Raymond C. Rumpf, Ph.D.

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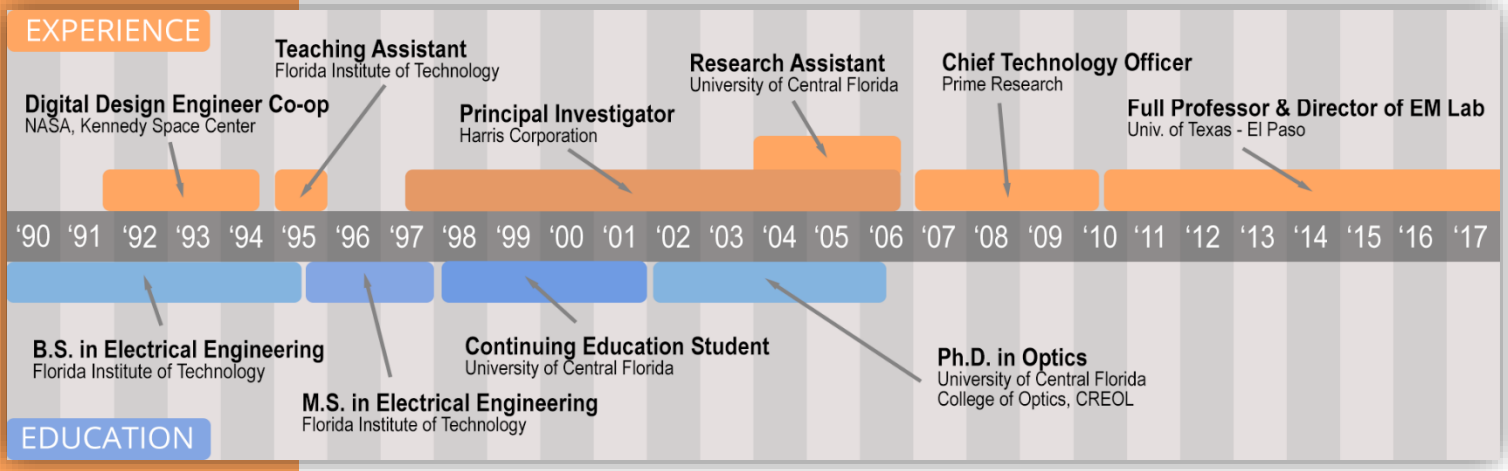
INNOVATIVE • DIVERSE • BUSINESS DEVELOPMENT • MOTIVATING LEADER

Dynamic, results-oriented Engineer/Scientist with extraordinary record of accomplishments in business, research, teaching, and innovation. Helped transform technology portfolio for Prime Research LC, to position it for unlimited opportunities in commercial and government sectors, including DoD. Founded EM Lab with a mission to develop revolutionary technologies enabled by 3D printing and delivered an array of significant breakthroughs in a short time. Skilled in forecasting technology trends, building teams, writing proposals, directing research, and managing intellectual property. Able to make sound decisions based on limited data and to originate and direct high-risk/high-payoff research. Energetic and extremely ambitious.



Core Competencies

Nontechnical

- Teaching & education
- Business development
- Strategy
- Motivating leader
- Managing risk
- Technical writing
- Presentations
- Graphics & visualization
- Proposal writing

Technical

- Digital manufacturing
- Spatially variant lattices
- Electromagnetics
- Photonics
- Simulation & optimization
- Photonic crystals
- Metamaterials
- Metasurfaces
- Antennas & frequency selective surfaces
- Diffraction gratings
- Waveguides
- Advanced packaging
- Devices for extreme environments

— Interest Areas —

- Digital manufacturing (i.e. 3D printing)
- Electromagnetics & photonics
- Photonic crystals & metamaterials
- Antennas & frequency selective surfaces
- Leadership, education & mentoring
- Computational electromagnetics
- Electronics, RF & microwave circuits
- Graphics & visualization

— Major Awards & Recognitions —

- 2015 UT Regents' Outstanding Teaching Award
- Dean Eugene Thomas Award for Outstanding Faculty Member, 2017.
- Schellenger Prof. in Electrical Research
- BUILDing SCHOLARS & College of Engineering Mentoring Award
- Dean's Award for Teaching, 2012 & 2015
- Best in Photonics Technology 2015, Opli Magazine
- Research in 3D printed EM featured by IET
- Miguel Izquierdo Endowment for Outstanding Teaching
- DARPA Young Faculty Award, 2011-2013
- Five Official World Records in Skydiving

