

CURRICULUM VITAE

(Details at <http://pips.creol.ucf.edu>)

Nabeel A. Riza

Full Professor

Head, Photonic Information Processing Systems Laboratory

CREOL, The College of Optics & Photonics and Department of Electrical & Computer Engineering

University of Central Florida

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Visiting Professor, Summer 2007 and Summer 2008

Delft University of Technology (TU Delft), Netherlands.

Education:

Ph.D. - Electrical Engineering, California Institute of Technology (Caltech), Oct. 1989

M.S. - Electrical Engineering, California Institute of Technology (Caltech), June 1985

B.S. - Electrical Engineering, Illinois Institute of Technology (IIT), August 1984

Research Interests and Internationally Acknowledged Applied Optics Multi-Disciplinary Contributions in:

- (a) Energy (*Extreme Environment Physical Sensors – Active DOE program*)
- (b) Health/Biomedicine (*e.g., Fast Microscopy & Bio-Sensing*)
- (c) Communications (*e.g., Both Wired and Wireless/RF+ Optical*)
- (d) Defense/Aerospace (*e.g., Antenna/Radar Signal processing*)

Specialties are: Biomedical Optical Imaging & Sensing, Nano-scale Test & Measurement Optical Instruments, Extreme Environment Sensors, Adaptive Optics Devices & Systems, Fiber-Optic Communications and Switching, Acousto-optic Signal Processing, Optical MEMS, Liquid Crystal Devices, Microwave Photonics and Radar, Freespace Laser Communications

Research Sponsors: General Electric, Office of Naval Research, DARPA, Army Research Office, Air Force Wright Labs., NAVSEA, NAVAIR, Ballistic Missile Defense Agency/MDA, DOE

Research Funding: Over US \$ 7 M support since joining academia in 1995.

Research Related Awards & Honors:

- **2008 German Berthold Leibinger Innovation Prize Nominee Distinction (one of 8 world-wide) for Innovation in Applied Laser Technology**
- **2008 Distinguished Alumni Professional Achievement Award from the Illinois Institute of Technology**
- **2007-2008 European Union (EU) Erasmus Mundus Visiting Scholar Professorship Award. One of three winners worldwide selected by EU Optical MSc Course Program. Visiting TU-Delft, Institute of Optics-Univ. Paris, & Univ. Jena-Germany.**
- **2007 Institute of Electrical & Electronic Engineers (IEEE) Fellow Award**
Citation: For contributions to acousto-optic, liquid crystal, and micromirror device applications in photonic signal processing and controls”
IEEE Society: Lasers and Electro-Optics Society (LEOS)
- ***International Commission for Optics (ICO) 2001 International Prize in Optics and 2001 Ernst Abbe Medal from Carl Zeiss Foundation-Germany***
(Generally Considered the Highest International Prize in Optics for Scientists under 40 years)
See full ICO citation published in the Jan.2002 ICO Newsletter at:
http://www.ico-optics.org/ico_jan02.html#Riza

Related Distinctions:

- First South-Asian Origin Scientist to Win ICO Prize & Abbe Medal
 - First Caltech Alumnus to win ICO Prize & Abbe Medal
 - First Illinois Inst. of Tech. Alumnus to win ICO Prize & Abbe Medal
 - First Student-Ph.D. Advisor Team to Win ICO Prizes (Advisor: D. Psaltis, ICO Prize 1989)
 - First Grand Advisor (Psaltis ICO 1989)-Advisor (Riza ICO 2001)-Riza Student Team (Sarun Sumriddetchkajorn Abdus Salam ICTP-ICO Award 2005) to win ICO based International Awards.
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- *Fellow* of the Optical Society of America (OSA), March 1998
Citation: For pioneering and sustained optical inventions in photonic control systems for phased array antennas
 - *Fellow* of the International Society for Optical Engineering (SPIE), March 1998
Citation: For specific achievements in the area of photonic information processing systems, including the invention of scanning acousto-optic interferometers, wideband acousto-optic signal processors, liquid crystal optical switches and programmable lenses.

