TABLE OF CONTENTS
INTERNATIONAL SYMPOSIUM ON QUALITY ELECTRONIC DESIGN 2016

SESSION 1A: Low Power Memory & Logic Design
Chair: Kurt Schwartz, Texas Instruments
Co-Chair: Charles Augustine, Intel

Sizing-Priority Based Low-Power Embedded Memory for Mobile Video Applications ......................... 1
Seyed Alireza Pourbakhsh, Xiaowei Chen, Dongliang Chen, Xin Wang, Na Gong, Jinhui Wang,
North Dakota State University

Bit-Upset Vulnerability Factor for eDRAM Last Level Cache Immunity Analysis ................................. 6
Navid Khoshavi, Xunchao Chen, Jun Wang, Ronald F. DeMara, University of Central Florida

Optimizing SRAM Bitcell Reliability and Energy for IoT Applications ............................................... 12
Harsh N. Patel, Farah B. Yahya, Benton H. Calhoun, University of Virginia

Variability- and Correlation-Aware Logical Effort for Near-Threshold Circuit Design ...................... 18
Jun Shiomi, Tohru Ishihara, Hidetoshi Onodera, Kyoto University

SESSION 1B: Advanced Three-Dimensional Integrated Circuits
Chair: Payman Zarkesh-Ha, University of New Mexico

Design Challenges and Methodologies in 3D Integration for Neuromorphic Computing Systems ...... 24
M. Amimul Ehsan1, Hongyu An1, Zhen Zhou2, Yang Yi1, 1University of Kansas, 2Intel Corp.

Optimization of Dynamic Power Consumption in Multi-Tier Gate-Level Monolithic 3D ICs ............. 29
Sheng-En (David) Lin, Partha Pande, Dae Hyun Kim, Washington State University

Electromigration-Aware Placement for 3D-ICs ..................................................................................... 35
Tiantao Lu, Zhiyuan Yang, Ankur Srivastava, University of Maryland, College Park

Monolithic 3D IC Design: Power, Performance, and Area Impact at 7nm ........................................ 41
Kartik Acharya1, Kyungwook Chang1, Bon Woong Ku1, Shreepad Panth1, Saurabh Sinha2, Brian Cline2,
Greg Yeric3, Sung Kyu Lim1, 1Georgia Institute of Technology, 2ARM Inc.

SESSION 2A: Network on a Chip
Chair: Hai (Helen) Li, University of Pittsburgh
Co-Chair: Rajesh Berigei, Texas Instruments

Maximizing the Performance of NoC-based MPSoCs under Total Power and
Power Density Constraints ................................................................................................................ 49
Alireza Shafaei1, Yanzhi Wang2, Lizhong Chen3, Shuang Chen1, Massoud Pedram1,
1University of Southern California, 2Syracuse University, 3Oregon State University

Process Variation Aware Crosstalk Mitigation for DWDM-based Photonic NoC Architectures .......... 57
Sai Vineel Reddy Chittamuru, Ishan G. Thakkar, Sudeep Pasricha, Colorado State University

Memory-Aware Circuit Overlay NoCs for Latency Optimized GPGPU Architectures ....................... 63
Venkata Yaswanth Raparti and Sudeep Pasricha, Colorado State University

Design Guidelines for Embedded NoCs on FPGAs ............................................................................. 69
Noha Gamal1, Hosam Fahmy2, Yehea Ismail2, Hassan Mostafa4,
1Mentor Graphics, 2Cairo University, 3CND at Zewail City, 4AUC

A Delay Variation and Floorplan Aware High-level Synthesis Algorithm with Body Biasing .......... 75
Koki Igawa, Youhua Shi, Masanori Yanagisawa, Nozomu Togawa, Waseda University

17th Int'l Symposium on Quality Electronic Design
SESSION 2C: Circuits and Architecture for Emerging Logic and Memory Technologies
Chair: Paul Tong, Pericom Semiconductor
Co-Chair: Swaroop Ghosh, University of South Florida

