

# Charles P. Baylis II, Ph.D.

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## Position

Assistant Professor and Co-Director, Wireless and Microwave Circuits and Systems (WMCS) Program,  
Department of Electrical and Computer Engineering, Baylor University, Waco, Texas

## Education

*Doctor of Philosophy in Electrical Engineering, University of South Florida, Tampa, Florida, May 2007.*

Dissertation Title: "Improved Techniques for Nonlinear Electrothermal FET Modeling and Measurement Validation." 4.0 grade-point average.

*Master of Science in Electrical Engineering, University of South Florida, Tampa, Florida, May 2004.*

Outstanding Thesis Award, 4.0 grade-point average.

*Bachelor of Science in Electrical Engineering, Summa Cum Laude, with a minor in Mathematics,*

*University of South Florida, Tampa, FL, December 2002. 4.0 grade-point average.*

## Interests

High-efficiency power amplifier design for radar and communication systems, nonlinear microwave measurements, nonlinear transistor modeling techniques and approaches, related system applications.

## Related Experience

*Assistant Professor, Baylor University, August 2008-present.* Responsibilities include teaching graduate and undergraduate courses, conducting and supervising research, and developing new research initiatives.

Funded Research Projects Supervised (with Sponsor):

- C. Baylis (PI), "Characterization and Measurement of Nonlinear Power Amplifiers," Baylor University Undergraduate Research and Scholarly Achievement Program (Office of the Vice Provost for Research), June 2010 – May 2011
- C. Baylis (PI), "Combiner Design for Reducing Sidelobes in Radar Power Amplifiers," Baylor University Young Investigator Development Program Grant (Office of the Vice Provost for Research), June 2009 – May 2010
- C. Baylis (PI), Confidential Project Topic, TEM Consulting, November 2008 – December 2008.

Courses Taught:

- High Frequency Electronics I, Fall 2008, Fall 2009, Fall 2010 – Lecture and laboratory course in RF/Microwave circuits. Covers transmission line theory, microwave network analysis, matching network design, microwave filter design, diodes and mixers for microwave applications, network analyzer measurements, and an introduction to RF and microwave computer-aided design.
- High Frequency Electronics II, Spring 2009, Spring 2010 – Second course in RF/Microwave circuits. Covers microwave amplifier and oscillator design. Integrates CAD exercises and culminates in a student low-noise amplifier design project.
- Applied Electromagnetic Fields, Spring 2009 - Distributed circuit design, traveling waves, static and dynamic electric and magnetic fields.

- Signals and Systems, Fall 2009, Spring 2010, Fall 2010 – Time and frequency domain analysis of continuous-time signals and systems; finding system response, Fourier analysis, Laplace transform, sampling theorem, discrete-time systems

Program Development:

- Director of the Wireless and Microwave Circuits and Systems (WMCS) Program with Dr. Randall Jean. Initiated the formation of a WMCS Advisory Board (first meeting April 2009, second meeting March 2010).
- Constructed a new WMCS Teaching Laboratory that opened in September 2009. Secured a donation from advisory board member Agilent Technologies to purchase three vector network analyzers at a very significant discount for the laboratory.
- Organized and chaired the First and Second Mini-Symposia on Wireless and Microwave Circuits and Systems, April 2009 and March 2010. The mini-symposium is a student-industry forum involving multiple Texas universities and representatives of the wireless and microwave industry.

*Visiting Assistant Professor, Department of Electrical Engineering, University of South Florida, May 2007-August 2008.* Responsibilities included teaching graduate and undergraduate courses, conducting and supervising research, and developing new research initiatives.

Projects Supervised (with Sponsor):

- Predicting Residual Phase Noise in Amplifiers and Frequency Multipliers (Trak Microwave) – August 2007 – December 2008 – This project focuses on establishing 1/f noise modeling techniques for accurate prediction of phase noise in large-signal designs. The correlation of 1/f noise with bias current is examined and the resulting dependence of the phase noise on this current will be examined.
- FET Modeling Techniques for Power Amplifier Design (Modelithics, Inc.) - Developed and providing verification for bias-dependent modeling techniques; model code modification using Verilog-A.
- Design, Simulation, Fabrication, and Testing of a Microwave Power Amplifier (Senior Design Project) – Supervised a senior design student to design a power amplifier for high power-added efficiency. Worked with Modelithics industry mentors to expose students to the industry design review process.
- Design, Simulation, Construction, and Testing of a 900 MHz Voltage Controlled Oscillator (Senior Design Project) – Supervised a three-person design team to design a microwave VCO through all stages: design, simulation, fabrication, and testing. Worked with Trak Microwave industry mentor to expose students to industry design needs and capabilities. Won Second Prize in the Electrical Engineering Department for Fall 2007.

