

J. SCOTT TYO, Ph. D.

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Edgewood, NM 87015
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- Current Positions: Assistant Professor of Electrical and Computer Engineering
University of New Mexico, Albuquerque

Chief Technical Officer
Tyo Scientific Consulting, Edgewood, NM
- Education: PhD in Electrical Engineering, University of Pennsylvania, Philadelphia
May 1997 Thesis: *Polarization Difference Imaging: A Means for Seeing Through Scattering Media*
Advisors: Prof. Nader Engheta and Prof. Edward N. Pugh, Jr.

May 1996 MSE in EE, University of Pennsylvania, Major in Electrosience

May 1994 BSE in EE, *Summa Cum Laude*, University of Pennsylvania
Commissioned 2nd Lt., USAF, USAFROTC Detachment 750, St. Joseph's University
- Date of Birth: November 19, 1972 Citizenship: United States
- Clearance: DCID 1/14, SSBI, July 7, 1997
- Research Interests:
- Polarimetric and Hyperspectral Imaging with Visible and Near Infrared Light
 - Processing of High-Dimensional Spectropolarimetric Data
 - Investigation of Statistical Properties of Hyperspectral Imagery
 - Optimization of Polarimetric Sensors for Remote Sensing Applications
 - Integration of Polarimetric and Spectral Sensors and Information
 - Use of Spectropolarimetry to Improve Imaging in Scattering Media
 - Fusion of Multi-Dimensional Data into Intelligible Images
 - Ultra-Wideband (UWB) Electromagnetics
 - Design of UWB Antennas and Antenna Arrays
 - Development of Sensors, Measurement Techniques and Processing Strategies for UWB EM Measurements
 - Generation and Radiation of Electromagnetic Transients
 - Utilization of UWB Radar for Target Detection and Identification
- Awards and Honors: Best Paper Award, *Ultra Wideband, Short Pulse Electromagnetics 7, EUROEM 2004*
Summa Foundations Best Applied High Power Electromagnetics Paper,
SSN490 (shared with 28 total authors) (2004)
NSF Faculty Early CAREER Award (2003)
UNM ECE Department Outstanding Researcher Award (2003)
URSI Young Scientists Award (2002)
Naval Postgraduate School Research Recognition Award (2001)
Member of AFOSR STAR Team for Research in UWB Electromagnetics (2000)
Naval Postgraduate School Outstanding Instructional Performance Award (2000)
US Air Force Commendation Medal (1999)
URSI Commission B Young Scientists Award (1998)
National Science Foundation Graduate Research Fellowship (1994-1996)
USAF Institute of Technology Sponsored Fellowship (1994-1996)
Optical Society of America Annual Meeting Highlighted Poster (1996)
AFROTC Distinguished Graduate (1994)
Theodore von Karman Memorial Grant (Air Force Association) (1994)
Hugo Otto Wolff Award for Outstanding Senior Design Project (1994)
Walter Korn Award, Moore School of Electrical Engineering, (1994)
Air Force Communications and Electronics Association Grant (1994)
Benjamin Franklin Scholar, University of Pennsylvania, (1990-1994)
Eagle Scout, Boy Scouts of America (1991)

Experience:

<i>June 2001-Present</i>	Assistant Professor of Electrical and Computer Engineering University of New Mexico, Albuquerque, NM
<i>June 2002-Present</i>	Chief Technical Officer Tyo Scientific Consulting, Edgewood, NM
<i>May 1994-Aug 2001</i>	Officer, United States Air Force (2 nd Lt. 5/94 - 5/96, 1 st Lt. 6/96 - 6/98, Capt. 6/98 - 8/01)
<i>March 1999-Aug 2001</i>	Assistant Professor of Electrical and Computer Engineering Naval Postgraduate School, Monterey, CA
<i>June 1996-March 1999</i>	Research and Development Engineer USAF Research Lab, Directed Energy Directorate, Kirtland AFB, NM
<i>March 1993-June 1996</i>	PhD Dissertation Research/Undergraduate Research Assistant Air Force Institute of Technology Civilian Institutions Program Department of Electrical Engineering, University of Pennsylvania
<i>June 1992-May 1993</i>	Undergraduate Research Assistant Department of Material Science and Engineering, University of Pennsylvania
<u>Teaching/Advising:</u> <i>Classroom</i>	•Electrodynamics (Graduate) UNM ECE Department, (3 terms) •Electromagnetic Fields and Waves (Undergraduate), NPS (2 terms), UNM (1 term) •Antennas for Wireless Communications (Undergrad/Grad), UNM (1 term) •Spectral Imagery (Advanced Graduate), UNM ECE Department (1 term) •Electromagnetic Dynamics and Engineering (Undergraduate), NPS (1 term) •Discrete-Time Signal Processing (Undergraduate), NPS ECE Dept., (1 term) •High-Power Microwave Systems (Advanced Graduate), NPS Physics Dept., (2 terms) •Modern Spectral Estimation (Advanced Graduate), NPS ECE Dept., (1 term)
<i>MS Theses</i>	8. Jinhui Chen, "Modeling conductivity of subnanosecond breakdowns in liquids and gases," UNM Electrical and Computer Engineering Department, August 2004 7. Heidi A. Smartt, "Spectral Tagging," UNM Electrical and Computer Engineering Department, December 2002 6. Michael J. Baretela, "Optimization of IRA Aperture for Maximization of Response," NPS Electrical and Computer Engineering Department, March 2002 5. Athanasios Konsolakis, "Invariant Display Strategies for Hyperspectral Imagery" NPS Electrical and Computer Engineering Department, September 2001 (Co-advisor) 4. Steven M. Rutherford, "Heart & Respiration Rate Detection with Micro-Powered Impulse Radar," NPS Physics Department, June 2001 3. David I. Diersen, "An Analysis of Display Strategies for Hyperspectral Imagery," NPS Electrical and Computer Engineering Department, December 2000 2. Joel C. Robertson, "Target Spectra Statistics in Hyperspectral Imagery," NPS Information Warfare Academic Group, September 2000 1. Jack S. Thomas, "Sensitivity of Submarine Hyperspectral Contrast," NPS Operations Research Department, September 1999 (Second Reader)
<i>Postdoctoral Students</i>	Babar K. Minhas, UNM ECE Department, Postdoctoral Fellow (2003 - 04) Project: Transient wave propagation in isorefractive media
<i>Current Students</i>	Zhaoxian Zhou, UNM ECE Department PhD student, projected graduation: December 2004. Prospective thesis title: "Multiresolution Basis Functions For Time-Domain Integral Equation Electromagnetic Solvers." Bradley Ratliff, UNM ECE Department, PhD Student, Projected Graduation: December 2004 Prospective Thesis Title: "Algebraic Nonuniformity Correction Algorithms for Infrared Imagery" (Co-advisor with M. Hayat) Heidi A. Smartt, UNM ECE Department, PhD student, projected graduation 2006. Research Project: "Spectral Tagging for Remote Object Identification."

