Cristian Ferent

Curriculum Vitae

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RESEARCH INTERESTS

- Computer Aided Design Techniques for Mixed-Signal Design Automation
- Modeling and Characterization Methodologies of Integrated Circuits
- Distributed Data Modeling for Cyber Physical and Embedded Sensing Network Systems
- Hardware-Software Co-design for Systems-on-Chip

TEACHING INTERESTS

- VLSI Design Automation
- Embedded Systems Design
- Integrated Devices and Circuits
- Electrical Circuit Analysis
- VLSI Systems Design
- Hardware-Software Co-design
- Programmable Mixed-Signal Systems-on-Chip
- Data Mining Methods for Electrical Engineering

EDUCATION

Ph.D. in Electrical Engineering **August 2013** *(expected)*

Stony Brook University, Stony Brook, New York

- Dissertation Title: *Systematic Integrated Circuit Classification Schemes for Computer Aided Design using Data Mining Techniques*
- Advisor: Prof. Alex Doboli

M.S. in Electrical Engineering **December 2008**

Stony Brook University, Stony Brook, New York

B.E. in Telecommunications **July 2007**

Technical University of Cluj-Napoca, Cluj-Napoca, Romania

RESEARCH EXPERIENCE

Research Assistant, Stony Brook University **September 2009 to present**

Mentor: Prof. Alex Doboli

- Researched and developed a novel technique for systematically producing comparison models for integrated analog circuits; Several industrial partners expressed their interest in using the methods
  - Utilized dual matching of topologies and symbolic expressions to find nodes with similar behavior among different circuits
  - Characterized how dissimilarities among designs modify the design trade-offs, the achievable performance trends, and the hardness to find solutions
  - Developed an axiomatic model to express concept structures in analog circuit design based on differences and similarities in circuit topology, behavior, and performance
- Explored methods to automatically generate hierarchical classification schemes for sets of integrated analog circuits
  - Served as a systematic way of relating one circuit design to alternatives for topology selection
  - Considered novel circuit linearity models that can highlight the mechanisms through which design performance is enhanced
- Studied and evaluated the uniqueness and variety of the design features present in state-of-the-art analog circuits
  - Studied innovation metrics developed for circuit design to illustrate solution space coverage and suggest directions along which new design features may be found
  - Analyzed the evolution of design uniqueness and variety across time and fabrication process to identify various analog circuit innovation trends
- Investigated methods for optimizing the aggregation of sampled data from geographically-distributed cyber-physical systems while satisfy timing, precision, and resource constraints
  - Applications included real-time gas cloud detection and environment monitoring

Graduate Research, Stony Brook University **September 2007 to September 2009**

Mentor: Prof. Alex Doboli

- Developed distributed data aggregation methods for networks of embedded systems
  - Efficiently implemented data cube computation and frequent pattern matching for limited resource network nodes
- Proposed a robust algorithm for mapping virtual communication networks onto partially-known physical grid networks of reconfigurable nodes
  - Capable of automatically generating data collection paths while encountering network failures such as broken links or node malfunctions
- Worked on automated selection of the design points used in dynamic reconfiguration of analog-to-digital converters for sensor network applications

- Synthesized Pareto points for different performance trade-offs and implemented online selection of the best candidate

PROFESSIONAL SERVICE

Reviewer for *IEEE Transactions on CADICS* **January 2013 to present**

Reviewer for *Integration – The VLSI Journal* **September 2009 to present**

- Reviewed manuscripts on analog and RF circuit synthesis using evolutionary techniques and on automated hierarchical sizing and biasing strategies

TEACHING and MENTORING EXPERIENCE

Graduate Research Supervisor, Stony Brook University **September 2011 to present**

- Coordinated and advised teams of graduate students working to develop optimized implementations of systematic integrated circuit comparison methodologies
  - Investigated techniques included symbolic model and physical layout matching

Teaching Assistant, Stony Brook University **Fall 2007 to present**

- Embedded Microprocessor Systems Design
  - Assignments included supervising laboratory work, and lecturing
  - Aided in development and verification of laboratory modules using a vast range of peripheral devices
- VLSI Systems Design
  - Supervised students during laboratory and project activities, which includes RISC microprocessor architecture design and realization of the physical design
- Design using Programmable Mixed-Signal Systems-on-Chip
  - Laboratory and project duties for both on-campus and on-line versions of the course
  - Developed on-line submission methodologies for illustrating design functionality
  - Assisted the instructor in developing interesting and challenging course projects
- Electronics
  - Held recitations for the undergraduate level course

