using Faceted Reflectors," (with W. Cassarly, S. David, D. Jenkins, and A. Riser), Optical Engineering 39, 7, 1830-1839, (2000).

"Optimization Methods for Illuminators for sub-100nm Lithography," (with W. Cassarly, K. Thompson, T. Kuper, J. McGuire, and R. Shack), DARPA Advanced Lithography conference, Oral Presentation, (May 2000).

"Changes in Angular and Spatial Distribution Introduced into Fiber Optic Headlamp Systems by the Fiber Optic Cables," (with W. Cassarly, R. Hansler, T. Stenger, G. Allen, and R. Buelow), SAE International Congress and Exposition 981197 (1998).

"Comparison of Dual Focus Collector Schemes for Fiber Systems," (with W. Cassarly, R. Hansler, and G. Allen), SAE International Congress and Exposition 970254 (1997).

"Acoustic and Atomic Force Microscopy Study of the Martensitic Phase Transformation of Ni<sub>63</sub>Al<sub>37</sub> as a Function of Stress and Temperature," M.S. Thesis, John Carroll University, 1995.

"Temperature and Uniaxial Stress Dependence of the Martensitic Transformation Temperature in Ni<sub>63</sub>Al<sub>37</sub>," (with C. Grehofsky, M. Gonzalez, J. Worgull, and J. Trivisonno), Vol. 5, no. 8, (1995): 1023 Journal de physique. IV, Colloque: JP. ISSN: 1155-4339.

"Structure, structural phase transitions, mechanical properties, defects, etc - Ultrasonic and atomic force studies of the martensitic transformation induced by temperature and uniaxial stress in NiAl alloys," (with J. Trivisonno, and L. Zhou), Vol. 59, no. 5, (1999): 3421 Physical review. B, Condensed matter ISSN: 0163-1829.

## **Professional Societies**

Member, SPIE The International Society for Optical Engineering

Member, SID The Society for Information Displays