Exploring the Use of Volatile STT-RAM for Energy Efficient Video Processing .............................................. 81
Hengyu Zhao\textsuperscript{1}, Hongbin Sun\textsuperscript{1}, Qiang Yang\textsuperscript{2}, Tai Min\textsuperscript{1}, Nanning Zheng\textsuperscript{1},
\textsuperscript{1}Xi'an Jiaotong University, \textsuperscript{2}Changhong Electric Co., Ltd

Low Power Data-Aware STT-RAM based Hybrid Cache Architecture ................................................................. 88
Mohsen Imani, Shrut\ Patil\textsuperscript{1} Tajana Rosing, University of California San Diego

Yield Estimation and Statistical Design of Memristor Cross-point Memory Systems ....................................... 95
Jizhe Zhang and Sandeep K. Gupta, University of Southern California

ReMAM: Low Energy Resistive Multi-Stage Associative Memory for Energy Efficient Computing ... 101
Mohsen Imani, Pietro Mercati, Tajana Rosing, University of California San Diego

Ultra-Low-Power Compact TFET Flip-Flop Design for High-Performance Low-Voltage Applications ............... 107
Navneet Gupta\textsuperscript{1,2}, Adam Makosiej\textsuperscript{1}, Andrei Vladimirescu\textsuperscript{1}, Amara Amara\textsuperscript{1}, Costin Anghel\textsuperscript{1},
\textsuperscript{1}Institut supérieur d'électronique de Paris, \textsuperscript{2}Commissariat à l'Energie Atomique et aux Energies Alternatives (CEA-LETI)

SESSION 3A: On-Chip Machine Learning and Neuromorphic Computing
Chair: Rouwaida Kanj, American University of Beirut

Sparsely Connected Neural Networks in FPGA for Handwritten Digit Recognition ........................................... 113
Luca B. Saldanha and Christophe Bobda, University of Arkansas

Neuromorphic Architectures with Electronic Synapses ............................................................................................ 118
Sukru Burc Eryilmaz\textsuperscript{1}, Siddharth Joshi\textsuperscript{2}, Emre Neftci\textsuperscript{2}, Weihe Wan\textsuperscript{1}, Gert Cauwenberghs\textsuperscript{2}, H.-S. Wong\textsuperscript{1},
\textsuperscript{1}Stanford University, \textsuperscript{2}University of California San Diego, \textsuperscript{3}University of California Irvine

Towards a Scalable Neuromorphic Hardware for Classification and Prediction with Stochastic No-Prop Algorithms .......................................................... 124
Dan Christiani, Cory Merkel, Dhireesha Kudithipudi, Rochester Institute of Technology

SESSION P: Poster Presentations
Chair: Brian Cline, ARM
Co-Chair: Kamesh Gadepally, GigaCom Semiconductor

Equivalence Checking between SLM and RTL Using Machine Learning Techniques ........................................ 129
Jian Hu, Tun Li, Sikun Li, National University of Defense Technology

Very Low Supply Voltage Room Temperature Test to Screen Low Temperature Soft Blown Fuse Fails which Result in a Resistive Bridge ........................................... 135
Peter Sarson, ams AG

On-Line Harmonic-Aware Partitioned Scheduling For Real-Time Multi-Core Systems under RMS ... 140
Ming Fan\textsuperscript{1}, Rong Rong\textsuperscript{2}, Xinwei Niu\textsuperscript{3},
\textsuperscript{1}Broadcom Corporation, \textsuperscript{2}Florida International University, \textsuperscript{3}Penn State Erie

CovGen: A Framework for Automatic Extraction of Functional Coverage Models ............................................. 146
Eman El Mandouh, Mentor Graphics, and Amr G. Wassal, Cairo University

In-situ Trojan Authentication for Invalidating Hardware-Trojan Functions ..................................................... 152
Masaru Oya, Youhua Shi, Masao Yanagisawa, Nozomu Togawa, Waseda University

A 1.3\textmu W, 5pJ/cycle sub-threshold MSP430 Processor in 90nm xLP FDSOI for Energy-Efficient IoT Applications ................................................................. 158
Abhishek Roy\textsuperscript{1}, Peter J. Grossmann\textsuperscript{2}, Steven A. Vitale\textsuperscript{2}, Benton H. Calhoun\textsuperscript{1},
\textsuperscript{1}University of Virginia, \textsuperscript{2}MIT Lincoln Laboratory