- ***2004 LaserFocusWorld Commendation Award for Excellence in Technical Writings August 2004. (Related to Nuonics,Inc. Beam Profiler Technology)***
- Appointed Vice President IEEE for Lasers and Electro-Optics Society (LEOS) 2002-2005
- Senior Member IEEE 1994
- General Electric Company Corporate R & D Three Patent Medals (1994 Gold, 1993 Silver, 1991 Bronze Patent Medals) Gold is for 20 patents.
- General Electric Company Corporate R & D Publications Award 1994 (over 75 publ.)
- General Electric Company Corporate R & D New Start Research Award 1990
- International Society for Optical Engineering:SPIE Student Award 1987
- Caltech Scholarships 1984-89
- Illinois Institute of Technology Alumni Association Academic Achievement Award 1984 (Amongst top 3 seniors in Graduating Class of Entire University)
- Elected Member Phi Eta Sigma 1982 (Freshman Honor), Tau Beta Pi 1984 (National Engineering) and Eta Kappa Nu 1982 (Electrical Engineering) Student Honor Societies
- Illinois Institute of Technology Merit Scholarships 1982-84
- Double Distinction in Advanced (A) Level Mathematics, Cambridge University (U.K.) Overseas Higher Senior Cambridge Program 1980.

Teaching and Education Awards:

- Optical Society of America (OSA) International Traveling Professor Award 2009.
- EU Erasmus Mundus OptSc Program 2008 Univ. of Jena, Germany Optics Summer School Carl Zeiss Student Project Prize for 4-student Team mentored by Prof. Riza.
- Optical Society of America (OSA) International Traveling Professor Award 1999.
- Graduate Research Student Awards to Group Members:
 - 1997 New Focus Optics Essay Prize (N. Madamopoulos)
 - 1998 OSA-New Focus Prize (N. Madamopoulos)
 - 1997 SPIE Scholarship (N. Madamopoulos)
 - 2000 IEEE LEOS Student Fellow Award (Sarun Sumriddetchkajorn)
 - 2000 OSA-New Focus Prize (Sarun Sumriddetchkajorn)
 - 2000 SPIE D.J Lovell Prize (Sarun Sumriddetchkajorn for Highest graduate research honor from SPIE)
 - 2000 Best Thai Citizen Ph.D. Dissertation Award
 - 2003 SPIE Scholarship (Zahid Yaqoob)

2003 Best UCF Ph.D. Dissertation Award (Z. Yaqoob)
2004 IEEE LEOS Student Fellow Award (Muzammil Arain)
2004 SPIE Scholarship (Muzammil Arain)
2004 Best Young Scientist Award Thailand (Sarun Sumriddetchkajorn)
2005 Abdus Salam ICTP/ICO Young Scientist Award (Sarun Sumriddetchkajorn)
2005 OSA-New Focus/Bookham Prize (Sajjad Khan)
2005 IEEE Orlando Section Best Graduate Student Research Award (Sajjad Khan)

- IEEE LEOS Educational Grants

Two IEEE LEOS Educational Grants of \$ 2445 and \$ 1495 awarded to the UCF IEEE LEOS Student Chapter that I started in 1995 and now act as the advisor. The first project was “The Color Laser Scanner” and the second one is the “ Laser Communication Link” project. Both projects have both undergraduate and graduate UCF students involved from various departments.

- Illinois Inst. Of Tech. Student Counselor Recognition Award 1984

Service Awards:

- Recipient as Chair of the 1999 IEEE LEOS Chapter of the Year award
- Recipient as Chair of the 1998 IEEE LEOS Most Innovative Chapter award
- Recipient as Chair of the 1997 IEEE LEOS Most Innovative Chapter award
- Recipient as Chair of the 1996 IEEE LEOS Highest Membership Increase Chapter award

Optics & World Media Press Recognition:

- “All-digital and hybrid analog-digital beam profiling technology,” N. A. Riza, German Photonik Magazine, Metrology Feature, Feb.2009.
- “No Moving Parts Axial Scanning Confocal Microscopy,” Research Article Selected for the OSA Optics & Photonics News (OPN) Magazine, Optics in 2008 Special Issue, Dec., 2008. (www.photonik.de)
- “Taking Advantage of the Digital Realm: A Paradigm Shift in Laser Beam Profiling Technology,” N. A. Riza, Laser Focus World Magazine, August 2004.