— Key Accomplishments —

Business

- Transformed company's technology portfolio
- Awarded $4.3M in research in < 5 years
- More than doubled number of new programs
- Managed company intellectual property (IP)
- Awarded 14 US patents

Research

- First-ever automated 3D/volumetric circuits
- Algorithm to spatially vary lattices
- Tightest bend of unguided optical beam
- Highest power frequency selective surface
- Widest FOV and most broadband dielectric filter
- Thinnest all-dielectric antenna

Teaching

- Developed six graduate courses
- Graduated 7 PhD, 5 MS, & 7 BS students
- Developed course websites & lecture videos
- Top student evaluations

Service

- Associate Editor for SPIE
- Co-Chair for Photonics West
- Faculty Advisor for IEEE Eta Kappa Nu
- Outreach to middle and grade schools
- Mentor & advise numerous students in 3rd-world countries
- Frequent volunteer for the Boy/Girl Scouts

PROFESSIONAL EXPERIENCE

University of Texas at El Paso, El Paso, TX — 2010 – Present

Full Professor, Electrical & Computer Engineering — 2018 – Present
Associate Professor, Electrical & Computer Engineering — 2010 – 2017
Director, EM Lab — 2010 – Present

Established the EM Lab to develop revolutionary technologies in electromagnetics and circuits that are enabled by digital manufacturing (i.e. 3D printing). Developed and patented an array of breakthroughs, including invention/discovery of three new electromagnetic phenomena. Developed and taught six new graduate courses and four undergraduate courses in electromagnetics and in computation. Currently advising 2 undergraduate and 11 graduate students. Awarded well over $3M in external research funding since 2010.

Graduated Students: 7 PhD in ECE, 5 MS in ECE, 1 MS in CPS, and numerous BS in ECE

Prime Research LC, Blacksburg, VA — 2006 – 2010

Chief Technology Officer — 2006 – 2010

Responsible for strategic planning, business development, intellectual property, and technical management of research and development activities. Provided vision and strategic plan that transformed Prime Research and positioned company for new opportunities in commercial and government sectors, including DOD. Redesigned proposal process and generated over $5M in advanced research and development funds in less than three years and more than quadrupled the number of new programs. Proposal win rate well over 50%. Managed and negotiated more than 11 government contracts. Participated in trade shows and conferences.

Harris Corporation, Palm Bay, FL — 1997 – 2006

Principal Investigator, Microsystems Technology Group — 2000 – 2006
Senior Electrical Engineer, Government Communications Systems Division — 1997 – 2000

Responsible for identifying and developing revolutionary technologies to radically miniaturize communications systems. Technologies included microelectronics, advanced packaging, thermal management, antennas, materials, power generation, energy harvesting, radio, communications, signal processing, photonics, MEMS, and more.

NASA, Kennedy Space Center, FL — 1992 – 1994

Digital Design Engineer Co-Op, Developmental Systems — 1992 – 1994

Responsible for designing and testing digital circuits and software for NASA's Central Data Storage System. Technical duties included circuit design, layout, and testing as well as software development to control digital circuits. Digital circuits were based on the VMEbus architecture.

EDUCATION

University of Central Florida, Orlando, FL — 1999 – 2006

Ph.D. in Optics, GPA 4.0/4.0, The College of Optics and Photonics (CREOL) — 2006
Dissertation: *Design and Optimization of Nano-Optical Elements by Coupling Fabrication to Optical Behavior*
Advisor: *Dr. Eric Johnson*

- Pioneered design of nanophotonics by combining simulations of fabrication with simulations of optical behavior.
- First to fabricate 3D photonic crystals on a standard UV mask aligner. Technique was near-field nano-patterning.
- Founded and led UCF Numerical Modeling Focus Group that was open to all students.
- Developed tuning process used during fabrication of guided-mode resonant filters to control spectral response.
- Investigated space-variant photonic crystal filters for computational imaging applications.
- Investigated fabrication of high aspect ratio form-birefringent devices by autocloning.
- Developed numerical tools to simulate micro- and nano-fabrication including photolithography, developing, chemical deposition, autocloning, and plasma etching processes.
- Developed FDTD for dispersive materials based on a Lorentz-Drude model of arbitrary order.
- Investigated methods for passive alignment of micro-optic structures including fiber micro-grippers.