17th Int'l Symposium on Quality Electronic Design
Statistical Quality Modeling of Approximate Hardware .......................................................... 163
Seogoo Lee¹, Dongwook Lee¹, Kyungtae Han², Emily Shriver², Lizy K. John¹, Andreas Gerstlauer¹,
¹The University of Texas at Austin, ²Intel Corporation

Performance Evaluation of Stacked Gate-All-Around MOSFETs at 7 and 10 nm Technology Nodes .... 169
Meng-Yen Wu and Meng-Hsueh Chiang, National Cheng Kung University

Fast Stress Analysis for Runtime Reliability Enhancement of 3D IC Using Artificial Neural Network .......................................................... 173
Lang Zhang¹, Hai Wang², Sheldon Tan³,
¹University of Electronic Science and Technology of China, ²University of California at Riverside

Detection of Malicious Hardware Components in Mobile Platforms ............................................. 179
Fatih Karabacak, Umit Y. Ogras, Sule Ozev, Arizona State University

An Effective BIST Architecture for Power-Gating Mechanisms in Low-Power SRAMs .......................... 185
Alberto Bosio¹, Luigi Dilillo¹, Patrick Girard¹, Amaud Virazel¹, Leonardo B. Zordan²,
¹LIRMM, ²Intel Mobile Communication

Performance Evaluation Considering Mask Misalignment in Multiple Patterning Decomposition .... 192
Haitong Tian and Martin D.F. Wong, University of Illinois at Urbana Champaign

UM-BUS: An Online Fault-Tolerant Bus for Embedded Systems .................................................. 198
Jiqin Zhou¹, Weigong Zhang², Keni Qiu², Xiaoyan Zhu³,
¹Beijing Center for Mathematics and Information Interdisciplinary Sciences, ²Capital Normal University

Low-Leakage and Process-Variation-Tolerant Write-Read Disturb-Free 9T SRAM Cell Using CMOS and FinFETs .......................................................... 205
Ayushparth Sharma and Kusum Lata, The LNM Institute of Information Technology

Ruggedness Evaluation and Design Improvement of Automotive Power MOSFETs .......................... 211
Tianhong Ye and Kuan W.A. Chee, The University of Nottingham, Ningbo

Device/System Performance Modeling of Stacked Lateral NWFET Logic ........................................ 215
Victor Huang¹, Chenyun Pan¹, Dmitry Yakimets², Praveen Raghavan², Azad Naeemi¹,
¹Georgia Institute of Technology, ²IMEC

Accelerating Physical Level Sub-Component Power Simulation by Online Power Partitioning .... 221
Siddharth S. Bhargav, Andrew Kolb, Young H. Cho, University of Southern California

Power Efficient Router Architecture for Wireless Network-on-Chip ................................................ 227
Hemanta Kumar Mondal, Sri Harsha Gade, Raghab Kishore, Shashwat Kaushik, Sujay Deb,
Indraprastha Institute of Information Technology-Delhi

Preventing Integrated Circuit Piracy via Custom Encoding of Hardware Instruction Set ..................... 234
Vinay C. Patil, Arunkumar Vijayakumar, Sandip Kundu, University of Massachusetts, Amherst

Preventing Design Reverse Engineering with Recongurable Spin Transfer Torque LUT Gates .... 242
Theodore Winograd¹, Hassan Salmani², Hamid Mahmoudi³, Houman Homayoun¹,
¹George Mason University, ²Howard University, ³San Francisco State University

Portable Bio-sensor for Chronic Malaria Detection ................................................................. 248
Lalitha Sivaraj, Nurul Amziah Md Yunus, Mohamad Nazim Mohtar, Samsuzana Abd Aziz,
Zurina Zainal Abidin, M Iqbal Saripan, Fakhru Zaman Rokhani, University Putra Malaysia

Performance Modeling and Optimization for On-Chip Interconnects in 3D Memory Arrays .......... 252
Javaneh Mohseni, Chenyun Pan, Azad Naeemi, Georgia Institute of Technology