LIST of PUBLICATIONS

Journal Papers

[1] **C. Ferent**, A. Doboli, "*Symbolic Matching and Constraint Generation for Systematic Comparison of Analog Circuits*", IEEE Transactions on Computer Aided Design of Integrated Circuits, **2013** (accepted)

[2] **C. Ferent**, A. Doboli, "*An Axiomatic Model for Concept Structure Description and Its Application to Circuit Design*", Elsevier Journal on Knowledge-based Systems, **2013** (accepted)

[3] **C. Ferent**, A. Doboli, "*Measuring the Uniqueness and Variety of Analog Circuit Design Features*", Integration – The VLSI Journal, volume 44, January **2011**

[4] **C. Ferent**, A. Doboli, "*Analog Circuit Design Space Description based on Ordered Clustering of Feature Uniqueness and Similarity*", Integration – The VLSI Journal, **2012** (under review)

Book Chapters

[5] **C. Ferent**, A. Doboli, "*Improving Design Feature Reuse in Analog Circuit Design through Topological-Symbolic Comparison and Entropy-based Classification*" in "Analog/RF and Mixed-Signal Circuit Systematic Design", M. Fakhfakh, E. Tlelo-Cuautle, R. Castro-Lopez (Eds.), Springer, **2013**

Conference and Workshop Papers

[6] **C. Ferent**, A. Doboli, "*A Prototype Framework for Conceptual Design of Novel Analog Circuits*", International Conference on Synthesis, Modeling, Analysis and Simulation Methods and Applications to Circuit Design (SMACD), **2012**

[7] **C. Ferent**, A. Doboli, "*Systematic Comparison of Two Low-Voltage Amplifiers using Topology Matching and Performance Constraints*", IEEE International NEWCAS Conference (NEWCAS), **2012**

[8] **C. Ferent**, A. Doboli, "*Systematic Comparison of Analog Circuits through Dual Topological-Symbolic Matching*", Design Automation Conference (DAC) WIP, **2012**

[9] **C. Ferent**, A. Doboli, "*A Symbolic Technique for Automated Characterization of the Uniqueness and Similarity of Analog Circuit Design Features*", Design, Automation, and Test in Europe Conference (DATE), **2011**

[10] **C. Ferent**, A. Doboli, "*Towards Creative Analog Synthesis: A Symbolic Representation for Exploring Circuit Operation Principles*", Frontiers in Analog Circuit (FAC) Synthesis and Verification, **2011**

[11] **C. Ferent**, M. Gilberti, A. Doboli, "*Real-time Gas Cloud Detection by Data Aggregation in Networks of Embedded Sensors*", IEEE International Systems Conference (SysConf), **2010**

[12] **C. Ferent**, V. Subramanian, M. Gilberti, A. Doboli, "*Linear Programming Approach for Performance-Driven Data Aggregation in Networks of Embedded Sensors*", Design, Automation, and Test in Europe Conference (DATE), **2010**

[13] **C. Ferent**, A. Doboli, "*PNETMAP: Virtual Network Implementation on a Partially-known Physical Network*", International Workshop on Dependable Network Computing and Mobile Systems (DNCMS), **2009**

[14] P. Sun, **C. Ferent**, M. Gilberti, A. Doboli, "*Online AMS Frontend Reconfiguration for Sensor Networks Applications*", European Conference on Circuit Theory and Design (ECCTD), **2009**

[15] C. Volosencu, D. Curiac, O. Banias, **C. Ferent**, D. Pescaru, A. Doboli, "*Hierarchical Approach for Lighting Control in Future Urban Environments*", IEEE - TTTC International Conference on Automation, Quality and Testing, Robotics (AQTR), **2008**

[16] **C. Ferent**, A. Doboli, "*Formal Representation of the Design Feature Variety in Analog Circuits*", Design Automation Conference (DAC) WIP, **2013** (accepted)

LIST of PRESENTATIONS

Conference and Professional Presentations

[1] A Prototype Framework for Conceptual Design of Novel Analog Circuits
- Paper presentation at the *International Conference on Synthesis, Modeling, Analysis and Simulation Methods and Applications to Circuit Design*, Seville, Spain, **2012**

[2] Northrop Grumman Corporation – Stony Brook University HEALIX Kick-off Meeting
- Presentation of the collaborative research efforts of Stony Brook University and Northrop Grumman Corporation, Stony Brook, NY, **2012**

[3] Towards Creative Analog Synthesis: A Symbolic Representation for Exploring Circuit Operation Principles
- Paper presentation at the *Frontiers in Analog Circuit Synthesis and Verification Workshop*, Snowbird, UT, **2011**