Rakesh Kumar, UNM ECE Department, PhD student, projected graduation 2006.
Research Project: Radiometrically Accurate Calibration of Infrared Focal Plane Arrays

Oguz Demirci, UNM ECE Department, PhD Student, Projected Graduation: 2006
Research Project: Spatiotemporal and spatio-spectral pattern recognition algorithms
(Co-advisor with E. Ritchie)

Zhipeng Wang, UNM Optical Sciences, PhD student, Projected Graduation: 2007
Research Project: Spectrally Adaptive Quantum Dot Infrared Photodetectors

Jiayu Chen, UNM ECE Department, MS student, Projected Graduation: August 2004.
Research Project: "Polarization Mode Dispersion Emulator"

Hua Wei, UNM ECE Department, MS student, Projected Graduation: May 2005
Research Project: Optimization of Polarimeters

Mustafa Dogan, UNM ECE Department, MS student, Projected Graduation: December 2004
Research Project: Design and Analysis of Impulse Radiating Antennas

James Boddeker, UNM ECE Department Undergrad
Research Project: Time Domain Antenna Range

Alberto Martinez, UNM ECE Department Undergrad
Research Project: Underwater Polarization Imager

Short Courses

High-Power Microwave Systems and Effects (24 Hours), June 2000
Air Armament Center, Eglin AFB, FL

Ultra-Wideband Electromagnetics (8 Hours), March 2000, May 2001
Taught for Swedish National Defense University

HPM and RF Weapons in Information Operations (4 Hours), February 2000
US Naval Security Group, Ft. Meade, MD

Hyperspectral Imaging Technologies (with J. Acete and T. Cooley), October 2004,
Georgia Tech Research Institute

Societal Memberships: Institute of Electrical and Electronics Engineers (Member AP-S, GRSS, and LEOS)
Optical Society of America (Member)
International Radio Science Union (URSI) (Member Commissions B and E)
Society of Photo-Optical Instrumentation Engineers (SPIE, Member)
American Institute of Physics (Member)
Tau Beta Pi Engineering Honor Society (1993)
Eta Kappa Nu Engineering Honor Society (1993)

Editor & Reviewer: Associate Editor, *IEEE Antennas and Wireless Propagation Letters* 2003 - pres
Guest Editor for Special Session of *Optical Engineering* on Polarimetry (May 2002)
Journal Article Reviewer for

Proceedings of the IEEE 2004

IEEE Transactions on Antennas and Propagation 1999-2004

IEEE Antennas and Wireless Propagation Letters 2003-2004

IEEE Transactions on Plasma Science 2002

IEEE Transactions on Geoscience and Remote Sensing 2002-2003

IEEE Geoscience and Remote Sensing Letters 2004

IEEE Transactions on Pattern Analysis and Machine Intelligence 2003

Optics Letters, 1999 - 2004

Applied Optics, 1998 - 2003

Journal of the Optical Society of America A, 2000 - 2003

Optics Express, 2004

Optical Engineering 2001-2002

Radio Science 2002

Sensors and Actuators A 2002

Remote Sensing of the Environment 2000

Grant/Award Reviewer for

National Science Foundation 2002-2003

US Air Force Office of Scientific Research 2002
 IEEE Antennas and Propagation Society, Student Paper Contest 2002
 Book Reviewer for
 John Wiley and Sons (2002-2003)
 Artech House (2003)
 Harvard University Press

Conference Organization and Societal Activities:

- Conference co-Chairman, *SPIE Polarization Science and Remote Sensing II*, San Diego, CA July 2005
- Vice-Chairman, SPIE Polarization Working Group, 2002 – 2005
- Conference co-Chairman, *SPIE Polarization Science and Remote Sensing*, San Diego, CA August 2003
- Technical Program Committee co-Chairman, *IEEE Antennas and Propagation International Symposium*, Albuquerque, NM July 2006
- Technical Program Committee, *SPIE Polarization Measurement, Analysis and Remote Sensing VI*, Orlando, FL, April 2004
- Technical Program Committee, *2004 IEEE Antennas and Propagation International Symposium and URSI North American Radio Science Meeting* Monterey, CA, June 2004
- Technical Program Committee, *2003 IEEE Antennas and Propagation International Symposium and URSI North American Radio Science Meeting* Columbus, OH, June 2003
- Technical Program Committee and Session Chair, SPIE Polarization Measurement and Analysis V (2002)
- Technical Program Committee and Session Chair, SPIE Polarization Measurement and Analysis IV (2001)
- Special Session Organizer and Presider (with Dr. Everett Farr)
 “Transient Antennas” *EUROEM 2004*, Magdeburg, Germany, July
- Thrust Area and Session Chair “Measurement Technologies,” *2003 Space Based EO/IR Symposium* Kirtland AFB, NM, May 13 - 15
- Special Session Organizer “Transient Radiation” *2003 IEEE Antennas and Propagation International Symposium and URSI North American Radio Science Meeting*, Columbus, OH, June 23 – 27
- Student Paper Contest Judge, *2002 IEEE Antennas and Propagation International Symposium and USNC/URSI National Radio Science Meeting*, San Antonio, TX, June 16 – 21
- Special Session Organizer and Presider (with Dr. Moto Kanda, NIST)
 “Ultra-Wideband Metrology” *EUROEM 2000*, Edinburgh, Scotland, May 29 - June 2
- Technical Program Committee, *9th National Congress on HPM Technologies*
 Sponsored by the Electronic Defense Association, Albuquerque, NM, May 11-13 1999
- Symposium Co-organizer and Session Presider (with Dr. Ed Watson and Dr. Kevin Liddane)
 “Multi-Discriminant, Multispectral, and Polarization Imaging,” *1998 OSA Annual Meeting*
- Treasurer, Albuquerque Joint Electromagnetics Chapter (IEEE AP-S/MTT/EMC/NPSS) 1998
- Treasurer, Albuquerque Chapter IEEE-LEOS (2002 - 2004)