Near-threshold Circuit Variability in 14nm FinFETs for Ultra-low-power Applications .................... 258
Sriram Balasubramanian, Ninad Pimparkar, Mangesh Kushare, Vinayak Mahajan, Juhi Bansal, Takashi Shimizu, Vivek Joshi, Kun Qian, Arunima Dasgupta, Karthik Chandrasekaran, Chad Weintraub, Ali Icel,
GLOBALFOUNDRIES

An Efficient Timing Analysis Model for 6T FinFET SRAM using Current-Based Method .................. 263
Tiansong Cui, Ji Li, Alireza Shafaei Bejestan, Shahin Nazarian, Massoud Pedram,
University of Southern California

17th Int'l Symposium on Quality Electronic Design
SESSION 4B: Enabling 5nm Technology Node
Chair: Brian Cline, ARM
Co-Chair: Rajan Beera, Pall Corporation

Nanowire Transistor Solutions for 5nm and Beyond ................................................................. 269
Asen Asenov¹,², Y Wang³, B Cheng², X Wang¹, P Asenov², T Al-Ame³, V. P. Georgiev¹,
¹University of Glasgow, ²Gold Standard Simulations, ³Peking University

5nm: Has the Time for a Device Change Come? ......................................................................... 275
Praveen Raghavan, Marie Garcia Bardon, Peter Debcker, Pieter Schuddinck, Doyoung Jang,
Rogier Baert, Diederik Verkest, Aaron V-Y Thean, IMCE

Transistor Design for 5nm and Beyond: Slowing Down Electrons to Speed Up Transistors ............. 278
Victor Moroz¹, Joanne Huang¹, Reza Arghavani², ¹Synopsys, ²Lam Research

Decomposition Technologies for Advanced Nodes ....................................................................... 284
Fedor Pikus, Mentor Graphics, Inc

SESSION 4C: Advanced Testing Concepts
Chair: Vinod Viswanath, Real Intent
Co-Chair: Sreejit Chakravarty, Intel

Low Capture Power Dictionary based Test Data Compression .................................................. 289
Panagiotis Sismanoglou and Dimitris Nikolos, University of Patras

Analysis of Setup & Hold Margins inside Silicon for Advanced Technology Nodes ....................... 295
Deepak Kumar Arora¹, Darayus Adil Patel¹,³, Shahabuddin Qureshi¹, Sanjay Kumar¹, Navin Kumar
Dayani¹, Balwant Singh¹, Sylvie Naudet¹, Arnaud Virazel¹, Alberto Bosio², ¹STMicroelectronics, ²LIRMM

Protocol-Guided Analysis of Post-silicon Traces under Limited Observability ............................. 301
Hao Zheng¹, Yuting Cao¹, Sandip Ray³, Jin Yang³, ¹University of South Florida, ²Intel Corporation

Nonlinear Delay-Table Approach for Full-Chip NBTI Degradation Prediction ............................... 307
Song Bian, Michihiro Shintani, Shumpel Morita, Masayuki Hiromoto, Takashi Sato, Kyoto University

SESSION 5A: Embedded Systems
Chair: Yang Yi, University of Kansas
Co-Chair: Rajesh Berigei, Texas Instruments

Reliability and Energy-aware Cache Reconfiguration for Embedded Systems ............................ 313
Yuanwen Huang and Prabhat Mishra, University of Florida

Architecting STT Last-Level-Cache for Performance and Energy Improvement .......................... 319
Fazal Hameed and Mehdi Tahoori, Karlsruhe Institute of Technology

Instruction Cache Aging Mitigation through Instruction Set Encoding ........................................ 325
Anteneh Gebregiorgis¹, Fabian Oboi², Mehdi B. Tahoori¹, Said Hamdiou²,
¹Karlsruhe Institute of Technology, ²Delft University of Technology

Nga Dang¹, Zana Ghaderi², Moonju Park³, Elii Bozorgzadeh²,
¹Google Inc., ²University of California, Irvine, ³Incheon National University

Negotiation-Based Resource Provisioning and Task Scheduling Algorithm for Cloud Systems ....... 338
Ji Li¹, Yanzhi Wang², Xue Lin¹, Shahin Nazarian¹, Massoud Pedram¹,
¹University of Southern California, ²Syracuse University
SESSION 5B: Hardware and System Security
Chair: Gang Qu, University of Maryland

