

ROBERT O. PERUZZI, PhD, PE

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SUMMARY

Licensed Professional Electrical Engineer specializing in electronics and integrated circuits, with particular expertise in **Mixed-Signal**. Experience and skills bridge the gap between methodologies used by digital, analog and radio frequency circuit design teams. My subspecialty within this broad category is with signal-processing electronic systems and ICs, which

- Detect signals from a sensor (e.g. antenna, microphone, pixel, thermocouple and so forth)
- Amplify, filter, then convert the signal into digital signals
- Perform further processing on the digital signals
- Convert the result back to analog signals for further processing, and/or
- Deliver the final output to an actuator (e.g. speaker, antenna, LED, heater control-switch etc.).

Examples of these systems are

- Audio amplifiers
- Audio recording/reproduction systems
- Telephones, mobile phones and cell phones
- Data transmitting/receiving systems such as serializer/de-serializers (SERDES)
- Power-management devices including switch-mode power converters
- Data recording and retrieving systems for magnetic media such as disk drives or magnetic tape
- Radio transmitters/receivers and their building blocks such as low noise amplifiers, filters, automatic gain control, oscillators, frequency synthesizers and phase-locked loops, and frequency mixers (down-converters, up-converters)
- Heat, ventilation and air conditioning controllers

PROFESSIONAL EXPERIENCE

R. PERUZZI CONSULTING, INC., 2008-Present
President and Independent Consultant

As an Expert Witness, I offer the following services:

- Analyze patents and advise on validity and/or infringement
- Forensic investigation
- Litigation support including deposition and testimony

Notable projects for clients

- Forensic investigation of a quadcopter drone to ascertain if a malfunction had occurred, which caused an injury to a bystander. Reported operator error, not malfunction. Case settled.
- Deposition and report regarding a product requirements and specification dispute. The product was a vertical probe card used in automatic testing of chips while still in wafer form. Case settled after deposition
- Forensic Investigation: Verified the functionality and accuracy of an electronic module used as a drill-bit position sensor. This module and drill-bit were involved in a gas explosion.
- Electronic Testing, Analysis and Testimony: Tested LCD video display modules and compared them to their

data-sheet specifications, advertised features and their suggested applications. Submitted expert opinion report regarding their performance versus specifications and suitability for their suggested application.

Testified at trial

- Patent Analysis:
 - Relating to A/D, D/A converters and their calibration and submitted expert report
 - Relating to electronic control systems for HVAC systems and submitted expert report
- Forensic Investigation:
 - Investigated and submitted expert report regarding an alleged failure in an Electronic Toll Collection (ETC) system resulting in a personal injury

As a technical consultant, I have an in-depth understanding of analog/mixed-signal circuits and systems, as well as strong experience with design verification, especially for chip-level analog and mixed-signal ICs. I independently review and verify digital and analog/mixed-signal (AMS) ICs using electronic design automation (EDA) software before funds are committed to manufacturing the design. My services:

- Advise and provide solutions for top-down design methodologies, and the analysis, design, modeling and verification of RF, analog and digital circuits. For design verification (DV) of Systems-on-Chip (SOC) with embedded AMS sub-systems I develop DV strategies, verification plans, create behavioral models and test-cases to execute the verification-plan (V-Plan)
- Create the necessary behavioral models of electrical circuits, wireless system components and electro-mechanical units to be used for DV. DV languages include universal verification methodology (UVM), system Verilog (SV) using real-number modeling (RNM) of analog signals and systems, Verilog, Verilog-AMS, VHDL, VHDL-AMS, Verilog-A, Spice, Spectre and others.
- IC Circuit-Design and DV tools include those by Cadence and Mentor Graphics
- Design algorithms, software and hardware for system self-tuning and calibration