Courses Taught:

- Wireless and Microwave Instructional (WAMI) Laboratory Course, Spring 2008 – Required laboratory-based course in RF/Microwave circuits, systems, and measurements. Students characterize and build a 915 MHz receiver over the course of the semester.
- RF and Microwave Circuits I, Fall 2007 – Introductory course in RF circuit theory, covers transmission line theory, Smith Charts, S-parameters, matching networks, RF filter design, couplers, RF diodes, and mixers. The course also introduces students to microwave CAD techniques through a series of software laboratory exercises.
- Network Analysis and Design, Summer 2007 - Second course in linear circuit design, introduces Laplace and Fourier methods for circuit analysis as well as graph theory.

*Adjunct Instructor, Department of Electrical Engineering, University of South Florida, May 2004-May 2007.*

**Courses Taught:**

- Introduction to Communication Systems – Fall 2006 – Senior-level course in communication system theory and analog and digital modulation techniques.
- Network Analysis and Design – Fall 2005, Summer 2006, Spring 2007 – Second course in linear circuit design, introduces Laplace and Fourier methods for circuit analysis as well as graph theory.
- Electromagnetics – Summer 2004, Fall 2004, Spring 2005, Summer 2005 – Distributed circuit design, traveling waves, static and dynamic electric and magnetic fields.

*Graduate Research Assistant, Center for Wireless and Microwave Information Systems, Department of Electrical Engineering, University of South Florida, January 2003 – May 2007. Co- Advisors: Dr. Lawrence P. Dunleavy and Dr. Arthur David Snider. Research funded by Raytheon RF Components of Andover, Massachusetts and Modelithics, Inc, of Tampa, Florida.*

- Raytheon-funded research involved pulsed load-pull measurements and algorithm development. Have developed a new load-pull algorithm for more efficient measurements and simulations.
- Performed research in the area of microwave transistor modeling and measurement applications
- Gained valuable industry experience in the field.
- Oversaw and wrote Department of Defense grant proposals.
- Prepared industry grant proposals and budgets.

*Graduate Teaching Assistant, Department of Electrical Engineering, University of South Florida, Spring 2003 and Spring 2004. Served as a laboratory instructor for the Wireless Circuits and Systems Design Laboratory, an undergraduate and graduate course focusing on wireless circuit and system design and microwave measurements.*

*Undergraduate Research Assistant, Department of Electrical Engineering, University of South Florida, May 2002 – August 2002. Focus area of the research was software radio and its application in emerging communication systems. Advisor: Dr. Ravi Sankar.*

*Senior Design Student, Department of Electrical Engineering, University of South Florida, 2002. Successful design and construction of a 970 kHz superheterodyne amplitude-modulation receiver circuit. Advisor: Dr. Paris Wiley.*

*Audio-Visual Assistant, Idlewild Baptist Church Technical Ministries, Tampa, Florida, May 2000-August 2000. Assigned, delivered, and connected audio-visual equipment to rooms based on equipment reservations.*

*Mathematics Assistant, Kumon Math and Reading Center, Tampa, Florida, June 1999-August 1999. Instructed mathematics students ranging from 4 years old through middle school and graded assignments.*

## **Selected Accomplishments**

Honorable Mention, National Science Foundation Graduate Research Fellowship Competitions, 2003 and 2004.

Finalist, 2006 Provost's Award for Outstanding Teaching by a Graduate Teaching Assistant, University of South Florida.

National Automatic Radio-Frequency Techniques Group (ARFTG) Fellowship Recipient, 2004.

University of South Florida Outstanding Thesis Award for Master's Thesis, "Improved Current-Voltage Methods for RF Transistor Characterization," October 2004.