Florida Institute of Technology, Melbourne, FL 1990 – 1997

M.S. in Electrical Engineering, GPA 4.0/4.0 1997
Thesis: *Fiber Optic Temperature Sensor*
Advisor: *Dr. Barry Grossman*

- Designed and built complete fiber optic temperature sensing system using extrinsic Fabry-Perot interferometer attached to a thin aluminum rod.
- Designed and built fiber optic RS-232 data link connecting a printer to a computer.
- Designed and built velocity detection system using micro-bend fiber optic sensors embedded in the ground

B.S. in Electrical Engineering, GPA 3.74/4.0 1995
Senior Design: *Surveillance Robot*

- Developed surveillance robot that was fully programmable or could follow a reflective path and autonomously avoid obstacles. Equipped robot with custom-designed wireless video transmitter aimed by remote control.

MEMBERSHIPS & CERTIFICATIONS

- Institute of Electrical and Electronics Engineers (IEEE)
- Optical Society of America (OSA)
- International Society for Optical Engineering (SPIE)
- Amateur Radio Relay League (ARRL)
- Pi Lambda Phi Fraternity, Florida Delta Upsilon Chapter
- Extra Class Amateur Radio Operator, Federal Communications Commission
- Advanced Scuba Diver, Professional Association of Diving Instructors
- Master Skydiver, USPA
- Order of Omega, Greek Leadership Honor Society
- Tau Beta Pi, National Engineering Honor Society
- Eta Kappa Nu, National Electrical and Computer Engineering Honor Society
- Blue Key, National Honor Fraternity

HONORS, AWARDS, & RECOGNITIONS

- Dean Eugene Thomas Award for Outstanding Faculty Member, 2017.
- Keynote Speaker at University of Texas at El Paso Research Forum, 2016
- Distinguished Speaker at University of Central Florida, 2016.
- Distinguished Speaker at University of Wisconsin-Madison.
- Nominated for Texas Inventor of the Year, 2016.
- Certificate of Recognition for Excellence in Teaching, State of Texas, Jose R. Rodriguez, State Senator District 29, September 2015.
- Star On The Mountain Award, City of El Paso, 22 September 2015.
- Schellenger Professorship in Electrical Research, 2015.
- University of Texas Regents's Outstanding Teaching Award, 2015.
- BUILDing SCHOLARS & College of Engineering Mentoring Award, 2015.
- Dean's Award for Teaching, May 2015.
- Best Business Plan, Paso del Norte Venture Competition, March 2015.
- Featured Engineer, EEWeb.com, Feb. 2015.
- Best in 2015, EM Lab Photonics Technology, Opli Magazine.
- Invited Speaker at Royal Society Meeting on Spatial Transforms, Jan. 2015.
- Research featured on IET website, June 2013.
- Grant Award Recognition, Office of Research and Sponsored Projects, Dec. 2014.
- Awarded the Miguel Izquierdo Endowment for Outstanding Teaching, 2012.
- Research Award in Electrical and Computer Engineering, May 2012.
- Dean's Award for Teaching, May 2012.
- College Marshall, May 2012 & 2015.
- Recipient, DARPA Young Faculty Award, 2011–2013.
- Master of Ceremony, First Lego League of Southwest Virginia, 2007–2009.
- Finalist for Student of Year, University of Central Florida, 2006.
- Best Paper Award, SPIE Conf. on Micromachining Technol. For Micro- and Nano-Optics, 2006.
- Five Official World Records in Skydiving for Largest Parachute Formation.
- Numerous invited talks and distinguished lectures