Client products include

- Single-chip Transceivers for Products with Antenna Diversity
- Hard-Disk-Drive READ-Channel integrated circuits
- Single-Chip RF Receivers for Television Signals
- High Speed Serializer/De-serializer (SERDES) Circuits
- Mixed-signal Power management ICs comprising low drop-out (LDO) and switch-mode step-up (boost) and step-down (buck) converters intended for medical or general applications
- Magnetometers (for sensing magnetic field intensity and angle)
- Analog/Mixed-Signal Computer-Aided Design (CAD) Tools

Notable projects for clients

- Taught in-house class "An Introduction to Mixed-Signal Behavioral Modeling and Verification" for engineering and engineering management staff of client company
- Designed electronic system components for a high-accuracy magnetic field sensor. Created and validated Matlab/Simulink models for top-down design and verification of that complete magnetometer system
- Designed an optimal self-tuning algorithm for a local-oscillator generator's phase-locked-loop
- Designed a self-calibration mechanism for poly-phase filters used in a television receiver RF front end

XtremeEDA, 2015-2016

Principal Consultant

Duties:

- Provided design and consulting services to the company's various clients
- Participated in industry conferences and seminars
- Supported sales and marketing efforts in general
- Provided guidance regarding the development of the AMS services practices within the company
- Created behavioral models of analog and mixed signal circuits, including event-driven real-number modeling (RNM) in System Verilog, UVM, Verilog-AMS (wreal and electrical), and Verilog (real, with out-of-module references for inter-block signal flow)
- Created, ran, and debugged directed and constrained-random test-cases in verification environments including UVM
- Developed automated regression infrastructure setup for functional verification of high complexity mixed-signal SOC designs
- Developed and used constrained-random transactors to validate functionality of system designs
- Debugged regression failures at the behavioral model, RTL, gate and transistor level
- Used Cadence and Mentor Graphics (EDA) platforms

INFINEON TECHNOLOGIES (*LSI, Agere Systems, Lucent, AT&T Bell Labs*), Allentown, PA, 1990-2008

Multiple positions as AT&T Bell Labs, which evolved into Lucent Technologies, Agere Systems, LSI and Infineon.

Final Position: Senior Member of Technical Staff, 2007-2008

Department: Infineon, Allentown Location, Mobility Division

Duties:

- Create behavioral models in the VHDL language for new Infineon RF transceiver ICs as part of an existing design team based in Austria and Germany
- Create models, verification testbenches and testcases to troubleshoot existing mobility IC products and verify their revisions
- Create and write proposals for new IC products to be designed at the Allentown

facility Awards:

- Invited to Infineon Technologies Communication Tech Days Conference at Infineon headquarters in Munich: 2008

Invited Lecture:

- "High-level RF Behavioral Models with Time-Domain Noise", Infineon Technologies Communication Tech Days Conference, 2008

Position: Senior Member of Technical Staff, 2006-2007

Department: LSI Mobility

Division Duties:

- Lead the top-down design and verification of test-chip ICs for evaluating competing receive and transmit circuit architectures
- Create models for RF front end and analog subcircuits for satellite radio receiver ICs
- Create models for mixed signal power-management subcircuits and touch-screen sensor subcircuits in cellular handset baseband ICs
- Design specialized testbenches for troubleshooting specific design faults in satellite radio receiver RF ICs and cellular handset baseband ICs
- Ensure zero functional errors in test-chips so that fair and accurate parametric comparisons can be made

Technical writing: In-Company Publications

- Full reports on trouble-shooting findings including suggested circuit revisions

Position: Senior Member of Technical Staff, 2005-2006

Department: Agere Systems (Later LSI) Advanced RF Architectures Department

Department Charter: Research and develop novel RF circuits and architectures for ICs

Duties:

- Create prototypes and models of RF circuit alternative choices to compare relative merits of each choice
- Lead the top-down design and verification of test-chip ICs for evaluating competing receive and transmit circuit architectures
- Ensure zero functional errors in test-chips so that fair and accurate parametric comparisons can be made

Technical writing: In-Company Publications

- Full report on FM Receiver prototype and digital down converter/filter designs
- Top-down RF design methodology and HDL-Coder

methodology In-house Lectures and Seminars:

- Lecture at Agere Systems, circa 2006: "A method for choosing optimal test-tones and phases when designing multi-tone signals for simulation or hardware testing." A practical technique for both computer simulation and hardware test
- Lecture at LSI, circa 2007: "Extending the use of Lyrtech prototyping system" Demonstrated a systematic low-cost approach for early investigation of design feasibility

Position: Member of Technical Staff, 2003-2005

Department: Agere Systems Mass Storage Integrated Circuits

Division Duties:

- Create behavioral models of Analog and Mixed Signal circuits in Verilog-AMS modeling language
- Develop and execute plans for pre-manufacture verification of ICs
- Improve the design and verification methodology of the

division Technical Writing:

- Internal guide for the creation and validation of behavioral models in Verilog-AMS
- Company-wide guide for improving models of digital cells by making models aware of power supply

faults In-house Lectures and Seminars:

- Lecture at Agere Systems, circa 2004: "Guidelines for choosing the right level of detail in Verilog-AMS behavioral models" Taught practical circuit analysis and behavioral modeling techniques.
- Lecture at Agere Systems, circa 2004: "Motivation for adding power-supply awareness to the standard libraries of digital gates" Taught practical circuit analysis and behavioral modeling techniques.

Awards:

- Multiple instances of monetary and honorary departmental awards for performance excellence
- Company award for patent submission: "Amplifier having half-wave tracking power rails", based upon PhD research. Co-filed with one of my thesis advisors Patent #7498876 granted March 3, 2009

Promotion:

- To Senior Member of Technical Staff

Position: Member of Technical Staff, 2000-2003

Department: Lucent Technologies (later Agere Systems) Mobile Communications Integrated Circuits Division

Duties:

- Designing Analog and Mixed Signal (Analog/Digital) Circuits for mobile phone base-band ICs

- Creating behavioral models of Analog and Mixed Signal circuits in Verilog-AMS modeling language
- Laboratory testing, validation and trouble-shooting of ICs
- Improving the design and verification methodology of the division

Circuit Designs:

- Band-gap reference voltage and bias current generator
- Voice-band up-link path including
 - Microphone pre-amplifier
 - Variable gain amplifier
 - Anti-aliasing filter
 - Delta-sigma A/D converter
- Voice-band down-link path including
 - Delta-sigma D/A converter
 - Switched-capacitor reconstruction-filter
 - Continuous-time smoothing filter
 - Audio speaker driver amplifier

Technical Writing:

- Design, User and Test Specification documents for Band-gap and Voice-band subsystems
- Application notes which show customers how to program and electrically interface to the Voice-band

In-house Lectures and Seminars:

- Lecture at Lucent Technologies, circa 2000: "Silicon band-gap voltage references in CMOS technology – theory and design techniques to ensure start-up and optimize voltage temperature coefficient" Taught theory and design technique.
- Lecture at Lucent Technologies, circa 2001: "Delta-sigma analog to digital converters, theory and optimization for small area and low power consumption" Theory and design technique.
- Lecture at Lucent Technologies, circa 2001: "A method for deriving, by analysis, the frequency response of switched-capacitor filters as a function of component values" Theory and design technique.

Awards:

- Company award for patent submission "A software/hardware solution to prevent audible pops during cell phone operating mode transitions" Patent pending
- Selected for Lucent Technologies and then Agere Systems' tuition assistance program for PhD study

Position: Member of Technical Staff, 1995-2000

Department: AT&T Bell Labs (later Lucent Technologies) Mass Storage Integrated Circuits Division

Duties:

- Designing digital and analog circuits and creating behavioral models (in C-language) of analog circuits used in hard-disk and data-tape drive READ-channel ICs
- Developing and executing plans for pre-manufacture verification of ICs
- Laboratory testing, validation and trouble-shooting of ICs

Circuit Designs:

- Temperature sensor circuit
- Test-port gateway (for monitoring digital output of analog front end or for injecting a digital test signal which bypasses the analog front end)
- Multi-function test-access I/O ports
- Power-fault tolerant digital I/O ports