4.0 Grade-Point Average through all undergraduate and graduate coursework.

University of South Florida/Mini-Circuits Wireless and Microwave Fellowship Recipient, 2003-2004.

College of Engineering Outstanding Graduate Award Recipient, December 2002.

King/O'Neal Scholar Award Recipient, University of South Florida, December 2002.

Special Recognition for Senior Design Project Presentation, Department of Electrical Engineering, University of South Florida, July 2002.

Member, Automatic RF Techniques Group, 2004-present.

Student Member (2003-2007) and Member (2008-present), Institute of Electrical and Electronics Engineers (IEEE).

Student Member (2005-2007) and Member (2008-present), IEEE Microwave Theory and Techniques Society.

## **Publications and Conference Papers**

C. Baylis, L. Dunleavy, S. Lardizabal, R.J. Marks II, and A. Rodriguez, "Efficient Optimization Using Experimental Queries: A Peak-Search Algorithm for Efficient Load-Pull Measurements," *Journal of Advanced Computational Intelligence and Intelligent Informatics*, Vol. 15, No. 1, January 2011.

L. Dunleavy, C. Baylis, W. Curtice, and R. Connick, "Modeling GaN HEMT Devices," *Microwave Journal*, October 2010.

C. Baylis, L. Wang, M. Moldovan, J. Martin, H. Miller, L. Cohen, and J. deGraaf, "Designing for Spectral Conformity: Achieving Linearity and Efficiency in Power Amplifiers," IEEE Conference on Waveform Diversity, Niagara Falls, Ontario, Canada, August 2010.

C. Baylis, M. Moldovan, L. Wang, J. Martin, L. Cohen, and J. de Graaf, "LINC Power Amplifiers for Reducing Out-of-Band Spectral Re-growth: A Comparative Study," IEEE Wireless and Microwave Technology Conference, Melbourne, Florida, April 2010.

C. Baylis, J. Perry, M. Moldovan, R.J. Marks II, and L. Dunleavy, "Use of a Step-Response Approximation for Thermal Transient Modeling in Power MOSFETs," Automatic RF Techniques Group Conference, Broomfield, Colorado, December 2009.

S. Meena, C. Baylis, L. Dunleavy, and M. Marbell, "Duty Cycle Dependent Pulsed IV Simulation and Thermal Time Constant Extraction for LDMOS Transistors," Submitted September 2009 to Automatic RF Techniques Group (ARFTG) Conference, Broomfield, Colorado, December 2009.

C. Baylis and L. Dunleavy (invited), "Electrothermal Nonlinear FET Modeling for Spectral Prediction," 2009 IEEE Electromagnetic Compatibility Symposium, Austin, Texas, August 2009.

C. Baylis, L. Dunleavy, and R. Connick (invited), "Modeling Considerations for GaN HEMT Devices," 2009 IEEE Wireless and Microwave Technology Conference (WAMICON), Clearwater, Florida, April 2009.