ORANGIZATIONAL ACTIVITIES & SERVICE

- **Technical Outreach**, answer dozens of questions per week from around the world and unnoffial mentor of multiple students in third-world countries, 2016 – present.
- **Associate Editor**, SPIE Optical Engineering, 2010 – present.
- **Associate Editor**, Journal of Electronic Materials, 2013 – 2015.
- **Faculty Mentor**, UTEP Faculty-Student Mentoring Program, 2012.
- **Co-Chair, Photonics West**, MOEMS & Advanced Fabrication Technologies, 2009 to present.
- **Co-Chair**, MRS Symposium on Three-Dimensional Micro-Fabrication, 2009.
- **Faculty Advisor**, Eta Kappa Nu, 2012 – present.
- **Member**, Teaching Effectiveness and Development Committee, 2015 – present.
- **Member**, Senior Design Committee, 2011 – present.
- **Member**, Fields and Devices Committee, 2011 – present.
- **Mentor**, 6th grade student for science project investigating effect of wire gauge on strength of an electromagnet.
- **Mentor**, high school student in analysis, design, and construction of Acoustic Life Aid for Roaming Manatees (ALARM) for a winning high school science fair project.
- **Reviewer**, conducted numerous peer reviews of proposals and manuscripts.
- **Master of Ceremony**, First Lego League Competition in southern Virginia, 2008 to 2009.
- **Volunteer**, Boy Scouts and Girl Scouts, 2015 to present.

CONTRACTS & GRANTS

	Year	Project	Customer	Amount
University of Texas at El Paso (UTEP)	2019	3D Printed Metasurfaces and Metamaterials	DOE	$100,000
	2018	3D Printed Integrating Sphere	nScrypt	$30,000
	2018	3D Printed Antennas for High-G	ARL	$250,000
	2018	Reduction of Radar Cross Cection	Ball	$75,000
	2018	3D Printed Flexible Hybrid Circuits	FlexTech	$1,000,000
	2017	Photon Funnels	NSF	$150,000
	2017	Study of Asymmetric Electromagnetic Devices	LMC	$25,000
	2017	3D Printing for RF Sensor Systems	AFRL	$200,000
	2017	3D Printed High-Frequency Circuits	ARL	$120,000
	2017	SVAMs for MIMO Applications	Rogers	$84,000
	2016	Modulated Reflective Metasurface	LMC	$75,000
	2016	3D Conformal Meta-Optics (3D-COMET)	UNCC	$34,000
	2016	Optical Simulation of Selective Laser Melting	ARL	$50,000
	2015	Vector Signal Analyzer/Generator for 3D Printed Circuits	Keysight	$400,000
	2015	Spatially-Variant Anisotropic Metamaterials for Improved EMC	Texas	$50,000
	2014	Ultra-Wideband Antennas	ARL	$30,000
	2014	All-Dielectric Antennas	NPS	$272,000
	2013	3D Printed Structures by Micro-Dispensing	Raytheon	$40,000
	2012	Direct Digital Manufacturing of 3D Metamaterial Devices - Option	DARPA	$150,000
	2011	Direct Digital Manufacturing of 3D Metamaterial Devices - Base Effort	DARPA	$150,000
	2011	Evaluation of 3D Printed Impedance Elements	LMC	$14,400
	2010	STARS	Texas	$250,000
	2010	All-Dielectric Frequency Selective Surfaces for High Power Microwaves	PPLC	$167,000
Prime Photonics LC (PPLC)	2010	Ultra-Low Power CMOS Radar	NASA	$100,000
	2010	High Power Microwave Frequency Selective Surfaces -- Phase 2	AFRL	$750,000
	2010	Nano-Optical Elements for Multi-Mode Imaging	AFRL	$100,000
	2009	High Power Microwave Frequency Selective Surfaces -- Phase 1	AFRL	$99,912
	2009	Meta-Optic Fluorescence Probe	DARPA	$98,962
	2009	Power Harvesting Wireless Flow Sensor	DARPA	$98,976
	2009	Full-Field Strain Sensor	Navy	$69,997
	2009	Ultra-High Temperature Metamaterials for Wireless Sensing	DOE	$810,929
	2008	Optowireless	NSF	$150,000
	2008	Nano-Optical Elements for Polarization Selective Infrared Detection	AFRL	$99,797
			TOTAL UTEP:	**$3,716,400**
			TOTAL PPLC:	**$2,378,573**
			TOTAL:	**$6,094,973**