- “No-moving parts optical set-ups scan bar codes,” Daniel S. Burgess, Photonics Research, Photonics Spectra Magazine, pp.134-135, May 2004.
- “All digital profiler handles high power beams,” John Wallace, Optoelectronics World News Section, pp.23-25, Dec. 2002 Issue, Laser Focus World Magazine.
www.laserfocusworld.com
- “Scientists explore the outer limits,” Analysis Section, pp.17-18, March 2002 Issue, Fibre Systems Europe Magazine.
- “Nuonics rings changes on VOAs,” Technology Focus Section, Special report on optical components, p.14, March 2002, Fibre Systems Europe Magazine.
- “Variable attenuator for fast response high optical power applications,” Optical Engineering Section, p.41, Optics in 2002 Special Issue of OSA Optics & Photonics News (OPN) Magazine, Dec., 2002.
- “Sound waves shake up fiber-optic components,” Emerging Technologies Section, pp.21-23, Nov./Dec. Issue 2002, Fibre Systems International Magazine. Also pp.29-32, Sept.2002 Issue, Fibre Systems Europe Magazine. <http://fibers.org>
- “New ventures strive to air their message,” J. Devaney, pp.19-20, Analysis Section, April 2002 Issue, Fibre Systems International Magazine.
- MEMS pioneer wins ICO award , 14 March 2002 “Nabeel Riza has won the International Commission for Optics' annual prize.” Institute of Physics (IOP), UK Press Release. <http://optics.org>
- Optics Professor is World Class, by S. Loden, UCF Press Release, Oct.21, 2001. <http://www.news.ucf.edu/FY2001-02/011023.html>
- Pride in Accomplishments, Press Release, The 55th National Conference on the Advancement of Research, Dec. 2002. <http://www.ncar.org/ucf.html>
- The ICO Award Winners, Prizes and Awards in Physics: CIRS. <http://www.cirs.net/awards/physics/physicICOpriizes.htm>
- “High Speed Multiwavelength MEMS Fiber-Optic Attenuator,” Research Article Selected for the OSA Optics & Photonics News (OPN) Magazine, Optics in 1999 Special Issue, Dec., 1999.

- “High Speed Multiwavelength Photonic Switch,” Research Article Selected for the OSA Optics & Photonics News (OPN) Magazine, Optics in 1998 Special Issue, Dec., 1998.
- “High Speed Scanning Interferometer for Scientific & Industrial Applications” Research Article Selected for the OSA Optics & Photonics News (OPN) Magazine, Optics in 1997 Special Issue, Dec., 1997.
- “Photonic Signal Processing for Biomedical and Industrial Ultrasonic Probes” Research Article Selected for the OSA Optics & Photonics News (OPN) Magaz., Optics in 1996 Special Issue, Vol.7, No.12, pp.22-23, Dec., 1996.
- “Fault-tolerant fiber attenuator using micromirrors” Research Highlighted in World News Section of the Laser Focus World Magazine , Oct., 1999.
- “Fiber Enables Photonic Time Delay Signal” Research Highlighted in World News Section of the Laser Focus World Magazine , p.28, Sept., 1996.
- “Electro-Optic Controller for Phased Array Antennas,” SPIE Optoelectronics (OE) Reports Newsletter Article, No.121, Jan.,1994.

Professional Positions Held:

- Duration: Summer 2007 and Summer 2008
 Position: **Visiting Full Professor**
 Delft University of Technology (TU Delft), Netherlands.
- Duration: 2001 - Present
 Position: **Full Professor**
 CREOL, The College of Optics & Photonics and
 Department of Electrical & Computer Engg. (Joint Appt)
Head, Photonic Information Processing Systems (PIPS) Laboratory
 University of Central Florida, Orlando, FL
- Duration: Jan.2001- Aug. 2007 (on 50% part leave from UCF)
 Position: **Founder and President**
 Nuonics, Inc., Florida (www.nuonics.com)
- Duration: Feb.1 1995 to 2001
 Position: **Associate Professor of Optics and Electrical & Computer Engineering**
 School of Optics, Electrical Engg. Dept., and
 Center for Research & Education in Optics and Lasers (CREOL)
Head, Photonic Information Processing Systems (PIPS) Laboratory

University of Central Florida, Orlando, FL

HighLights: Trained international award winning Ph.D. students including 2005 ICO/Abdus Salam ICTP Award Winner, three OSA-New Focus Prizes, One SPIE D. J. Lovell Prize (highest award from SPIE), three IEEE LEOS Student Fellows and several SPIE Scholarships

In 1995, Won as PI \$ 1.1 M from the Office of Naval Research for R & D on a Photonic Controller for an Advanced Navy Phased Array Radar

In 1998, founded high technology small business Nuonics, Inc. via Riza inventions. Established operations and presently continuing commercialization efforts.

In 2000, Won as PI \$ 900 K from the Defense Research Projects Agency (DARPA) on a new generation of scanner technology called MOST

In 2004, Won as PI \$ 1.25 M from Department of Energy (DOE) on a new generation of extreme environment optical sensor technology

In 2006, Won as PI, one of six competitive DOE University Energy Research Program Grants to study a new generation of extreme environment optical sensor technology for clean energy coal-fired power plants.