- C. Baylis and R. Jean, "A Course Sequence in High Frequency Electronics with Hands-On Laboratory Experiments," American Society of Engineering Education (ASEE) Gulf Southwest Conference, Waco, Texas, March 2009.
- S. Somasundaram Meena, C. Baylis, and L. Dunleavy, "Benchmarking Comparison of Thermal and Diode Sensors for Pulsed Power Measurement," 72<sup>nd</sup> Automatic RF Techniques Group Conference, Portland, Oregon, December 2008.
- C. Baylis and L. Dunleavy, "Voltage Transient Measurement and Extraction of Power RF MOSFET Thermal Time Constants," 70<sup>th</sup> Automatic RF Techniques Group Conference, Tempe, Arizona, November 2007.
- C. Baylis, Improved Techniques for Nonlinear Electrothermal FET Modeling and Measurement Validation, Doctoral Dissertation, University of South Florida, 2007.
- C. Baylis, S. Lardizabal, and L. Dunleavy, "A Fast Sequential Load-Pull Algorithm Implemented to Find Maximum Power," IEEE Wireless and Microwave Technology Conference (WAMICON 2006), Clearwater, Florida, December 2006.
- C. Baylis, L. Dunleavy, and W. Clausen, "Design of Bias Tees for Pulsed-Bias S-Parameter Measurements Using Accurate Component Models," *Microwave Journal*, October 2006.
- S. Akamatsu, C. Baylis, and L. Dunleavy, "Accurate Simulation Models Yield High Efficiency Power Amplifier Design," *IEEE Microwave Magazine*, December 2005.
- C. Baylis, L. Dunleavy, and W. Clausen, "The Importance of a Slow Sweep Rate in Static DC-IV Measurements," *Microwave Journal*, March 2005.
- C. Baylis, L. Dunleavy, and J. Martens, "Constructing and Benchmarking a Pulsed S-Parameter System," 66<sup>th</sup> Automatic RF Techniques Group Conference, December 2005, Washington, D.C.
- R. Varanasi, C. Baylis, L. Dunleavy, and W. Clausen, "Prediction of Harmonic Tuning Performance in pHEMTs," 2005 IEEE Wireless and Microwave Technology Conference, Clearwater, Florida, April 2005.
- C. Baylis, L. Dunleavy, and A. Snider, "The Normalized Difference Unit as a Metric for Comparing IV Curves," 64<sup>th</sup> Automatic RF Techniques Group Conference, Orlando, Florida, December 2004.
- C. Baylis, L. Dunleavy, P. Ladbroke, and J. Bridge, "The Influence of Pulse Separation and Instrument Input Impedance on Pulsed IV Measurement Results," 63<sup>rd</sup> Automatic RF Techniques Group Conference, Fort Worth, Texas, June 2004.
- C. Baylis, L. Dunleavy, and J. Daniel, "Direct Measurement of Thermal Circuit Parameters Using Pulsed IV and the Normalized Difference Unit," IEEE Microwave Theory and Techniques Society International Microwave Symposium, Fort Worth, Texas, June 2004. (Refereed Conference)
- C. Baylis, Improved Current-Voltage Methods for RF Transistor Characterization, Master's Thesis, April 2004, University of South Florida, Tampa, Florida
- C. Baylis, L. Dunleavy, and J. Daniel, "Thermal Correction of IV Curves for Nonlinear Transistor Modeling," IEEE 2004 Wireless and Microwave Technology Conference, Clearwater, Florida, April 2004.

C. Baylis and L. Dunleavy, "Understanding Pulsed IV Measurement Waveforms," *Eleventh IEEE International Symposium on Electron Devices for Microwave and Optoelectronic Applications (EDMO 2003)*.

Papers Under Preparation:

C. Baylis, J. Martin, M. Moldovan, and R.J. Marks II, "Going Nonlinear: Unlocking the Capabilities of Nonlinear Network Analysis for Large-Signal Design," Invited Article, *IEEE Microwave Magazine*, April 2011.

Conference Presentations:

C. Baylis, H. Miller, L. Wang, and M. Moldovan (invited presentation), "Spectrum Issues in Power Amplifier Design," 2009 Tri-Service Radar Symposium, Boulder, Colorado, June 2009.

C. Baylis, L. Dunleavy, and S. Lardizabal, "A Peak-Search Algorithm for Faster Transistor Load-Pull Characterization," 2007 Raytheon Symposium, Tucson, Arizona, June 2007.

L. Dunleavy and C. Baylis (Invited Workshop Presentation), "Meeting the Challenges in High-Power Device Modeling," in IEEE MTT-S International Microwave Symposium Workshop: "Challenges of High Power Device Characterization and Modeling," Honolulu, Hawaii, June 2007.

C. Baylis, L. Dunleavy, and S. Lardizabal, "Efficient Load-Pull Measurement Using a Sequential Search Algorithm," IEEE Topical Symposium on Power Amplifiers for Wireless Communications, Long Beach, California, January 2007.

Seminars and Guest Lectures:

C. Baylis, "High-Efficiency, Linear, Power Amplifier Design and Related Characterization Techniques," Texas Analog Center for Excellence (TxACE) Seminar, University of Texas at Dallas, Richardson, Texas, May 2010.

C. Baylis, "X-Parameters: A New Paradigm for Nonlinear Design?," Baylor Engineering and Research Seminar (B.E.A.R.S.), Baylor University, Waco, Texas, February 2010.

C. Baylis, L. Dunleavy, S. Lardizabal, H. Miller, J. Perry, R. Marks II, "A Peak-Search Algorithm for More Efficient Load-Pull Measurements," IEEE Microwave Theory and Techniques Society, Dallas Chapter Meeting, Dallas, Texas, June 2009.