BUSINESS ACCOMPLISHMENTS

- Founded the EM Lab with a mission to develop revolutionary technologies enabled by digital manufacturing. Awarded over $3M in external funding that led to multiple technological discoveries and breakthroughs.
- Co-Founder of Kraetonics LLC in Melbourne, Florida.
- Won and directed over a dozen contracts and grants from academia.
- Generated major new revenue for Prime Research LC by diversifying technologies to include sensors, communications, and engineered materials for extreme applications, rather than company's relying on a single, underperforming fiber optic sensor.
- Led Prime Research LC to win over $4.3 million in government contracts for advanced R&D and product development.
- More than doubled number of new programs by redesigning proposal process as well as contributing ideas and innovation.
- Expanded research by taking advantage of federal Small Business Innovation Research (SBIR) program as funding source.
- Played key role in company's achieving $3.4 million in SBIR funding in less than three years.
- Won and directed over a dozen government contracts in industry where ten were SBIR programs.
- Dramatically expanded company's intellectual property (IP) portfolio.
- Significantly increased research capabilities and prospects by partnering with many new industry and university researchers.
- Developed staff through cross-training, "lunch-and-learn" seminars, and short courses.
- Motivated staff by winning exciting research and creating a relaxed/friendly work environment.
- Restructured company business model from commercializing IP from a single source to generating its own IP, collaborating with industry, and directing research at multiple universities.

RESEARCH ACCOMPLISHMENTS

- Awarded 16 US patents across a broad range of disciplines including 3D printing, photonics, electromagnetics, MEMS, microsystems, thermal management, sensors, and packaging. More are pending.
- Authored over 70 journal articles; cited 1600+ times. Citation indices are: h-Index 22, i10-Index 40.
- Developed a comprehensive suite of custom simulation and optimization algorithms for electromagnetics and lithography.
  - Finite-difference time-domain (FDTD)
  - Finite-difference frequency-domain (FDFD)
  - Unstructured grids for finite-differences
  - Method of Lines (MoL)
  - Finite element method (FEM)
  - Method of moments (MoM)
  - Genetic algorithms (GA)
  - Particle swarm optimization (PSO)
  - Simulated annealing
  - Transformation optics
  - Transfer matrix method (TMM)
  - Improved scattering matrices for semi-analytical methods
  - Plane wave expansion method (PWEM)
  - Rigorous coupled-wave analysis (RCWA)
  - Slice absorption method (SAM)
  - Beam propagation method (BPM)
  - Level set methods (LSM)
  - Fast marching method (FMM)
  - Cell volume method (CVM)
  - String method
  - Generating spatially-variant lattices
- **Innovated or co-innovated a wide variety of technologies**
  - 3D/volumetric circuits in arbitrary form factors produced by hybrid 3D printing.
  - Automated process for building arbitrary metal-dielectric structures via hybrid direct-write 3D printing.
  - CAD tool for layout and routing of true 3D/volumetric circuits.
  - Spatially-variant anisotropic metamaterials (SVAMs) to decouple electric components placed in close proximity. Demonstrated concept in a 3D printed mobile phone, reducing envelope correlation coefficient (ECC) from 0.65 to 0.01.
  - Spatially-variant photonic crystals (SVPCs) and achieved world record for tightest bend of an unguided optical beam, while simultaneously breaking records for using low refractive index.
  - Algorithm to bend, twist, and functionally grade periodic structures without deforming the unit cells which would weaken or destroy their magical properties.
  - World's highest power frequency selective surface. Operated at over 2.0 GW.
  - World's most broadband and widest field-of-view guided-mode resonance filters. Filters provided > 50% fractional bandwidth.
  - Wireless sensor concept for operation in the hostile environment of a coal gasifier.
  - Magneto-dielectric materials for tuning and miniaturizing electromagnetic components.
  - Ceramic MEMs switch for radio and microwave frequency circuits.
  - Embedded heat pipes for thermal management in LTCC.