Duration: Nov., 1989 to Jan., 1995

Position: **Lead Scientist & Project Manager**

Optically Controlled Radar Project

General Electric Corporate Research and Development Center, Schenectady, New York

HighLights: Introduced, Organized, Managed, and Secured a \$ 2 Million, 4 year Effort to Develop Novel Antenna Controllers & Subsystems for GE Aerospace

Made the Key Technical Breakthroughs for meeting the Changing Business Goals described extensively in over 75 publications & 20 patents

Duration: Sept., 1984 to Oct., 1989

Position: **Research & Teaching Assistant** (Doctoral Candidate)

Optical Information Processing Group, Electrical Engineering Dept. California Institute of Technology, Pasadena, U.S.A.

HighLights: Amongst the earliest contributions to the field of “Photonics & Phased Array Systems (PAPAS)”

First Ph.D Thesis in this field

Specifically, introduced the use of Ultra-Stable Coherent Optics for Reversible Transmit/Receive Mode Optical Control of Phased Array Antennas

Invented an ultra-stable optical interferometer called the “In-line Acoustooptic Interferometer, “ that is also now proving itself as a high performance optical system for key signal processing tasks such as Correlation, Convolution, I-Q Processing, & Wideband Spectrum Analysis

Teaching Activities

Taught both graduate and undergraduate classes that include:

1. Photonic Signal Processing (Graduate)
2. Wave Optics (Graduate)
3. Optical Engineering (Undergraduate)

Supervised Visiting Professors, Post-Doctoral Staff, and Ph.D., Master’s, and BS level students that include:

1. Nicholas Madamopoulos (MS. & Ph.D. student; Ph.D awarded 1999)
2. Sarun Sumriddetchkajorn(MS & Ph.D. student; Ph.D awarded 2000)
3. Jian Chen (MS student, MS awarded 1998)
4. Dr. Jinkee Kim (Postdoc 1996)
5. Dr. Shifu Yuan (Postdoc 1997-98)
6. Prof. Azhar Rizvi (Visiting Professor 2000)
7. Yu Huang (MS student, MS awarded 2001)
8. Dr. Deepak Sengupta (Postdoc 2000)
9. Zahid Yaqoob (MS awarded 2001, Ph.D awarded 2003)
10. Sajjad Khan (MS awarded 2002, Ph.D Nov. 2005)
11. Muzamil Arain (MS awarded 2002, Ph.D. Summer 2005)
12. Miranda Stratton (1997 NSF undergraduate REU scholar from Univ. of Maryland- College Park)

13. Jeff Steedle (1998 NSF undergraduate REU scholar from Univ. of Notre Dame)
14. Doug Jorgenson (2002 NSF undergraduate REU scholar from Univ. of Illinois-Urbana)
15. Ruud Gilesen (2000 International Master Research Project, Technical Univ. of Eindhoven, Netherlands)
16. Martin van Buren (2002 International Master Research Project, Technical Univ. of Eindhoven, Netherlands)
17. Fredrico Pierra (2002 International Master Research Project, Imperial College London, UK)
18. Jason Karp (2003 NSF undergraduate REU scholar from Univ. of Miami)
19. Marten Bakker (2003 International Master Research Project, Technical Univ. of Eindhoven, Netherlands)
20. Tiffany Metzsig (2004 NSF undergraduate REU scholar from UCF)
21. Matteo Gentili (2006 International Masters Research Project, University of Ancona , Italy)
22. Farzan Ghauri (2003 MS Awarded, Ph.D. Aug.2007)
23. Mumtaz Sheikh (2007 M.S., current Ph.D. student)
24. Syed Azer Reza (2007 M.S., current Ph.D. student)
25. Philip Marraccini (current MS/Ph.D student)

Ph.D. Dissertation Committee Member for the Following Non-Group Students:

1. Muhammed Al-Mumin (Advisor: G. Li)
2. Walleed Mohamed (Advisor: E. Johnson)
3. M. Mujat (Advisor: A. Dogariu)
4. Nan Zhang (Advisors: D. Polla and S. Roorda; Univ. of Montreal-Canada)
5. Claire Fan (Advisor: S. T. Wu)
6. Fang Du (Advisor: S. T. Wu)
7. Yi-Hsin Lin (Advisor: S. T. Wu)
8. Yung-Hsun Wu (Advisor: S. T. Wu)
9. Shinwok Lee (Advisor: P. Delfyett)
10. Meizi (Advisor: S. T. Wu)
11. C. Song (Advisor: S. T. Wu)
12. Likai Zhu (Advisor: G. Li)