C. Baylis, "Research in Wireless and Microwave Active Circuits at Baylor University," CASPER Seminar, Baylor University, May 2009.

C. Baylis, "An Overview of Transistor Modeling for RF and Microwave Applications," Baylor Engineering and Research Seminar (B.E.A.R.S.), March 2009.

C. Baylis, "Improving the RF Active Circuit Design Cycle Through Innovations in Electrothermal Modeling, Characterization, and Design Techniques," Baylor Engineering and Research Seminar (B.E.A.R.S.), Baylor University, April 2008.

C. Baylis, "PDFs and MGFs for Sums of Random Variables," Guest Lecture in Probability and Random Processes Course, Cedarville University, Cedarville, Ohio, March 2008.

C. Baylis, "RF/Microwave Transistor Modeling Research at the University of South Florida," Wireless Seminar, University of South Florida, Tampa, Florida, February 2008.

- C. Baylis, "Development of New Time-Dependent Modeling and Characterization Techniques for Thermal and Trapping Effects in GaN FETs and HEMTs," Army Research Laboratory, Adelphi, Maryland, January 2008.
- C. Baylis, "Active Circuit Research at the USF WAMI Center," Freescale Semiconductor, Tempe, Arizona, November 2007.
- C. Baylis, "Improved Microwave Transistor Modeling Techniques Using Pulsed Measurements," Wireless Seminar, University of South Florida, Tampa, Florida, January 2007.

## **Conference Organization and Synergistic Activities**

Journal Reviewer, *IEEE Transactions on Microwave Theory and Techniques*, 2009.

Technical Program Committee Member, Session Co-Chair, and Paper Awards Competition Coordinator, 2010 IEEE Wireless and Microwave Technology Conference, April 2010, Melbourne, Florida.

Chair, First and Second Mini-Symposia on Wireless and Microwave Circuits and Systems, Waco, Texas, April 2009 and March 2010.

Executive Committee Member and Student Activities Chair, IEEE Microwave Theory and Techniques Society, Dallas Chapter, 2009-2010.

Evaluator, IEEE Microwave Theory and Techniques Society Undergraduate Scholarship Competition, 2009-2010.

Steering Committee Member and Website Chair, 2009 IEEE Wireless and Microwave Technology Conference, April 2009, Clearwater, Florida

Session Co-Chair: Special Session on Transistor Modeling, 2009 IEEE Wireless and Microwave Technology Conference, April 2009, Clearwater, Florida.

Local Arrangements Chair, 2008 IEEE Power Amplifier Symposium, January 2008, Orlando, Florida.

Steering Committee Member, 2014 IEEE International Microwave Symposium, June 2014, Tampa, Florida.

## **University Committee Service**

*Baylor School of Engineering Strategic Thinking – Phase 1 Committee, Baylor University, 2008 – 2009.*  
Appointed as the Electrical and Computer Engineering Department representative on a school-wide committee to oversee Phase 1 of the strategic plan development process for the School of Engineering and Computer Science.

*Baylor Engineering Graduate Recruiting Committee, 2008 – present.* Serving on a committee to enhance graduate recruiting efforts and develop strategies. Have visited universities to establish graduate recruiting alliances.

*USF College of Engineering Dean Search Committee, University of South Florida, 2006-2007.*  
Participated in conducting a successful search for USF College of Engineering Dean in the 2006-2007 academic year.

## Agency Grant Proposal Writing Activities

2010 National Science Foundation, *Transforming Undergraduate Education in Engineering and Science*, May 2010, "Collaborative Research: A Hybrid Design for Enhanced STEM Learning: Studying the Balance Between Explicit Instruction, Real-Space Labs, and Socially-Mediated Online Communication in Wireless and Microwave Engineering Education," (pending)

- PIs: Charles Baylis (Baylor University), Rashaunda Henderson (University of Texas at Dallas)
- Co-PIs: Randall Jean (Baylor University), Steve Eisenbarth (Baylor University), W. Gardner Campbell (Baylor University)
- Proposes a study of using social mediation and hands-on laboratory experiments in microwave circuits courses. If funded, the study will be conducted by Baylor University as a cooperation between WMCS and the Academy for Teaching and Learning and will utilize microwave circuits courses at both Baylor and UT-Dallas.
- Total Funds Requested: approximately \$199,000
- Proposed Period: August 1, 2010 – July 31, 2013.