University Service

- OSE Graduate Committee, 2003 - Pres
- Faculty Search Committee, Microelectronics, 2003-04
- Area Chair, Applied Electromagnetics (UNM ECE) 2001 - 2003
- ECE Departmental ABET Accreditation Committee, 2003-pres
- Faculty Advisor, HKN Honor Society, 2002-Pres.
- ECE Graduate Committee 2001 - 2003
- Faculty Search Committee, Applied EM, 2002

Consulting

- Ultra-Wideband Antenna Design, Para-IRA Project, Farr Research, Albuquerque, NM 215 Hours, 2002 – 2003
- Ultra-Wideband Antenna Design and Analysis, Defocused IRA Project, Farr Research, Albuquerque, NM 100 hours, 2003
- Materials analysis for Thermal Measurement of Microwave power
 ITT Industries, Albuquerque, NM 20 hours, 2003
- Real-Time Nonuniformity Correction in IR FPAs
 K & A Wireless, Albuquerque, NM 240 Hours, 2003

PUBLICATIONS AND PATENTS

Refereed Journals

22. B. M. Ratliff, M. M. Hayat, and J. S. Tyo, “Generalized Algebraic Scene-based Nonuniformity Correction Algorithm,”

21. J. S. Tyo, M. C. Skipper, M. D. Abdalla, S. P. Romero, and B. Cockreham, "Frequency and Bandwidth Tunable Pulser for Use in Wideband Applications," to be published in *IEEE Trans. Plasma Sci.*, October 2004
20. J. S. Tyo, E. G. Farr, J. S. H. Schoenberg, L. H. Bowen, and L. L. Altgilbers, "Time and Frequency domain radiation patterns of reflector impulse radiating antennas: effect of aperture field distributions," *IEEE Trans. Antennas Propagat.*, **52**: 1767-1776 (2004)
19. J. Gaudet, R. J. Barker, M. Gunderson, A. Kuthi, A. Neuber, J. Dickens, W. Nunnally, E. Schamiloglu, C. Christodoulou, J. S. Tyo, K. Schoenbach, R. Joshi, M. Laroussi, J. Kolb, and R. Vidamr, "Research Issues in Developing Compact Pulsed Power for High Peak Power Applications on Mobile Platforms," *Proc. IEEE*, **92**:1144 – 1165 (2004)
18. Ü. Sakoğlu, J. S. Tyo, M. M. Hayat, S. Raghavan, and S. Krishna, "Spectrally Adaptive Infrared Photodetectors Using Bias-Tunable Quantum dots," *J. Opt. Soc. Am. B* **21**:7 – 17 (2004)
17. B. M. Ratliff, M. M. Hayat, and J. S. Tyo, "Radiometrically Accurate, Scene-Based nonuniformity Correction for Array Sensors," *J. Opt. Soc. Am. A*, **20**:1890–1899 (2003)
16. M. J. Baretela and J. S. Tyo, "Improvement of Prompt Radiated Response from Impulse Radiating Antennas by Aperture Trimming," *IEEE Trans. Antennas Propagat.* **51**:2158 – 2167 (2003)
15. J. S. Tyo, "A Class of Artificial Materials Isorefractive with Free Space," *IEEE Trans. Antennas Propagat.* **51**: 1093–1099 (2003)
14. J. S. Tyo, D. I. Diersen, A. Konsolakis, and R. C. Olsen, "Principal components-based display strategy for spectral imagery," *IEEE Trans. Geosci. Remote Sens.* **41**: 708 – 718 (2003)
13. J. S. Tyo and C. J. Buchenauer, "Experimental Verification of the Effect of Aperture Shape on Prompt IRA Response," *IEEE Trans. Antennas Propagat.* **50**:1032–1034 (2002)
12. J. S. Tyo, "Design of Optimal Polarimeters: Maximization of SNR and Minimization of Systematic Errors," *Appl. Opt.* **41**:619–630 (2002)
11. C. J. Buchenauer, J. S. Tyo, and J. S. H. Schoenberg, "Aperture Efficiency of Impulse Radiating Antennas," *IEEE Trans. Antennas Propagat.*, **49**:1155–1165 (2001)
10. J. S. Tyo, "Optimization of the TEM Feed Structure for 4-Arm Impulse Radiating Antennas," *IEEE Trans. Antennas Propagat.* **49**:607–614 (2001)
9. J. S. Tyo and T. S. Turner, "Variable Retardance, Fourier Transform Imaging Spectropolarimeters for Visible Spectrum Remote Sensing," *Appl. Opt.* **40** pp. 1450–1458 (2001)
8. J. S. Tyo, "Noise Equalization in Stokes Parameter Images Obtained Using Variable Retardance Polarimetry," *Opt. Lett.* **25** pp. 1198-1200 (2000)
7. J. S. Tyo, "Improvement of the Point-Spread Function in Scattering Media by Polarization Difference Imaging," *J. Opt. Soc. Am. A* **17** pp. 1-10 (2000)
6. J. S. Tyo, C. J. Buchenauer, and J. S. H. Schoenberg, "Use of Isorefractive Media to Improve Prompt Aperture Efficiency in Impulse Radiating Antennas," *IEEE Trans. Antennas Propagat.* **46** pp. 1114-1115 (1998)
5. J. S. Tyo, "Optimum Linear Combination Strategy for an N -Channel Polarization Sensitive Imaging or Vision System," *J. Opt. Soc. Am. A* **15** pp. 359-366 (1998)
4. J. S. Tyo, E. N. Pugh, Jr., and N. Engheta "Colorimetric Representations For Use With Polarization-Difference Imaging Of Objects In Scattering Media" *J. Opt. Soc. Am. A* **15** pp. 367-374 (1998)
3. J. S. H. Schoenberg, J. W. Burger, J. S. Tyo, M. D. Abdalla, M. C. Skipper, and W. R. Buchwald, "Ultra-Wideband Source Using Gallium Arsenide Photoconductive Semiconductor Switches," *IEEE Trans. Plasma Sci.* **25** pp. 327-334 (1997)
2. J. S. Tyo, M. P. Rowe, E. N. Pugh, and N. Engheta, "Target Detection in Optically Scattering Media by Polarization-Difference Imaging," *Appl. Opt.* **35** pp. 1855-1870 (1996)
1. M. P. Rowe, E. N. Pugh, J. S. Tyo, and N. Engheta, "Polarization-Difference Imaging: A Biologically Inspired Technique for Imaging Through Scattering Media," *Opt. Lett.* **20** pp. 608-610 (1995)

papers in review

J. S. Tyo, E. G. Farr, and D. I. Lawry, "Effect of defocus on the prompt response from reflector IRAs," submitted to *IEEE Trans. Antennas Propagat.* June 2004