Teaching/Educational/Service Extracurricular Activities

1. IEEE LEOS Vice President for Memberships, 2002-2005.
2. Faculty Advisor to the IEEE LEOS UCF Student Chapter 1996-2002
3. Organizer of the UCF IEEE LEOS Distinguished Seminar Series 1996-2002
4. Guest Presentation at the Summer 1997 and 1998 College of Optics NSF REU Program.
5. Invited Member of OSA A. Lomb Medal Committee 2005 and 2006.
6. Invited Member IEEE LEOS Distinguished Lecturer Award Committee 2005 and 2006.
7. Selected on basis of scientific contributions in Information Optics as an International Official Nominator for the 2009 Japan Kyoto Prize in Advanced Technology.
8. Invited Member of OSA Esther Hoffman Beller Medal Committee 2009 and 2010.
9. Appointed Associate Editor of International Journal of Optomechatronics, Francis Taylor, Feb. 2009.

Committee Assignment: University, School, and Departmental Committees

College of Optics & Photonics-CREOL

1. Screening and Recruiting Committee (1998-2000)
2. Industrial Affiliates Committee (1996-1999, 2004-2007)
3. Academic Affairs Committee (1995-1998)
4. Distinguished Visiting Scholars Committee (1999-2007)
5. Student Recruiting Committee (1999-2001)
6. CREOL Industrial Affiliates Day Organizing Committee Member (2004-2007)
7. UCF University Committee on Emeritus Professorships (2005-2007)
8. UCF Research Council (2007-2009)

Professional Service

Professional Organization Activities:

1. Committee Member, SPIE Conference on Algorithms, Devices, and Systems for Optical Information Processing, San Diego, 1998 to 2007.
2. Committee Member "Electro-Optic Systems & Sensors," IEEE LEOS Annual Meetings, 1997, 1998, 1999, 2000, 2001.

3. Session Chair, IEEE LEOS Annual Meetings, 1995, 1996, 1997, 1998, 1999, 2000.
4. Chair, IEEE LEOS Orlando Chapter 1995-2002.
5. Reviewer for the Journals: Optical Engineering, Optics Communications, Optics Letters, Applied Optics, Journal of Lightwave Tech., IEEE Photonic. Tech. Letters
6. Guest Editor, SPIE Working Group Newsletter, April 1999 and Fall 2001.
7. Co-Chair, SPIE Conference on Adv. in Optical Information Processing, Orlando, April 1996
8. Committee Member, SPIE Conference on Adv. in Optical Information Processing, Orlando, April 1998 and 2000
9. Committee Member & Session Chair, SPIE Conferences on Optical Tech. Microwave Appl., 1995 & 1997
10. Committee Member, SPIE Conference on Emerging Optoelectronic Technologies, Bangalore, India, Dec. 1990.
11. Chair, SPIE Special Panel on “ Optical Technologies for Wireless Communications,” SPIE Annual Meeting, August 2001.
12. Chairman, IEEE LEOS Special Symposium on Agile Optical Beams, Glasgow, Nov. 2002.
13. Vice President, Membership Americas, IEEE LEOS, Nov. 2002-to-2005
14. OSA Optics in the South East Student Awards Committee, Georgia Tech, Oct. 2005.

External Service:

Served as an Invited Scientific Expert for:

- (a) US National Science Foundation 1996, 2009
- (b) National Institute of Standards & Technology (NIST) 1998
- (c) OIDA (Optoelectronics Industry Development Association) 1997
- (d) Office of Naval Research (ONR) 1994
- (e) DARPA 1999, 2000, 2007.
- (f) Government of Netherlands NRO Panel on Top Research NRC Institutes, 2003.
- (g) Dept. of Energy (DOE) 2006, 2007
- (h) National Institute of Health (NIH) 2002
- (i) Swedish Research and Technology Council 2008.