2010 National Science Foundation, *Unsolicited Proposal*, February 2010, "Nonlinear Network Parameters: Creating a Paradigm Shift in Large-Signal Design."

- PI: Charles Baylis (Baylor University), Co-PI: Robert J. Marks II (Baylor University)
- Proposes the creation of a paradigm shift in large-signal design and application to interdisciplinary fields through creation of a low-cost measurement approach for nonlinear network parameters.
- Total Funds Requested: \$490,655
- Proposed Period: June 1, 2010 – May 31, 2013.

2010 Baylor University Undergraduate Research and Scholarly Activity Grant, February 2010, "Characterization and Measurement of Nonlinear Power Amplifiers," Funded.

- PI: Charles Baylis (Baylor University)
- Proposes the development and application of measurement techniques for measurements related to power amplifier design, including nonlinear network parameters.
- Total Funds Requested: \$5,000
- Proposed Period: June 1, 2010 – May 31, 2011.

2010 Baylor University Faculty Research Investment Program, February 2010, "Nonlinear Network Parameters for Large-Signal Amplifier Design and Spectral Prediction," (pending)

- PI: Charles Baylis (Baylor University)
- Proposes the development of nonlinear measurement techniques and theory to support the use of X-parameters and/or other nonlinear network parameter sets in nonlinear design. Also proposes the expansion of these techniques into interdisciplinary fields such as microwave design, power electronics, power systems, and vibrations.
- Total Funds Requested: \$25,000
- Proposed Period: June 1, 2010 – May 31, 2011.

2009 Navy SBIR Phase 1 Proposal: "Ultra Low PIM Diplexer."

- PI: Stephen Berger (TEM Consulting), Co-PI: Charles Baylis (Baylor University), Co-PI: Tom DiStefano
- Proposes the creation of a test bed for intermodulation nonlinearities in diplexers, a problem known as passive intermodulation (PIM).
- Total Funds Requested: \$75,000
- Proposed Period: January 1, 2010 – July 1, 2010.

2009 National Institute of Standards and Technology, "Metrology and Extensible Evaluation System Architecture for Next Generation Wireless Technology."

- PI: Charles Baylis (Baylor University), Co-PI: Doug Sicker (University of Colorado), Co-PI: Stephen Berger (TEM Consulting)



- Proposes the creation, construction, and implementation of a test architecture and procedure to evaluate new wireless protocols such as dynamic spectrum access. The evaluation will include identification and minimization methods for system nonlinearities, which is of interest to the Baylor research team.
- Total Funds Requested: \$1,498,107
- Proposed Period: September 1, 2009 – August 31, 2012.

*2009 National Science Foundation, Course Curriculum and Laboratory Improvement, May 2009, “An Industry-Advised Microwave Circuits Course Sequence Including a Hands-On Laboratory.”*

- PI: Charles Baylis (Baylor University), Co-PI: Randall Jean (Baylor University)
- Proposes the development of a teaching laboratory to support the High Frequency Electronics course sequence developed at Baylor University.
- Involved leveraging departmental funds to secure an in-kind equipment donation from Agilent Technologies.
- Obtained letters of support from multiple WMCS Advisory Board members, Agilent Technologies (partial sponsors), and the Baylor Academy for Teaching and Learning.
- Total Funds Requested: \$200,000
- Proposed Period: August 1, 2009 – July 31, 2011.

*2009 Naval Research Laboratory (Initial Proposal in Response to NRL BAA 53-07-02), April 2009, “Combiner Design for Reduced Spectral Spreading in Radar LINC Power Amplifiers.”*

- PI: Charles Baylis (Baylor University)
- Proposes comparison of different power-amplifier design techniques for radar, examining Linear Amplification with Nonlinear Components topology using both a 180-degree coupler and a Chireix combiner.
- Total Funds Requested: \$33,454
- Proposed Period: July 1, 2009 – December 31, 2009.