Z. X. Zhou and J. S. Tyo, "An Adaptive Time-Domain Integral Equation Method For Transient Analysis of Wire Scatterer," submitted to *IEEE Antennas and Wireless Propagation Letters* August 2004

J. S. Tyo, M. Dogan, J. H. Boddeker, and C. J. Buchenauer, "Increasing Prompt Response of Impulse Radiating Antennas through Polarization Control of Aperture Fields," submitted to *IEEE Trans. Antennas Propagat.*, August 2004

Special Journal Issues Edited

1. D. L. Goldstein, D. B. Chenault, and J. S. Tyo, "Polarization," special section of *Optical Engineering* **41** May 2002

Conference Proceedings Books Edited

1. J. A. Shaw and J. S. Tyo (Eds.), *Proceedings of SPIE vol. 5158: Polarization Science and Remote Sensing*, (SPIE, Bellingham, WA, 2003)

Patents and Patents Pending

3. E. N. Pugh, Jr., N. Engheta, M. P. Rowe, and J. S. Tyo (Inventors) "Method Of Using Polarization Differencing To Improve Vision," US Patent Number 5,975,702 (Nov. 2, 1999)

2. B. M. Ratliff, M. M. Hayat, J. S. Tyo, and T. S. Turner, Jr., "Uniform, Non-Diruptive and Radiometrically Accurate Calibration of Infrared Focal Plane Array Sensors Using Global Scene Motion," US Patent Pending, Filed April 15, 2004

1. S. Krishna, M. M. Hayat, J. S. Tyo, and Ü. Sakoğlu, "Spectrally Adaptive Quantum Dots-in-a-Well Infrared Photodetectors," Provisional Patent Application filed on September 23, 2003

Technical Reports

14. D. V. Giri, *et al.*, (28 total authors), "JOLT: A Highly Directive, Impulse-Like Transient Radiator," *Sensor and Simulation Notes* #480, C. E. Baum, Ed., Air Force Research Lab, Kirtland AFB, NM, March 2004

13. J. S. Tyo, E. G. Farr, and D. I. Lawry, "Effect of defocusing on the prompt response of an Impulse Radiating Antenna. I. Hyperboloidal Defocus," *Sensor and Simulation Notes* #486, C. E. Baum, Ed., Air Force Research Lab, Kirtland AFB, NM, January 2004

12. J. S. Tyo, E. G. Farr, L. H. Bowen, and L. L. Altgilbers, "IRA Variations Useful for Flexible Feed Arms," *Sensor and Simulation Notes* #472, USAF Research Lab, Kirtland AFB, NM, December 2002

11. J. S. Tyo, "Improved Aperture Efficiency in IRAs and ORAs with Uniaxially Conducting Reflectors," *Sensor and Simulation Notes* #468, C. E. Baum, Ed., Air Force Research Lab, Kirtland AFB, NM, May 2002

10. L. M. Atchley, E. G. Farr, J. S. Tyo, N. de la Merced, and L. L. Altgilbers, "Development and testing of a parachute deployable impulse radiating antenna," *Sensor and Simulation Notes* #465, C. E. Baum, Ed., Air Force Research Lab, Kirtland AFB, NM, March 2002

9. M. J. Baretela and J. S. Tyo, "Selective Trimming of Impulse Radiating Antenna Apertures to Increase Prompt Radiated Field," *Sensor and Simulation Notes*, #461, USAF Research Lab, Kirtland AFB, NM November 2001

8. J. S. Tyo and C. J. Buchenauer, "Measurement of Prompt IRA Responses Under Different Focused Aperture Configurations," *Sensor and Simulation Notes* #454, USAF Research Lab, Kirtland AFB, NM March 2001

7. J. S. Tyo, "Optimization of the Feed Impedance for an Arbitrary Crossed-Feed-Arm Impulse Radiating Antenna," *Sensor and Simulation Notes* #438, USAF Research Lab, Kirtland AFB, NM, November 1999

6. J. S. Tyo and J. S. H. Schoenberg, "Radiated Field Measurements from a 1-m-Diameter Half IRA," *Sensor and Simulation Notes* #471, C. E. Baum, Ed., Air Force Research Lab, Kirtland AFB, NM, Jan 1999

5. C. E. Baum and J. S. Tyo, "Transmission Line Solution for Propagation on a Periodic Array of Wave Launchers, All-In-Phase," *Sensor and Simulation Notes* #424, USAF Research Lab, Kirtland AFB, NM, July 1998

4. J. S. Tyo, "Estimating the Optimum Aperture for Maximizing Prompt Aperture Efficiency in an IRA," *Sensor and Simulation Notes* #422, USAF Research Lab, Kirtland AFB, NM, January 1998

3. C. J. Buchenauer, J. S. Tyo, and J. S. H. Schoenberg, "Aperture Efficiency of Impulse Radiating Antennas" *Sensor and Simulation Notes* #421, USAF Research Lab, Kirtland AFB, NM, November 1997
2. J. S. Tyo and C. E. Baum, "Reduced Skin-Effect at the Edge of a Conducting Sheet Using a High-Voltage Rollup," *Measurement Notes* #51 USAF Research Lab, Kirtland AFB, NM, May 1997
1. C. E. Baum and J. S. Tyo, "Transient Skin Effects in Cables," *Measurement Notes* #49 USAF Research Lab, Kirtland AFB, NM, July 1996