Industry Related Activities:

- Founder, Nuonics, Inc. a 1998 Start-up Company Specializing in Photonic Products for Telecommunications, Manufacturing, and Medical/Health Industries. Awarded Several DOD SBIR Contracts.
- GE Corporate Ph.D Level Recruiter 1990-94 at the California Institute of Technology (doubled Caltech Alumni at GE)
- Have had a Teaming Relationship with Lockheed-Martin Govt. Electronic Systems (LM-GES) on my ONR Sponsored 3-year (1995-1998) radar project

- Photonic Systems Inc., Melbourne, FL have proto-typed a two channel acousto-optic radar receiver under a Navy 1995 SBIR Phase 2 program. PSI has named this system the “Riza Correlator,” as originally invented by N. A. Riza. This is a case of successful technology transfer from a R & D lab. to a commercial end-user
- Successfully won and completed a Joint SBIR Phase 1 1996 Navy Program with Photonic Systems Inc., Melbourne, FL, on the 2-D Acousto-optic Inverse Synthetic Aperture Radar Image Processor invented by N. A. Riza

Outreach & University Based Extracurricular Activities:

1. Conducted Photonic Information Processing Lab. Tours for visiting local school students and guests from various conferences such as SPIE Aero-Sense and IEEE LEOS meetings held in Orlando.
2. Using the LEOS student projects such as the mobile setup of CD music transmission through optical communications, highlighted fun in optics at various local and UCF fairs and Expos.
3. Hosted Local High School Students Ben Katz (Winter Park High School) and Chris Bock (University High School; later BS Stevens Institute of Tech., NJ) in PIPS Lab. as a student assistants.
4. President Caltech International Student Association 1987-89. Started the First Caltech International Fair Day for Caltech/JPL Community.
5. Captain, Caltech KAOS Soccer Team 1987-89.
6. President, International Student Association, Illinois Inst. of Technology, 1983-84.

Invited Books and Book Chapters

1. N. A. Riza, Editor, SPIE Milestone Series Book on “*Photonic Control Systems for Phased Array Antennas*”, Vol.136, 1997. (A Reference Book for the Microwave Photonics Field)
2. N. A. Riza Co-Editor (with C. Cox & E. Ackerman from MIT Lincoln Labs.), SPIE Milestone Series Book on “*Analog Fiber-Optic Links*” , Vol.149, March 1998
3. N. A.Riza, Chapter on “ Acousto-Optic Signal Processing,” Wiley /IEEE Encyclopedia of Electrical & Electronics Engineering, Editor, J. Webster, March 1999.
4. N. A. Riza, Chapter on “ Acousto-Optics,” Comprehensive Dictionary of Electrical Engineering, CRC & IEEE Press, Jan. 1999.

Publications/Patents Summary:

Peer-reviewed Journal Publications:	125
Conference Proceedings Publications:	150
Issued Patents:	37
GE Journal Publications	29
Total Publications & Patents	341
Invited Seminars/Lectures:	57

Research Firsts: Example Pioneering Contributions

Nabeel A. Riza is responsible for the invention of several exceptional performance optics and photonics that for example include:

1. All digital paradigm for optical power control in fiber-optic systems where not only is the optical module control via simple digital electronics means but the optical hardware itself is also two state or digital. This innovation has lead the way to replacing today's limited performance all-analog gain control fiber-optics to hysteresis free all-digital highly scalable and robust digital power control fiber-optics. Riza has recently demonstrated these fiber-optic attenuators using micromirror and liquid crystal technologies. This is also the first time that the spatial nature of light in terms of its position and interaction area has been exploited in single-mode fiber-optics to realize truly intelligent and simple fiber-optic components. These innovations have successfully undergone development at Nuonics, Inc. (www.nuonics.com) and independent commercialization at Cidra Corporation (www.cidra.com) and Newport Corporation (www.newport.com). Cidra sold it as an equalizer for optical networks and Newport offers it as a test instrument for processing broadband light (<http://www.newport.com/lambdacommander/>).
2. Multiplexed Optical Scanner Technology called MOST that exploits polarization, wavelength, and optical codes to realize powerful multidimensional scans. For example, the polarization MOS or P-MOS is a digitally controlled, no moving parts, low (mW) control power, LC-based structure for fast microsecond speed three dimensional scanning of a light beam where birefringent static lenses and x- and y- prisms are placed sequentially along the beam and are dynamically activated or deactivated by digital control of polarization switches. Another scanner invention, the wavelength MOS or W-MOS exploits the exceptionally fast (e.g., nanosecs) wavelength tuning ability of modern lasers that are fiber-coupled with large planar dispersive optics (and Volume Grating Optics) and fiber-optic space switches to realize large beam active area yet superfast speed scanners over large scan ranges. The W-MOS can be effective in numerous applications such as three dimensional non-destruction testing/mapping and optical wireless communications. The Code MOS or

C-MOS uses holography with input beam activation codes to produce a simple no-movings parts 3-D scanner with tremendous beamforming capabilities over wide angles (e.g., 360 degrees) and large apertures (e.g., 2 cm). All MOSs are unique pixelation-free devices with large clear apertures, a great asset for optical scanners.