Technical writing:

- READ-Channel Specification Document

- Wrote individual chapters of document
- Edited, compiled and maintained entire document
- User application notes
 - For test-port gateway
 - For power-fault tolerant digital I/O port features and limitations
- In-Company Technical Memorandum
 - "Guide for Writing Analog Behavioral Models in the C Programming Language"

In-house Lectures and Seminars:

- Seminar at AT&T Bell Labs, circa 1995: "An overview of computer hard-disk-drive technology and introduction to AT&T READ-Channel ICs" Full-day seminar for new hires held periodically.
- Lecture at AT&T Bell Labs, circa 1995: "Writing Analog Behavioral Models in the C Programming Language" Lecture taught advanced modeling concepts targeted toward company approach to verification.
- Lecture at Lucent Technologies, circa 1999: "A procedure for creating mathematical models of dynamically tunable continuous-time biquadratic filters using analog and digital controlled time-varying coefficients in differential or integral state equations" How to model a very specific circuit type.

Awards:

- Multiple instances of monetary and honorary departmental awards for performance excellence

Initial position: Member of Technical Staff Level One, 1990-1995

Department: AT&T Bell Labs Telecommunication Integrated Circuits

Division Duties:

- Developing and debugging custom hardware and software for automatic testing of telecommunication ICs
 - Prove in hardware and software for wafer probing of devices and for packaged devices, and over temperature ranges -40 deg-C, ambient, and 100 deg-C

Award:

- Selected for AT&T and then Lucent Technologies' tuition assistance program for Master's Degree study

Promotion:

- To Member of Technical Staff (MTS)

LTX CORPORATION, Westwood, MA

Hardware Engineer, 1988-1990

Duties:

- Interface with customers. Evaluate customer requirements and translate into hardware design specifications and software algorithms
- Design, inspect and prove-in custom hardware to interface between company's tester product and customer's devices to be mass-production tested
- Write and debug software modules to be executed with the company's tester
- Write documentation describing the custom hardware and software for customer's use in future maintenance and troubleshooting
- Deliver the tester application (custom hardware, software and documentation) to the customer's premises. Install, troubleshoot (if necessary) and prove-in the application to the customer's satisfaction

Co-op Student Employee, 1986-1988

Duties:

- Assemble electrical products by placing and soldering components and wires and attaching hardware

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- Construct custom electrical products by attaching components to prototyping boards, hand-routing connecting wires and attaching hardware
- Visually inspect assembled electrical products
- Test, troubleshoot and repair electrical products
- Design or modify and supervise the assembly of custom electrical products
- Write or modify software programs

UNITED STATES AIR FORCE, 1977-1984

Honorably discharged as E-5 (Staff Sergeant)

BOB PERUZZI ORCHESTRAS, 1975-1977

Professional Musician

EDUCATION

PhD, Electrical Engineering, Lehigh University, Bethlehem, PA, 2005

Dissertation: "A Novel Amplifier System Combining Class D D/A Conversion and Low-Power Class AB Operation"

MS, Electrical Engineering, Lehigh University, Bethlehem, PA, 1996

Thesis: "A Continuous-Time Analog Adaptive Bi-quadratic Filter – Design, Construction and Characterization"

BS, Electrical Engineering, Northeastern University, Boston, MA, 1988

Summa cum Laude: GPA:

3.94/4.0 Awards and Honors:

- Phi Kappa Phi award for outstanding Engineering freshman, 1985.
- Elected to Tau Beta Pi Electrical Engineering Honor Fraternity in junior year, 1987
- Academic distinction award from the Boston chapter of the IEEE Power Engineering Society in 1986

Bachelor of Music in Music Education, Boston Conservatory of Music, Boston, MA, 1974