Conference Proceedings Papers

30. **(Invited)** M. M. Hayat, B. Ratliff, J. S. Tyo, and K. Agi, "Generalized algebraic algorithm for scene based nonuniformity correction," *Proc. SPIE vol. 5556: Photonic Devices and Algorithms for Computing VI*, K. M. Iftikharuddin and A. A. S. Awwal, Eds. (SPIE, Bellingham, WA, In Press)
29. Z. Wang, U. Sakoglu, S. Raghavan, J. S. Tyo, M. M. Hayat, and S. Krishna, "Real Time implementation of matched filtering algorithms using adaptive focal plane array technology," *Proc. SPIE vol. 5546: Imaging Spectrometry X*, S. S. Shen and P. E. Lewis, Eds., (SPIE, Bellingham, WA, In Press)
28. **(Invited)** J. Chen, C. J. Buchenauer, and J. S. Tyo, "Modeling the conductivity of a subnanosecond breakdown gas switch," submitted to *Ultra Wideband, Short Pulse Electromagnetics 7*, F. Sabath and E. Mokole, Eds., (Plenum, NY, In Press)
27. **(Invited)** J. S. Tyo, "Aperture Engineering for Impulse Radiating Antennas," submitted to *Ultra Wideband, Short Pulse Electromagnetics 7*, F. Sabath and E. Mokole, Eds., (Plenum, NY, In Press)
26. **(Invited)** J. S. Tyo, E. G. Farr, and D. I. Lawry, "Effect of reflector defocus on the radiation pattern of impulse radiating antennas," submitted to *Ultra Wideband, Short Pulse Electromagnetics 7*, F. Sabath and E. Mokole, Eds., (Plenum, NY, In Press)
25. J. S. Tyo and R. C. Olsen, "PC-Based Display Strategy for Spectral Imagery," *IEEE/GRSS Workshop on Advances in Processing of Remotely Sensed Imagery* (IEEE, Piscataway, NJ, In Press)
24. P. Li and J. S. Tyo, "Experimental measurement of optimal polarimeter systems," *Proc. SPIE vol. 5158: Polarization Science and Remote Sensing*, J. A. Shaw and J. S. Tyo, Eds., pp. 103 – 112 (SPIE, Bellingham, WA, 2003)
23. J. Chen, C. J. Buchenauer, and J. S. Tyo, "Numerical and Experimental Modeling of Subnanosecond Plasma Closing Switches in Liquids and Gases," *Proceedings of the 14th IEEE Pulsed Power Conference*, Dallas, TX June 2003, M. Gies-selmann and A. Neumber, Eds., pp. 59 – 62 (IEEE, Piscataway, NJ, 2003)
22. M. C. Skipper, M. D. Abdalla, S. P. Romero, and J. S. Tyo, "Frequency and Bandwidth Tunable Pulser for Electric and Biological Effects Testing," *Proceedings of the 14th IEEE Pulsed Power Conference*, Dallas, TX June 2003, M. Gies-selmann and A. Neumber, Eds., pp. 331 – 334 (IEEE, Piscataway, NJ, 2003)
21. B. M. Ratliff, M. M. Hayat, and J. S. Tyo, "Algorithm for radiometrically accurate nonuniformity correction with arbitrary scene motion," *Proc. SPIE vol. 5076: Infrared Imaging Systems: Design, Analysis, Modeling, and Testing XIV*, G. C. Holst, Ed., pp. 82–91 (SPIE, Bellingham, WA, 2003)
20. J. Kern and J. S. Tyo, "Multivariate Histogram Shaping and Statistically Independent Principle Components," *Proc. SPIE vol. 5093: Algorithms for Multispectral, hyperspectral, and Ultraspectral imaging IX*, S. S. Shen and P. E. Lewis, Eds., pp. 263–274 (SPIE, Bellingham, WA, 2003)
19. B. M. Ratliff, M. M. Hayat, and J. S. Tyo, "Radiometrically calibrated scene-based nonuniformity correction for infrared array sensors," *Proc. SPIE vol. 4820: Infrared Technology and Applications XXVIII*, B. Andresen, G. F. Fulop, and M. Strojnik, Eds., pp. 359 – 367 (SPIE, Bellingham, WA, 2002)
18. J. S. Tyo, "Extending Optimization to Active Mueller Polarimeters," *Proc. SPIE vol. 4418: Polarization: Measurement and Analysis V*, D. B. Chenault and D. L. Goldstein, Eds., pp. 68 – 74 (SPIE, Bellingham, WA, 2003)
17. J. S. Tyo, "Reshaping The Aperture Fields In Impulse Radiating Antennas (IRAs) And Oscillator Resonating Antennas (ORAs)," *Ultra Wideband, Short Pulse Electromagnetics 6*, E. Mokole, M. Kragalott, and K. R. Gerlach, Eds., pp. 269–280 (Plenum, New York, 2003)
16. J. S. Tyo, "Relationship Between System Optimization and Systematic Errors in Stokes and Mueller Polarimeters," *Proc. SPIE vol. 4481 Polarization: Measurement, Analysis, and Remote Sensing IV*, D. H. Goldstein and D. B. Chenault, Eds., pp. 22–30 (SPIE, Bellingham, 2002)