- **Projects directed from academia**
  - *Reduction of Radar Cross Section* – Project is developing a technique to reduce the scattering and radar cross section of metallic elements (Ball Aerospace).
  - *3D Printed Integrating Sphere* – Project will develop a new electromagnetic mechanism called self-uncollimation to radically miniaturize integrating spheres (nScrypt/AFRL).
  - *3D Printed Antennas for High-G* – Project is focused on evolving hybrid 3D printing to produce 3D antennas that can operation in high-g environments (ARL).
  - *Photon Funnels* – Based on spatially-variant self-collimation to suppress refraction, project is developing structures that funnel light to a common collection point regardless of where the light is incident and from what angle (NSF).
  - *3D Printed High-Frequency Circuits* – Project goal is to develop and demonstrate methods for designing and testing 3D printed high-frequency circuits (ARL).
  - *SVAMs for Electromagnetic Compatibility* – Project aimed to mature SVAMs and demonstrate their use in a MIMO antenna system (Proprietary Customer).
  - *Modulated Reflective Metasurfaces* – Exploring electromagnetic techniques to realize a thin metasurface that can reflect an incident wave in a controlled direction. Device must be polarization independent, broadband, and able to handle multiple beams (LMC).
  - *Optical Simulation of Selective Laser Melting* – Developed rapid simulation techniques for SLM process that are calibrated and validated by rigorous electromagnetic simulations (ARL).
  - *3D Conformal Meta-Optics (3D COMET)* – Explored ways to break fundamental laws of optics and identifying applications. Research involved spatially-variant lattices for putting periodic structures onto curves and multiplexing physics within the same volume of space (DARPA).
  - *All-Dielectric Antennas* – Developed and demonstrated world's thinnest all-dielectric antenna (DoD).
  - *Spatially-Variant Anisotropic Metamaterials for Improved EMC* – Project to study and to commercialize SVAM technology, with initial focus on mobile phones (State of Texas).
  - *Ultra-Wideband Antennas* – Studied ultra-wideband antennas that also have a very short ring-down time (ARL).
  - *3D Printed Structures by Micro-Dispensing* – Created dielectric and magnetic materials and then manufactured 3D structures from them by micro-dispensing (Raytheon).
  - *Direct Digital Manufacturing of 3D Metamaterial Devices* – Explored 3D printed metamaterials and innovated many new concepts including spatially-variant photonic crystals and spatially-variant anisotropic metamaterials (DARPA YFA).
  - *Evaluation of 3D Printed Impedance Elements* – Manufactured and tested inductors and capacitors by 3D printing (LMC).
  - *All-Dielectric Frequency Selective Surfaces for High Power Microwaves* – Developed and demonstrate the world's highest power devices operating at over 2.0 GW. Same devices also broke records for large bandwidth and wide field-of-view (AFRL).

- **Projects directed from industry**
  - *Ultra-High Temperature Metamaterials for Wireless Sensing* - Explored a new class of microwave metamaterials for wireless sensing in highly corrosive and extremely hot (4000°F) environments. (DOE, DE-FE0001249)
  - *Ultra Low Power CMOS Radar* - Developed an ultra-low power radar and communications device in CMOS for space exploration. (NASA)
  - *Optowireless™* - Project to integrate radically miniaturized radios into optical fibers to seamlessly convert between optical and wireless signal domains. Entire system barely larger than the fiber itself and requires no external electrical power. (NSF, IIP-0740453)
  - *Meta-Optic Fluorescence Probe* - Revolutionary fiber optic fluorescence sensor using nanoscale metamaterials to detect hazardous chemicals. (DARPA, W31P4Q-09-C-0354)
  - *High-Power Microwave Frequency Selective Surfaces* - Developing advanced all-dielectric metamaterials capable of operating at ultra-high power (1 MW/cm2). (Air Force, FA9451-09-M-0053)
  - *Nano-Optical Elements for Polarization Selective Infrared Detection* – Explored integration of nano-optical elements directly onto focal plane arrays and imaging sensors to enable adjacent pixels to detect different wavelengths and polarizations with minimal interference between adjacent pixels and wide FOV. (Air Force, FA8650-08-M-1337).
  - *Hyperspectral and Multimode Imaging Using Nanophotonics* - Developing all-dielectric metamaterials for improved imaging sensors. (Air Force)
  - *Full Field Strain Sensor* - Explored innovative diffractive optical appliqué for real-time measurement of full field mechanical strain over large areas in composite materials and on nonplanar surfaces. (Navy, N68335-09-C-0345)
  - *Power Harvesting Wireless Flow Sensor* - Developed postage-stamp size "stick-on" wireless sensors to measure fluid flow. (DARPA, W31P4Q-09-C-0352)
  - *Water Quality Sensor* - Demonstrated a fiber optic water quality sensor system based on colorimetric chemical and temperature sensing. (Army, W91CRB-07-C-0030)