*2009 DARPA Young Faculty Award, February 2009, “Fast Load and Source Pull Algorithms for Reconfigurable Amplifiers”*

- PI: Charles Baylis (Baylor University)
- Proposes the development of a method for simultaneous load- and source-pull to be performed in a reconfigurable amplifier setting.
- Involved proposed collaboration with Raytheon RF Components, Andover, Massachusetts.

*2009 National Science Foundation, Unsolicited Proposal, February 2009, “Efficient Information Extraction from Oracle Interrogation, Application to Power Amplifier Optimization.”*

- PI: Robert Marks (Baylor University), Co-PI: Charles Baylis (Baylor University)
- Proposes a method to select an appropriate search algorithm for given problems, i.e. a “search for a search”. Uses load- and source-pull for power amplifier design for a case study.
- Total Funds Requested: \$380,000 over 3 years.

*2009 Baylor University Young Investigator Development Program, February 2009, “Combiner Design for Reducing Sidelobes in LINC Power Amplifiers.” Funded.*

- PI: Charles Baylis (Baylor University)
- Proposes combiner design for optimal linearity and efficiency in a Linear Amplification With Nonlinear Components (LINC) power amplifier configuration used for radar applications.
- Total Funds: \$25,000 over 1 year.

*2008 IEEE Electromagnetic Compatibility (EMC) Society University Grant Program, November 2008, “A New Course on Electromagnetic Compatibility in Wireless and Microwave Systems.”*

- PI: Charles Baylis (Baylor University), Co-PI: Randall Jean (Baylor University)
- Requests equipment funding to start a course in EMC at Baylor University beginning in January 2010.
- Total Funds Requested: \$10,000.

*2008 National Science Foundation (NSF) Unsolicited Proposal, October 2008, "High-Precision Microwave Measurements for Cell Cultures."*

- PI: Charles Baylis (Baylor University), Co-PIs: Shekhar Bhansali (University of South Florida) and Mark Jaroszeski (University of South Florida)
- Proposes measurement of cell cultures at microwave frequencies to gain insight into diagnostic capabilities for disease detection.
- Involves collaboration with the National Institute of Standards and Technology (NIST), Boulder, Colorado, and the Czech Technical University in Prague, Czech Republic (Prof. Karel Hoffmann). In addition, proposes an international student exchange program with CTU and a student internship program with NIST.
- Total Funds Requested: \$389,840 over 3 years.

*2008 Naval Research Laboratory (NRL), March 2008, "Investigation of Combining Techniques for Reduced Spectral Sidelobes in Radar Power Amplifiers."*

- PI: Charles Baylis (University of South Florida)
- The proposed work involved the development of improved combining methods for power amplifiers to be used in shipboard radar systems.

*2008 National Science Foundation (NSF) Unsolicited Proposal, February 2008, "Development of High-Precision Microwave Measurement Techniques for Cell Cultures."*

- PI: Charles Baylis (University of South Florida), Co-PI: Shekhar Bhansali (University of South Florida)
- Interdisciplinary proposal involving developing microwave techniques capable of measuring the high impedances of cell cultures with high precision.
- Proposed work to study applications including cancer detection, study of disease spreading, and adult stem cell research.
- An international collaboration and student exchange program was proposed with Czech Technical University in Prague, Czech Republic (Professor Karel Hoffmann).
- Total Funds Requested: \$361,381 over 3 years.

*2008 Army Research Laboratory (ARL), January 2008, "Development of New Time-Dependent Modeling and Characterization Techniques for Thermal and Trapping Effects in GaN FETs and HEMTs (White Paper)."*

- PI: Charles Baylis (University of South Florida)
- White-paper proposal involving the application of trap modeling techniques previously developed by the PI to time-domain modeling of GaN FETs and HEMTs and improvements on available time-domain techniques.

*2006 Defense University Research Instrumentation Program (DURIP), Army Research Office, Naval Research Office, Air Force Office of Scientific Research August 2005, "A Thermal Imaging System for Electrothermal Wide-Bandgap Device and Materials Characterization and Optical Sensor Development."*

- Coordinated and wrote the majority of a proposal that was a multidisciplinary effort between members of the Electrical Engineering, Chemical Engineering, and Physics Departments at USF.
- Applied for funds to purchase an infrared imaging temperature measurement system designed to create temperature maps of micron-scale electronic devices and materials
- Total Funds Requested: \$199,325.