15. J. S. Tyo, D. I. Diersen, A. Konsolakis and R. C. Olsen, "Application of Principal-Components Based Invariant Display Strategy to Wide-Area Hyperspectral Data," *Proc. SPIE vol. 4480 Imaging Spectrometry VII*, M. R. Descour and S. S. Shen, Eds., pp. 166-175 (SPIE, Bellingham, 2002)
14. J. S. Tyo, "Optimal Feeds for 4-Arm IRAs," *Ultra-Wideband, Short-Pulse Electromagnetics 5*, P. D. Smith and S. R. Cloude, Eds., pp. 363-370 (Plenum, New York, 2002)
13. **(Invited)** J. S. Tyo, M. J. Baretela, C. J. Buchenauer, L. H. Bowen, and E. G. Farr, "Increase in the Prompt Radiated Field from an IRA by Aperture Design " *Proc. SPIE vol. 4371 Intense Microwave Pulses VIII.*, H. E. Brandt, Ed., pp. 19-29 (SPIE, Bellingham, WA, 2001)
12. J. S. Tyo, "Considerations in Polarimeter Design," *Proc. SPIE vol. 4133 Polarization Measurement and Analysis III*, D. B. Chenault, M. J. Duggin, W. G. Egan, and D. H. Goldstein, Eds., pp. 65-74 (SPIE, Bellingham, WA, 2000)
11. J. S. Tyo, D. I. Diersen, and R. C. Olsen, "Development of an Invariant Display Strategy for Spectral Imagery," *Proc. SPIE vol. 4132 Imaging Spectrometry VI* M. R. Descour and S. S. Shen, Eds., pp. 147-156 (SPIE, Bellingham, WA, 2000)
10. J. S. Tyo, J. C. Robertson, J. Wollenbecker, and R. C. Olsen, "Target Spectral Statistics in HSI Scenes," *Proc. SPIE vol. 4132 Imaging Spectrometry VI* M. R. Descour and S. S. Shen, Eds., pp. 306-314 (SPIE, Bellingham, WA, 2000)
9. **(Invited)** J. S. Tyo and T. S. Turner, "Imaging Spectropolarimeters for use in Infrared and Visible Remote Sensing," *Proc. SPIE vol. 3753 Imaging Spectrometry V*, M. R. Descour and S. S. Shen, Eds., pp. 214-225 (SPIE, Bellingham, WA, 1999)
8. C. J. Buchenauer, J. S. Tyo, and J. S. H. Schoenberg, "Aperture Efficiency of Impulse Radiating Antennas," *Ultra-Wideband, Short-Pulse Electromagnetics 4* E. Heymon, B. Mandelbaum, and J. Shiloh, Eds., pp. 91-108 (Plenum, New York, 1999)
7. T. S. Turner, K. W. Peters, and J. S. Tyo, "Portable, Visible, Imaging Spectropolarimeters for Remote Sensing Applications," *Proc. SPIE vol. 3498 Sensors, Systems, and Next Generation Satellites* H. Fujisada, Ed., pp. 223-230 (SPIE, Bellingham, WA, 1998)
6. J. S. Tyo and C. E. Baum, "Enhanced Skin Effects Near Edges in Transient Cables," *Proceedings of the 16th URSI Commission B International Symposium* Thessaloniki, Greece, pp. 530-532 (1998)
5. J. S. Tyo, C. J. Buchenauer, and J. S. H. Schoenberg, "Improving Power Concentration in IRAs Using Conformal Isorefractive Media," *Proceedings of the 16th URSI Commission B International Symposium* Thessaloniki, Greece, pp. 784-786 (1998)
4. **(Invited)** N. Engheta, J. S. Tyo, M. P. Rowe, and E. N. Pugh, "Biologically Inspired Polarization-Difference Imaging," *Proceedings of the 1997 European Microwave Conference* Haifa, Israel, 1997
3. J. W. Burger, J. S. H. Schoenberg, J. S. Tyo, M. D. Abdalla, S. M. Ahern, M. C. Skipper, W. R. Buchwald, "High-Voltage, Photoconductive Semiconductor Switched for use in Ultra-Wideband, HPM Generation," *Proc. SPIE vol. 3158: Intense Microwave Pulses V* F. J. Agee, H. Brandt, Eds., pp. 65-71 (SPIE, Bellingham, WA, 1997)
2. J. S. Tyo, M. P. Rowe, E. N. Pugh, and N. Engheta, "Improved Detection of Targets in Optically Scattering Media Using Polarization-Difference Imaging," *Optics and Imaging in the Information Age* pp. 230-237 (Society for Imaging Science and Technology, Springfield, VA, 1997)
1. C. J. Buchenauer, J. S. Tyo, and J. S. H. Schoenberg, "Antennas and Electric Field Sensors for Ultra-Wideband, Transient Measurements: Applications and Methods," *Ultra-Wideband, Short-Pulse Electromagnetics 3* C. E. Baum, L. Carin, and A. P. Stone, Eds., pp. 405-421 (Plenum, New York, 1997)

Conference Abstracts

44. Z. X. Zhou and J. S. Tyo, "Multiresolution Analysis of Thin Wire Scatterer by time-domain integral equation method," *2004 IEEE Antennas and Propagation International Symposium*, Monterey, CA
43. J. S. Tyo, C. J. Buchenauer, and J. Boddeker, "Improvement of aperture efficiency in impulse radiating antennas by polarization control," *2004 IEEE Antennas and Propagation International Symposium*, Monterey, CA, June
42. **(Invited)** B. Minhas, J. S. Tyo, K. J. Malloy, S. R. Brueck, "Some comments on perfect imaging in materials with negative permittivity and permeability," *2004 URSI Commission B Electromagnetic Theory Symposium*, Pisa, Italy, May
41. Z. Zhou and J. S. Tyo, "Adaptive and Implicit Haar-Wavelet-based Time Domain Integral Equation Analysis of

Straight Wire Scatterer,” *2004 URSI Commission B Electromagnetic Theory Symposium*, Pisa, Italy, May

40. O. Demirci, E. A. Ritchie, and J. S. Tyo, “Application of Spatiotemporal Pattern Recognition Techniques to Prediction of Extratropical Transition in Tropical Cyclones,” *Americal Meteorological Society Tropical Meeting*, Miami, FL, April 2003

39. **(Invited)** J. S. Tyo, C. J. Buchenauer, E. G. Farr, and L. H. Bowen, “Theory and measurements of defocused impulse radiating antennas,” *PIERS 2003*, Waikiki, HI, October 13 – 16

38. **(Invited)** J. S. Tyo, E. G. Farr, L. H. Bowen, and J. S. H. Schoenberg, “Off Boresight Radiation from Impulse Radiating Antennas,” *2003 URSI North American Radio Science Meeting*, Columbus, OH, June 2003

37. Z. Zhou and J. S. Tyo, “Transient analysis of straight thin wire scatterer by multiresolution time-domain integral equation method,” *2003 IEEE Antennas and Propagation International Symposium*, Columbus, OH, June

36. **(Invited)** E. G. Farr, W. S. Bigelow, L. M. Atchley, L. H. Bowen, J. S. Tyo, and D. I. Lawry, “New Developments in IRAs: Shaped Reflectors, Unbalanced Feeds and Sidelobe Suppression,” *2003 URSI North American Radio Science Meeting*, Columbus, OH, June 2003

35. S. Krishna, P. Rotella, S. Raghavan, A. Stintz, M. Hayat, and J. S. Tyo, “Bias-dependent tunable response of normal-incidence long-wave infrared quantum dot detectors,” *IEEE LEOS*, Glasgow, Scotland November 2002

34. **(Invited)** J. S. Tyo, “Aperture Design for Impulse Radiating Antennas,” *2002 URSI General Assembly*, Maastricht, Netherlands, August 24 – 31

33. **(Invited)** J. S. Tyo, “Wave propagation in longitudinally symmetric metamaterials that are isorefractive with free space,” *2002 URSI General Assembly*, Maastricht, Netherlands, August 24 – 31

32. **(Invited)** B. M. Ratliff, M. M. Hayat, and J. S. Tyo, “On the Performance of a Radiometrically-calibrated Nonuniformity Correction Algorithm”, *The 6th World Multiconference on Systemics, Cybernetics and Informatics (SCI 2002)*, July 14-18, 2002, Orlando, FL