- Dean's List, 1974

CURRENT PROFESSIONAL LICENSE AND AFFILIATIONS

- Professional Engineer (PE) Pennsylvania License Number PE078294
- National Academy of Forensic Engineers, Associate Member
- Philadelphia Consultants Network (CONET) Former Chair
- National, Pennsylvania and Lehigh Valley Societies of Professional Engineers (NSPE, PSPE, LVSPE)
- Lehigh Valley Engineering Council: Chair, Representative from Lehigh Valley Section of IEEE
- IEEE Senior Member Society Memberships:
 - Solid State Circuits Society (SSCS): Founder and Vice Chair, Lehigh Valley SSCS Chapter
 - Product Safety Engineering Society (PSES)
 - Circuits and Systems Society (CSS)
 - Behavioral Modeling and Simulation Society: Member of 2010 BMAS Conference Committee
- Audio Engineering Society
- American Bar Association Section of Intellectual Property Law (ABA-IPL)
- American Bar Association Section of Science and Technology Law

PATENTS

- Patent Number 7498876: Amplifier having half-wave tracking power rails. March 3, 2009
- Patent Number 20090275322: Prevention of audio pop in a digital audio device. July 9, 2009

PUBLICATIONS

- "A Systematic Approach to Creating Behavioral Models", a White Paper to accompany lecture of the same name, CDNLive, March 10, 2015. <http://tinyurl.com/Xtreme-EDA-Customer-Resources>
- "Efficient Verification and Virtual Prototyping of Analog and Mixed-Signal IP and SOCs Using Behavioral Models" <http://www.design-reuse.com/articles/23018/verification-virtual-prototyping-ams-behavioral-model.html>
- "High-level RF Behavioral Models with Transient Noise", Infineon Technologies Communication Tech Days Conference, 2008
- "Verification of Digitally calibrated analog systems with Verilog-AMS Behavioral Models", IEEE Behavioral Modeling and Simulation (BMAS) Conference, 2006
- "A Novel Amplifier System Combining Class D D/A Conversion and Low-Power Class AB Operation" Audio Engineering Society Conference, 2004
- "A 200 Mb/s CMOS EPRML channel with integrated servo demodulator for magnetic hard disks", Proc. Int. Solid-State Circuits Conf., San Francisco, CA, Feb. 6–8, 1997. Co-author
- "A Median Peak Detecting Analog Signal Processor for Hard Disk Drive Servo", IEEE Journal of Solid-State Circuits, Vol. 30, No. 4, April, 1995. Co-author
- "A high-speed, low-power PRML read channel device", IEEE Transactions on Magnetics, vol. 31, no. 2, pp. 1186-1195, March 1995. Co-author

LECTURES

- "Introduction to Intellectual Property and Patents." Guest lecturer for Lehigh University Senior Project Class, Bethlehem, PA, September 2016
- "Mixed-Signal UVM Demonstration using Real-Number Models and System Verilog," CDNLive Conference, Boston, MA, September 2015
- "A Systematic Approach to Creating Behavioral Models." CDNLive Conference, Silicon Valley, CA March 2015
- Lecture in conjunction with poster exhibit: "Using Class D digital to analog conversion to create signal-tracking power rails for a Class AB audio amplifier," Audio Engineering Society Conference, 2004
- Lecture to accompany slide-show and paper presentation: "Verification of Digitally calibrated analog systems with Verilog-AMS Behavioral Models," IEEE Behavioral Modeling and Simulation (BMAS) Conference, 2006
- Lecture in conjunction with poster exhibit: "High-level RF Behavioral Models with Time-Domain Noise," Infineon Technologies Communication Tech Days Conference, 2008
- Invited Lecture "An Overview of Mixed-Signal IC Verification with Behavioral Models," IEEE Princeton Section, Solid-State Circuits Society Chapter Technical Meeting, December 2010
- Invited Lecture "Reducing the Risk of Human Error in Digitally Calibrated Analog Circuits with Mixed-Signal Simulation Techniques," IEEE Philadelphia Section Technical Meeting, October 2011
- Invited Lecture "Consulting as a Solid-State Circuits Electrical Engineer – Panel Discussion," IEEE Lehigh Valley Section Solid State Circuits Society Technical Meeting, November 2013