*2005 Defense University Research Instrumentation Program (DURIP), Army Research Office, Naval Research Office, Air Force Office of Scientific Research, August 2004, "A Thermal Imaging / Nonlinear Network Analyzer System for Accurate Electrothermal Characterization of Wide Bandgap Devices and Materials."*

- Coordinated and wrote the majority of a proposal that was a multidisciplinary effort between members of the Electrical and Chemical Engineering Departments at USF.

- Applied for funds to purchase an infrared imaging temperature measurement system and a large-signal network analyzer.
- Total Funds Requested: \$608,968.

## Research Highlights

Established a metric known as the normalized difference unit (NDU) to describe differences between two sets of IV curves, a metric useful in quantifying differences between static and pulsed IV measurements.

Discovered a method for thermal resistance and thermal capacitance measurement in Si FETs and BJTs. Presented this method at the 2004 International Microwave Symposium in Fort Worth, Texas (refereed conference).

Created a method for thermally correcting transistor IV curves to reflect different temperature and quiescent bias conditions in silicon devices.

Developed teaching and problem-solving methods for Coulomb's Law and the Biot-Savart Law and integrated this approach into the undergraduate Electromagnetics course at the University of South Florida, Summer 2004-Summer 2005. Results submitted for publication in *IEEE Transactions on Education*, October 2007.

Constructed and benchmarked a pulsed S-parameter system at USF using available vector network analyzer. Designed and constructed a bias tee to be used in this system. Presented results at Fall 2005 Automatic RF Techniques Group Conference.

Began Development of a novel method for measuring thermal resistance of devices with significant trapping; illustrated the use of this method for a GaN HEMT.

Developed an efficient load-pull algorithm to find impedance providing maximum output power in power amplifier design. Have implemented this algorithm in both measurement and simulation systems using MATLAB as the controlling software. This work is detailed in a journal paper submission under preparation, as well as in two conference papers/presentations.

Developed modifications to the Angelov nonlinear FET model to create a quiescent bias dependence, allowing better model fitting for devices with significant trapping effects, such as GaN.

Studying linearity and efficiency tradeoffs in radar power amplifiers using the Linear Amplification With Nonlinear Components (LINC) technology. Through examination of two common implementations of the combiner, initial results of the study have shown that the 180-degree coupler implementation is advantageous for many situations over the Chireix combiner implementation.

Developing applications of Wurtinger calculus and X-parameter theory for power systems.

## Faculty Research Grants

2010 Baylor University Undergraduate Research and Scholarly Activity Grant, "Characterization and Measurement of Nonlinear Amplifiers," Baylor University Office of the Vice Provost for Research, June 1, 2010 – May 31, 2011, \$5,000.

2009 Baylor University Young Investigator Development Program, "Combiner Design for Reducing Sidelobes in LINC Power Amplifiers," June 1, 2009 – May 31, 2010, \$25,000.

TEM Consulting, Topic Confidential, November 2008 – December 2008, \$1,467.

Trak Microwave Corporation, "Prediction of Phase Noise in Amplifiers and Frequency Multipliers," August 1, 2007 – December 31, 2008, \$12,000 company contribution + \$6,000 match from Florida High Tech Corridor Program = \$18,000.

Modelithics, Inc., "Characterization and Modeling for Improved Amplifier Design," December 1, 2007 – May 31, 2009. \$25,000 company contribution + \$25,000 match from Florida High Tech Corridor Program = \$50,000.

## **Students**

Current and Former Graduate Students: Loria Wang (M.S.E.C.E. expected May 2012), Josh Martin (M.S.E.C.E. expected May 2012), Lance Nettles (M.S.E.E. 2008, now at TriQuint Semiconductor), Sivalingam Somasundaram Meena (M.S.E.E. December 2009, beginning at RF Micro Devices in January 2010), Brent Seward (M.S.), Chris Reul (M.S.), Kosol Son (M.S.)

Current Undergraduate Research Assistants: Matthew Moldovan (joint B.S./M.S. program), Hunter Miller (joint B.S./M.S. program)

Former Undergraduate Students: Nathan Varney (B.S. 2008), Kosol Son (B.S. 2008)