31. J. S. Tyo, C. J. Buchenauer, Z. Zhou, S. MacGregor, A. Dick, R. C. Pate, P. E. Patterson, D. Riley, M. Buttram, “Two- and Three-dimensional time domain modeling of transient breakdown phenomena in gases and liquids,” *14th International Conference on High-Power Particle Beams and 5th International Conference on Dense Z-Pinches*, Albuquerque, NM June 23 – 28

30. **(Invited)** J. S. Tyo and M. J. Baretela, “Calculation of Optimum Size and Shape for IRA Apertures,” *2002 URSI/USNC National Radio Science Meeting*, Boulder, CO Jan. 9-12

29. **(Invited)** J. S. Tyo, “A Class of Longitudinally Symmetric Artificial Media Isorefractive with Free Space,” *2002 URSI/USNC National Radio Science Meeting*, Boulder, CO Jan. 9-12

28. M. J. Baretela and J. S. Tyo, “Increasing Prompt Response from an IRA Using Aperture Shaping,” *17th URSI Commission B International Symposium*, Victoria, BC, Canada, May 2001

27. **(Invited)** J. S. Tyo, “Maximization of Information Content in Polarimetric Measurements,” *2000 IEEE Antennas and Propagation Society International Symposium*, Salt Lake City, UT July 16-20

26. **(Invited)** J. S. Tyo and C. J. Buchenauer, “Compact Sensors for Time Domain Measurements,” *EUROEM 2000*, Edinburgh, Scotland, May 30 - June 2

25. J. S. Tyo and T. S. Turner, “Use of a Variable Retardance, Fourier Transform Device to Obtain Spectropolarimetric Images for Remote Sensing,” *1999 OSA Annual Meeting*, San Jose, CA, Sept. 21-24

24. J. S. Tyo, J.C. Gueits, C. J. Buchenauer, J. S. H. Schoenberg, “Artificial Materials for Time-Domain Applications,” *1999 URSI General Assembly*, Toronto, Ontario, August 13-20

23. J. S. Tyo, C. J. Buchenauer, and J. S. H. Schoenberg, “Beamforming in Time-Domain Arrays,” *1999 IEEE Antennas and Propagation Society International Symposium*, Orlando, FL, July 7-11

22. **(Invited)** J. S. Tyo and J. S. H. Schoenberg, “Radiation Pattern of a 1-m Diameter Half IRA,” *1999 URSI/USNC National Radio Science Meeting*, Boulder, CO, Jan. 4-7

21. K. W. Peters, T. S. Turner, and J. S. Tyo, “A Portable, Imaging, Visible Spectrum Spectropolarimeter for Remote Sensing Applications,” *1998 OSA Annual Meeting*, Baltimore, MD, Oct. 4-9

20. J. S. Tyo, “Polarization Dependent Properties of the Point Spread Function in Scattering Media,” *1998 OSA Annual Meeting*, Baltimore, MD, Oct. 4-9

19. J. S. Tyo and K. W. Peters, "Partial Polarization Upon Emission Through a Chiral-Air Interface," *1998 OSA Annual Meeting*, Baltimore, MD, Oct. 4-9
18. J. M. Lehr, M. D. Abdalla, J. S. H. Schoenberg, J. S. Tyo, M. C. Skipper, and J. W. Burger, "Progress Towards a Compact, High-Power, Ultra-Wideband Array Using Gallium Arsenide Photoconductive Semiconductor Switches," *1998 Power Modulators Conference* Redondo Beach, CA
17. J. S. H. Schoenberg, J. W. Burger, J. S. Tyo, M. D. Abdalla, M. C. Skipper, S. M. Ahern, and M. R. Richardson, "Dielectric Influence on Bulk Photoconductive Switches Used for Ultra-Wideband, High Power Microwave Generation," *EUROEM 98*, Tel Aviv, Israel, June 15-19
16. J. S. H. Schoenberg, J. S. Tyo, M. C. Skipper, M. D. Abdalla, and J. W. Burger, "A Linear Array of Ultra-Wideband Radiators Driven by Photoconductive Semiconductor Switches," *EUROEM 98*, Tel Aviv, June 15-19
15. **(Invited)** C. J. Buchenauer, J. S. Tyo, and J. S. H. Schoenberg, "Aperture Efficiencies of IRAs," *1998 URSI/USNC National Radio Science Meeting*, Boulder, CO, Jan. 5-9
14. J. S. H. Schoenberg, J. S. Tyo, M. D. Abdalla, and M. C. Skipper, "Ultra-Wideband Source Using Photoconductively Switched, Coupled Blumleins," *1998 URSI/USNC National Radio Science Meeting*, Boulder, CO, Jan. 5-9
13. J. S. Tyo, "Polarization-Difference Point Spread Function in Scattering Media," *1997 OSA Annual Meeting*, Long Beach, CA, Oct. 12-17
12. J. S. Tyo, E. N. Pugh, and N. Engheta, "Colorimetric Representations of Optical Polarization Information," *1997 OSA Annual Meeting*, Long Beach, CA, Oct. 12-17
11. J. S. Tyo, "A Comparison of the Point Spread Functions for Polarization-Difference and Intensity Only Imaging in Scattering Media," *1997 IEEE Antennas and Propagation Society International Symposium*, Montreal, Quebec, July 13-18
10. W. R. Clark, R. W. Hutchins, J. S. H. Schoenberg, and J. S. Tyo, "A Three-Dimensional Radiation Pattern Mapping of a UWB TEM Horn," *1997 IEEE Antennas and Propagation Society International Symposium*, Montreal, Quebec, July 13-18
9. C. J. Buchenauer, J. S. Tyo, and J. S. H. Schoenberg, "Experimental Characterization of the Effects of Individual Element Aperture Design on the Early-Time Response of Impulse Radiating Arrays," *1997 IEEE Antennas and Propagation Society International Symposium*, Montreal, Quebec, July 13-18
8. J. W. Burger, J. S. H. Schoenberg, J. S. Tyo, M. D. Abdalla, S. M. Ahern, M. C. Skipper, and W. R. Buchwald, "Development and Testing of Bulk Photoconductive Switches for Ultra-Wideband, High Power Microwave Generation," *11th Interanational Pulsed Power Conference*, Baltimore, MD, June 29 - July 2 (1997)
7. W. R. Buchwald, A. Balekdjian, J. Conrad, J. W. Burger, J. S. H. Schoenberg, J. S. Tyo, M. D. Abdalla, M. C. Skipper, and S. M. Ahern, "Design and Fabrication Issues of Bulk Photoconductive Switches Used for Ultra-Wideband, High Power Microwave Generation," *11th Interanational Pulsed Power Conference*, Baltimore, MD, June 29 - July 2 (1997)
6. J. S. Tyo, E. N. Pugh, and N. Engheta, "2- and 3-Parameter Colorimetric Representations for use with Polarization-Difference Imaging of Objects in Scattering Media," *1996 OSA Annual Meeting*, Rochester, NY
5. J. S. Tyo, M. P. Rowe, E. N. Pugh, and N. Engheta, "Colorimetric Representations of Poalrization-Difference Imaging of Objects in Scattering Media," *14th Annual Benjamin Franklin Symposium*, Philadelphia, PA, May 3, 1996
4. J. S. Tyo, M. P. Rowe, E. N. Pugh, and N. Engheta, "Biologically-inspired Polarization Difference Imaging: From Double Cone Photoreceptors to Imaging in Scattering Media," *13th Annual Benjamin Franklin Symposium*, Philadelphia, PA, May 11, 1995
3. J. S. Tyo, M. P. Rowe, E. N. Pugh, and N. Engheta, "Polarization Difference Imaging: A Biologically-Inspired Technique for Seeing Through Scattering Media," *1994 OSA Annual Meeting*, Dallas, TX, Oct. 3-8
2. J. S. Tyo, M. P. Rowe, E. N. Pugh, and N. Engheta, "Contrast Enhancement in Underwater Imaging Using A Biologically Inspired Polarization-Difference Imaging Technique," *1994 IEEE Antennas and Propagation International Symposium*, Seattle, WA June 20-24
1. J. S. Tyo, M. P. Rowe, E. N. Pugh, and N. Engheta, "Polarization-Difference Vision and Imaging: From Double Cone Photoreceptors to Underwater Observation," *The World Congress on Neural Networks*, San Diego, CA, Jun. 6-10, 1994