- **Key contributor in many other projects:**
  - *Micro-Optic Devices for Ultra-High Power Optics* – Developed algorithms suitable for design and analysis of optical devices operating at ultra-high power.
  - *Heat Removal by Thermal Integrated Circuits* – Successfully demonstrated micro-capillary loop fabricated directly into IGBT transistor for thermal management (DARPA).
  - *MEMS Rotary Engine Power Supply* – Investigated micro-power generation using micro-scale Wankel combustion engines (DARPA).

- *Metamaterials for RF Circuits* – Demonstrated passive RF circuits with enhanced performance using magneto-dielectric metamaterials (DARPA).
- *Coherent Communications, Imaging, and Targeting* – Program to develop MEMS mirror arrays and deformable surfaces for correction of atmospheric aberrations of optical beams. (DARPA).

TEACHING ACCOMPLISHMENTS

- Awarded, Dean Eugene Thomas Award for Outstanding Faculty Member, 2017.
- Awarded, University of Texas Regents' Outstanding Teaching Award, 2015. Largest and most prestigious award offered by the University of Texas system.
- Awarded, BUILDing SCHOLARS Mentoring Award, 2015.
- Students Graduated – 6 PhD in ECE, 4 MS in ECE, 1 MS in CPS, and numerous BS in ECE.
- Best MS Thesis in Computational Science awarded to Asad Gulib for this thesis titled "Numerical Calculation of Spatially-Variant Anisotropic Metamaterials (SVAMs)."
- Best Ph.D. Dissertation in the College of Engineering awarded to Cesar Garcia for his dissertation titled "3D Printed Spatially Variant Anisotropic Metamaterials."
- Developed course websites for most courses taught that provided 24/7 access to homework, notes, recorded lectures, and other resources to the students.
- Accommodated many remote students in four of the graduate courses taught.
- Consistently receive excellent reviews from students.

- **Graduate Courses Taught and/or Developed:**
  - EE 5303 Electromagnetic Analysis Using FDTD
    http://emlab.utep.edu/ee5390fdtd.htm
    A course on the finite-difference time-domain method for rigorous analysis of electromagnetic devices. The course covers the detailed formulation and how to implement the method in MATLAB. Topics include MATLAB, data visualization, finite-differences, Yee algorithm, perfectly matched layer absorbing boundary condition, sources, Fourier transforms, and modeling of electromagnetic devices.
  - EE 5320 Computational Electromagnetics
    http://emlab.utep.edu/ee5390cem.htm
    A course covering many of the most popular methods used in modern computational electromagnetics. Methods include transfer matrix method, finite-difference frequency-domain, finite-difference time-domain, beam propagation method, plane wave expansion method, rigorous coupled-wave analysis, method of lines, slice absorption method, finite element method, and optimization.
  - EE 5322 21st Century Electromagnetics
    http://emlab.utep.edu/ee5390em21.htm
    A comprehensive study of the most advanced concepts in modern electromagnetics. Topics include dispersive and anisotropic materials, transmission lines, coupled-mode theory, periodic electromagnetic structures, gratings, guided-mode resonance, metamaterials, photonic crystals, transformation optics, spatially variant lattices, frequency selective surfaces, surfaces waves, and slow waves. Problems associated with interfacing CAD and MATLAB are also covered.
  - EE 5390 Advanced Electromagnetic Design
    Incorporated elements from both Computational Electromagnetics and 21st Century Electromagnetics described above.
  - EE 5390 Microwave Engineering
    http://emlab.utep.edu/ee4380microwave.htm
    Broad introduction to the area of microwave engineering. Topics include basic electromagnetic theory, electromagnetic properties of materials, waves, network theory, waveguides, Smith Charts, impedance matching, and metamaterials.
  - EE 5301 Computational Methods for Electrical Engineers
    http://emlab.utep.edu/ee4386_5301_CompMethEE.htm
    An introduction to numerical computation. Course begins with an introduction MATLAB, graphics, and visualization. Topics include linear algebra, interpolation, root finding, curve fitting, optimization, and solving differential equations using the finite-difference method. Algorithms are applied to topics that arise in electrical engineering.