3. An all-digital paradigm in optical beam profiling. For the first time, 100% digital repeatability spatial profile measurements, in particular, for high power laser beams is possible via the use of a digital micromirror device (e.g., TI MEMS DMD). Unlike old analog mechanical profiling methods, the new digital method performs real-time measurements in addition to implementing several profiling methods (e.g., slit, knife-edge, pinhole, etc.) via software programming of the same unit.
4. fiber-optic attenuator design that for the first time can simultaneously deliver features such as zero net Doppler, high 50 dB dynamic range, sub-microsecond switching speed, low < 1.6 dB loss, high 1 Watt laser damage threshold, and low < 0.2 dB polarization dependent loss (PDL). This attenuator uses a unique in-line Doppler-free two acousto-optic Bragg cell architecture with polarization geometry flipping induced via a waveplate that leads to a drastic reduction in PDL.
5. self-aligning, microsecond/point scanning speed, acousto-optic (AO) interferometer measuring optical phase/displacement with both high temporal (e.g., 1 ps) and spatial resolution (e.g., 0.1 nm).
6. liquid crystal (LC) and acousto-optic device-based structures for freespace optical beam switching with exceptionally high (e.g., -50 dB) optical noise rejection. Variable optical delay lines covering 10-13 sec. to 10-6 sec. were invented and realized based on digital control of these switches.
7. liquid crystal (LC) switches for fiber-optics that simultaneously demonstrate the fastest speeds and lowest crosstalk levels by employing passive and active noise rejection schemes. These methods have been deployed in commercial LC-based products.
8. Free-space fiber GRIN lens to fiber GRIN lens coupling model that mathematically showed the tilt and translational sensitivity involved with designing and building freespace systems deploying input/output GRIN-based fiber-optics. This model is now used in industry to optimize freespace-fiber designs.
9. a simple yet highly effective fiber-optic attenuator that takes deliberate advantage of a nasty 3-D beam spoiling effect to give controlled optical power attenuation. Here, a negative aspect of physical optics was turned into a positive aspect for fiber-optic component design.
10. self-imaging technique for fiber-lens to fiber-lens interconnections via freespace gaps using less than quarter-pitch design fiber lens that leads to an exceptional low loss

coupling. Specifically, the Gaussian beam over a given freespace distance experiences a converging and diverging effect that is equivalent to self-imaging. This effect and self-imaging method is commercialized and used by industry (e.g., LightPath fiber collimators).

11. coherent high phase stability and low control power method for generating frequency, amplitude, and phase-controllable microwave radar signals using acousto-optic modulation of two polarization encoded optical waves illuminating an array of LC pixels.
12. coherent and robust acousto-optic processor for spectrum analysis, correlation, and convolution delivering high (>70dB) dynamic range processing of extremely wide instantaneous bandwidth (>500MHz) RF signals.
13. LC device that incorporates simple thin film resistor-based control within the device electrode structure to provide optical beam control via a simple control voltage vs. a multi-voltage computer controller.
14. digitally controlled fault-tolerant and alignment robust fiber-optic switches, and optical delay lines using small tilt micromirrors based on optical microelectromechanical systems (MEMS) technology.
15. high speed, no moving parts, optical/ultrasonic phased array scanning probe using a single fiber cable and multiple wavelengths to deliver intracavity access.
16. freespace multiple access optical communication scheme using space-time codes.
17. optical security system using the multidimensional optical scanning of ID data.
18. First Hybrid Digital-Analog MEMS Optical Beam Profilers for Laser Beam Characterization.
19. First Non-Invasive Liquid Crystal Optical Beam Profiler for Laser Beam Characterization.
20. Under the theme “Hybrid Photonic Signal Processing”, the First Hybrid Analog-Digital Technique Fiber-Optic Variable Delay Line and Variable Optical Attenuator that can simultaneously provide the highest resolution over the widest dynamic control range- a feat not possible before for the mentioned component categories. Results have shown World Record Numbers.
21. Highest weight and time delay tap programmability RF filter using optical MEMS for Microwave/mm-wave signal processing.