[4] Linear Programming Approach for Performance-Driven Data Aggregation in Networks of Embedded Sensors
- Paper presentation at the *Design, Automation, and Test in Europe Conference*, Dresden, Germany, **2010**

[5] PNETMAP: Virtual Network Implementation on a Partially-known Physical Network
- Paper presentation at the *International Workshop on Dependable Network Computing and Mobile Systems*, Niagara Falls, NY, **2009**

Teaching Presentations

[6] Data Mining Applications in Analog Circuit Synthesis
- Lecture at Stony Brook University for the *Pattern Recognition* graduate level course, Stony Brook, NY, October **2011**

[7] Introduction to Design using PSoC
- Lecture at Hofstra University for the *Mixed-Signal System-on-Chip Design* undergraduate level course, Hempstead, NY, September **2008**

[8] JAVA Programming Basics
- Lecture at Hofstra University for the *JAVA Programming Language* undergraduate level course, Hempstead, NY, April **2008**

AREAS of EXPERTISE and PROFESSIONAL SKILLS

Mixed-Signal Circuit Design Automation and Modeling

- Extensive experience with heuristic optimization, linear programming, hierarchical, knowledge based, and simulation based synthesis methods

- Expert knowledge of automated macromdeling of analog circuits and systems, including linear and nonlinear symbolic approaches
- Expertise with design knowledge representations, focusing on classification schemes to highlight commonalities and differences and their use in circuit synthesis

Distributed Data Mining in Networks of Embedded Systems

- Expert knowledge of data aggregation methods using both monotonic and non-monotonic aggregation functions
- Extensive experience with redundancy elimination, frequent pattern detection, real-time, hierarchical, and regression based distributed data mining schemes
- Expertise on constrained data aggregation path generation, including predictable error modeling for dynamic decision making
- Vast experience with embedded node interfaces, sensors, and peripheral devices

Microprocessor Devices

- Expert knowledge of the *Atmel AVR* family, including *AVR Studio* and *IAR Embedded Workbench* IDE solutions
- Extensive experience with *Cypress Programmable System-on-Chip (PSoC)* and with the *PSoC Designer* and *PSoC Creator* development environments
- Familiar with *Microchip PIC* devices and the *MPLAB* IDE package

Professional Skills

- Teaching and tutoring of undergraduate and graduate students at a university level
- Management and supervision of interdisciplinary projects
- Active collaboration with members of other research laboratories
- Analysis and presentation of data at international scientific conferences
- Assembly and C programming languages, Matlab/Simulink, and Verilog HDL
- Cadence IC design framework usage, setup, and configuration on Linux systems, including design kit integration
- Linux server management and configuration, including user accounts, webpage, SSH remote access, and FTP

AFFILIATIONS

IEEE – *Institute of Electrical and Electronics Engineers*

- Graduate student member since 2009

MAJOR GRADUATE PROJECTS

Gas Sensor Array Front-end **Spring 2008**

- Designed the integrated analog read-out circuitry for a resistive gas sensor array
- System included self-calibration for accurately covering a large range of measured sensor resistance
- A low-power segmented current steering DAC, switched capacitor comparator, and ΔΣ ADC were implemented in a 0.6μm technology

Modeling of the SPU Architecture **Spring 2008**

- Used Verilog to implement a model of the SPU Architecture powering the Cell Processor in Sony Playstation-3
- Design was an 8-stage, dual issue pipeline using branch prediction and instruction forwarding mechanisms with a 128-bit data path width incorporating a floating-point ALU
- Instruction set was developed with focus on multimedia extensions

VLSI Design Automation Methods **Fall 2007**

- Implemented a set of C routines for automated circuit partitioning and placement
- Efficient data structures were developed for handling large circuit complexities
- Optimization algorithm cost functions were derived to minimize cutset size, interconnect length, and circuit area

VLSI Design of RISC Processor **Fall 2007**

- Designed the data path for a 5-stage pipelined microprocessor
- Used the Cadence IC design framework to implement the full custom design in a 0.6μm CMOS technology

GRADUATE COURSES COMPLETED

- VLSI Physical and Logic Design Automation
- Integrated Analog Circuits
- HW-SW Co-design of Embedded Systems
- MOS Transistor Modeling
- Pattern Recognition
- Auto ID Technologies
- Multi-agent Systems
- Advanced VLSI Design
- Advanced VLSI Signal Processing
- Solid State Electronics
- Bipolar Junction Devices
- Stochastic Systems
- Computer Architecture
- Computational Models