- **Undergraduate Courses Taught:**
  - EE 3321 Electromagnetic Field Theory
    http://emlab.utep.edu/ee3321emf.htm
    Fundamentals of the electromagnetic model are developed for static and magnetic fields, for the propagation of electromagnetic waves in various media and for reflection and refraction at material interfaces. Basic applications of the model to transmission lines, waveguides, and radiating systems are developed.
  - EE 4347 Applied Electromagnetics
    http://emlab.utep.edu/ee4347appliedem.htm

In depth study and application of electromagnetics. Topics include waves, polarization, transmission lines, waveguides, computational electromagnetics, and modern topics including metamaterials and photonic crystals.

- EE 4380 Microwave Engineering
  Broad introduction to the area of microwave engineering. Topics include basic electromagnetic theory, electromagnetic properties of materials, waves, network theory, waveguides, Smith Charts, impedance matching, and metamaterials.
- EE 4386 Computational Methods for Electrical Engineers
  http://emlab.utep.edu/ee4386_5301_CompMethEE.htm
  An introduction to numerical computation. Course begins with an introduction MATLAB, graphics, and visualization. Topics include linear algebra, interpolation, root finding, curve fitting, optimization, and solving differential equations using the finite-difference method. Algorithms are applied to topics that arise in electrical engineering.
- EE 4395 Advanced Electromagnetic Design
  First course taught at UTEP. It was essentially a combination of EE 5320 and EE 5322 and covered some computational electromagnetics as well as advanced electromagnetic theory.

PEER-REVIEWED PUBLICATIONS

1. Gilbert T. Carranza, Ubaldo Robles, Cesar L. Valle, Jesus J. Gutierrez, and Raymond C. Rumpf, "CAD Tool for Three-dimensional Circuit Layout, Routing, and Manufacturing," IEEE Trans. on Components, Packaging, and Manufacturing, accepted for publication November 2018.
2. Ubaldo Robles, Andelle Kudzal, and Raymond C. Rumpf, "Automated Hybrid 3D Printing of 3D Meandering Interconnects," IEEE Trans. on Components, Packaging, and Manufacturing, submitted for publication August 2018.
3. Ubaldo Robles, Edgar Bustamante, Prya Darshni, and Raymond C. Rumpf, "High-Frequency Filters Manufactured Using Hybrid 3D Printing Method," submitted to PIER, November 2018.
4. Ubaldo Robles, Justin Kasemodel, Jose Avila, Tenoch Benitez, and Raymond C. Rumpf, "3D Printed Structures by Micro Dispensing Materials Loaded with Dielectric and Magnetic Powders," IEEE Trans. on Components, Packaging, and Manufacturing, Vol. PP, Issue 99, pp. 1-7, 2018.
5. Stephen M. Kuebler, Rashi Sharma, Jennefir L. Digaum, Noel Martinez, Cesar L. Valle, and Raymond C. Rumpf, "Nanophotonic Devices for Three-Dimensional Control of Optical Beams," presented at FiOs, September 2017.
6. Cesar R. Garcia, Edgar Bustamante, Paul I. Deffenbaugh, Carlos Rodriguez, Eric A. Berry, and Raymond C. Rumpf, “Reduced Mutual Coupling Between Closely Spaced Antennas Using All-Dielectric Metamaterials,” submitted to IEEE, June 2017.
7. Jose A. Avila, Cesar L. Valle, Edgar Bustamante, and Raymond C. Rumpf, "Optimization and Characterization of Negative Uniaxial Metamaterials," PIER C, Vol. 74, pp. 111-121, 2017.
8. Hasanul Karim, Diego Delfin, Luis A. Chavez, Luis Delfin, Ricardo Martinez, Jose Avila, Carlos Rodriguez, Raymond C. Rumpf, Normal Love, and Yirong Lin, "Metamaterial Based Passive Wireless Temperature Sensor" Advanced Engineering Materials 1600741, 2017.
9. Carlos Rodriguez, Jose Avila, Raymond C. Rumpf, "Ultra-Thin 3D Printed All-Dielectric Antenna," PIER C, Vol. 64, pp. 117-123, 2016.
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