22. First no-moving parts axial scan confocal microscope applicable also for broadband light.
23. Largest beam profiling aperture (15 inch diagonal) no-moving parts LC-based laser beam profiler.
24. Highest measurement range hazardous environment wireless optical sensors for ultra hot (> 1500 C) and ultra-cold (< 100 K) temperature and extreme pressure (> 600 psi) measurements.
25. First direct spatial processing distance/displacement sensor. Applications include 3-D object reconstruction.

Journal Publications (125)

1. N. A. Riza and D. Psaltis, "Acousto-optic signal processors for transmission and reception of phased array antenna signals," *Applied Optics*, (Journal of the Optical Society of America, Washington, D.C.) Vol.30, No.23, pp.3294-3303, 1991.
2. N. A. Riza, "A transmit/receive time delay optical beamforming architecture for phased array antennas," *Applied Optics*, Vol.30, No. 32, pp.4594-4596, Nov., 1991.
3. N. A. Riza, "An acousto-optic phased array antenna beamformer with independent phase and carrier control using single sideband signals," *IEEE Photonics Tech. Lett.*, Vol.4, No.2, pp.177-179, February, 1992.
4. N. A. Riza, "Optically efficient interferometric acousto-optic architecture for spectrum analysis," *Applied Optics*, Vol.31, No.17, pp.3194-3196, June 10, 1992.
5. N. A. Riza, "Acousto-optic architecture for two dimensional beam scanning in phased array antennas," *Applied Optics*, Vol.31, No.17, pp.3278- 3284, June 10, 1992.
6. N. A. Riza, "An acousto-optic phased array antenna beamformer for multiple simultaneous beam generation," *IEEE Photonics Tech. Lett.*, Vol.4, No.7, pp.807-809, July, 1992.
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3. N. A. Riza, “Optical Signal Processing,” Dept. of Electronics, Quaid-e-Azam Univ., 1993.
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10. N. A. Riza, “The Road to Innovation and Advanced Product Development,” LUMS Center for Management & Economic Research (CMER) Seminar, LUMS, Jan., 1994.
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19. N. A. Riza, Seminar on “Photonics for Next Generation Telecommunication Systems,” Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, Nov. 1998.
20. N. A. Riza, Seminar on “Photonic Innovations: A High Impact Multidisciplinary Approach for Advanced Sensing, Testing, Computing, and Communication Systems,” Northwestern University, Feb., 1999.
21. N. A. Riza, “Optics for wireless technologies,” US-Japan Joint Optoelectronics Program (JOP) Workshop, San Francisco, April 1999.
22. N. A. Riza, “Optical Beamforming for laser communications,” DARPA ETO Program Workshop on Laser Communications, Virginia, April 1999.

23. N. A. Riza, Seminar on “Telecommunication Controls See the Light,” University of California-Sana Cruz, March 14, 2000.
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37. N. A. Riza, " Free-space Optics and Fiber-Optics for Communications and Controls," Institute of MicroTechnology (IMT) Seminar, Univ. of Neuchatel, Switzerland, July 18, 2003.
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47. N. A. Riza, “Space-Time Manipulations of Light Beams,” EE Dept. Seminar, University of Southern California, July 27, 2005.
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51. N. A. Riza, Seminar on “Optical Sensor Solutions for 21st Century Global Challenges in Energy,” Institute of MicroTechnology (IMT), Univ. of Neuchatel, Switzerland, July 5, 2007.
52. N. A. Riza, Seminar on “Photonic Sensor Solutions for 21st Century Global Challenges in Energy Production,” Department of Electrical Engineering, COBRA Institute, Eindhoven University of Technology (TUE), Eindhoven, The Netherlands, July 18, 2007.
53. N. A. Riza, Seminar on “Silicon Carbide Hybrid Optical Sensors for Next Generation Greener Gas Turbines,” Department of Mechanical Engineering, Caltech, Pasadena, Nov.13, 2007.

54. N. A. Riza, Seminar on “ Silicon Carbide Hybrid Optical Sensors for Next Generation Greener Power Generation Systems,” Illinois Institute of Technology, Chicago, May 1, 2008.
55. N. A. Riza, Seminars on “Advances in Photonic Signal Processing,” Institute of Optics Graduate School, Ecole Polytechnic-Campus Palaiseau, University of Paris-SUD, May 13-15, 2008.
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57. N. A. Riza, Seminars on “Advances in Laser Beam Measurement and Wideband Microwave Radar Controls,” Ernst Abbe Center, Friedrich Schiller University of Jena, Germany, July 10, 2008.

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