submitted abstracts

U. Sakoglu, Z. Wang, M. M. Hayat, J. S. Tyo, S. Annamalai, P. Dowd, and S. Krishna, "Effect of Dark Current on the

Research Grants

16. S. Krishna (PI), J. S. Tyo, M. M. Hayat, “Spectrally Adaptive Smart Sensors Based on Quantum Dots,” National Science Foundation, \$210,000, May 2004 - April 2007
15. J. S. Tyo (PI), “Characterization of Instrument Effects in Polarimeters,” AFOSR/NE, \$50,969, December 2003 - December 2004
14. S. Krishna (PI), J. S. Tyo, and M. M. Hayat, “Adaptive Focal Plane Array Technology,” NRO Directors Innovative Initiatives Program, \$350,000, October 2003 - June 2004
13. J. S. Tyo (PI) “Modeling and Measurement of Sub-Nanosecond Breakdown Phenomena in Liquids and Gases,” Sandia National Laboratories under the SURP program, \$40,000, October 2003 - September 2004.
12. J. S. Tyo (PI), “CAREER: Polarimetry in Remote Sensing, Communications, and Biological Sciences,” national Science Foundation, \$400,000, May 2003 - April 2008
11. J. S. Tyo (PI) “Modeling and Measurement of Sub Nanosecond Breakdown Phenomena in Spark Gap Switches,” Sandia University Research Program October 2002 - September 2003, \$35,000
10. J. S. Tyo (PI) and D. Evans, “Non-thermal, Non-ionizing Interaction of High-intensity Pulsed Electromagnetic Fields with Small Scale Electrical and Biological Systems,” 2002 DEPSCoR Program, funded through AFOSR 2002 – 2005 (\$400,000 total)
9. J. S. Tyo (PI), “Hyperspectral Tagging,” funded by Sandia National Labs, \$7,116, FY 2002
8. Edl Schamiloglu (PI), J. S. Tyo, C. G. Christodoulou, K. H. Schoenbach, R. Widmar, “Compact, Portable Pulsed Power MURI,” Funded through AFOSR 2001 - 2006 (total project \$1M/year)
7. J. S. Tyo (PI), “Spectropolarimetric Remote Sensing,” funded through BAE Systems for the US Army Collaborative Technology Alliance, 2001–2005 (\$50k per year)
6. J. S. Tyo (PI) “Processing and Display of Hyperspectral Imagery,” funded by National Reconnaissance Organization, FY2001 \$15k
5. J. R. Powell (PI) and J. S. Tyo “Student and Faculty Research on HPM,” funded by the Naval Research Lab, FY2000 \$30k
4. J. S. Tyo (PI) “Ultra-Wideband Electromagnetic Measurement Research,” funded by the USAF Research Lab, Directed Energy Directorate, FY2000 \$23k
3. J. S. Tyo (PI) “Ultra-Wideband Antenna Array Analysis,” funded by the NPS Center for Reconnaissance Research, FY2000 \$18k
2. J. S. Tyo (PI) “Polarimetry and Spectropolarimetry for Remote Sensing Applications,” funded by the NPS Research Office, FY1999 \$30k
1. J. S. Tyo (PI) and J. S. H. Schoenberg, “Low-Voltage, UWB Array Development,” funded by the AFRL Entrepreneurial Research Program, FY1998 \$30k

submitted proposals

- J. S. Tyo (PI), “Calibration Requirements for Polarimeters,” submitted to General Dynamics, Veridian Systems Division, \$50,000 May 1 - November 30 2004
- J. S. Tyo (PI), “TEM Horns for Compact Packages,” submitted to Farr Research, Inc., \$30,000, October 1 2004 - April 30, 2005
- E. A. Ritchie (PI) and J. S. Tyo, “Use of Space-Time Pattern Analysis in Understanding and Predicting Tropical Cyclone Genesis,” submitted to NASA TCSP Program, \$382,927, January 2005 - December 2007 J. S. Tyo (PI) and M. M. Hayat, “Calibration and Compensation of Instrumental Errors in Imaging Polarimeters,” submitted to AFOSR, \$167,290, January 2005 - December 2007

Equipment Grants

2. J. S. Tyo (PI) and E. Schamiloglu, "Pulsers and Fast Transient Measurement Equipment for Compact Portable Pulsed Power Systems," 2002 DURIP, funded through AFOSR, \$166,000
1. J. S. Tyo (PI), "Microwave Test and Measurement Equipment," Agilent University Relations Program, \$93,840 March 2002