Digital IP Protection Using Threshold Voltage Control ................................................................. 344
Joseph Davis, Niranjan Kulkarni, Jinghua Yang, Aykut Dengi, Sarma Vrudhula, Arizona State University

Trojan Detection in Digital Systems Using Current Sensing of Pulse Propagation in Logic Gates ... 350
Sabyasachi Deyati, Barry J. Muldrey, Abhijit Chatterjee, Georgia Institute of Technology

Active Protection against PCB Physical Tampering ........................................................................... 356
Steven Paley¹, Tamzidul Hoque², Swarup Bhunia²,
¹Case Western Reserve University, ²University of Florida

SVM-based Real-Time Hardware Trojan Detection for Many-Core Platform .............................. 362
Amey Kulkarni¹, Youngok Pino², Tinoosh Mohsenin¹,
¹University of Maryland, Baltimore County, ²University of Southern California

On Testing Physically Unclonable Functions for Uniqueness ......................................................... 368
Arunkumar Vijayakumar, Vinay C. Patil, Sandip Kundu, University of Massachusetts Amherst

SESSION 5C: Analog Design
Chair: Riaz Naseer, Intel
Co-Chair: Stephan Heinrich-Barnes, Texas Instruments

Dot-Product Engine as Computing Memory to Accelerate Machine Learning Algorithms .......... 374
Miao Hu, John Paul Strachan, Zhiyong Li, R. Stanley Williams, Hewlett Packard Labs

0.5-V 50-mV-Swing 1.2-GHz 28-nm-FD-SOI 32-bit Dynamic Bus Architecture with Dummy Bus .... 380
Khaja Ahmad Shaik, Kiyoo Itoh, Amara Amara, Institut supérieur d’électronique de Paris (ISEP)

Analysis and Design of a Triangular Active Charge Injection for Stabilizing Resonant Power Supply Noise .......................................................................................................................... 386
Masahiro Kano, Toru Nakura, Kunihiro Asada, The University of Tokyo

An Ultra-fast and Low-power Design of Analog Circuit Network for DoG Pyramid Construction of SIFT Algorithm ................................................................. 392
Zheyu Liu, Fei Qiao, Qi Wei, Xinghua Yang, Yi Li, Huazhong Yang, Tsinghua University

SESSION 6A: Design Optimization for Performance, Reliability, and Yield
Chair: Fedor Pikus, Mentor Graphics
Co-Chair: Vivek Joshi, GlobalFoundries

Impact of Interconnect Variability on Circuit Performance in Advanced Technology Nodes .......... 398
Divya Madapusi Srinivas Prasad, Chenyun Pan, Azad Naeemi, Georgia Institute of Technology

Hotspot Detection using Machine Learning .................................................................................... 405
Kareem Madkouri¹, Sarah Mohamed¹, Dina Tantawy², Mohab Anis³,
¹Mentor Graphics, ²Cairo University, ³American University in Cairo

Efficient Analog Circuit Optimization Using Sparse Regression and Error Margining ............... 410
Mohamed Baker Alawieh¹, Fa Wang², Rouwaida Kanj¹, Xin Li², Rajiv Joshi³,
¹American University of Beirut, ²Carnegie Mellon University, ³IBM

State Encoding based NBTI Optimization in Finite State Machines ............................................. 416
Shilpa Pendyala and Srinivas Katkoori, University of South Florida Tampa
SESSION 6B: EDA for Design Exploration & Analysis Beyond Moore’s Law
Chair: Takashi Sato, Kyoto University
Co-Chair: Ofelya Manukyan, Synopsys

Gate Movement for Timing Improvement on Row Based Dual-VDD Designs .................................................... 423
Hua Xiang, Lakshmi Reddy, Haifeng Qian, Ching Zhou, Yu-Shiang Lin, Fanchieh Yee, Andrew Sullivan, Pong-Fei Lu, IBM Research

Multiple Shift-vector Importance Sampling Method using Support Vector Machine and Clustering for High-Density DRAM Designs ................................................................................................. 430
Jinyoung Lee, Sunghee Yun, Jeongha Kim, Dongsoo Kang, Jeongyeol Kim, Sanghoon Lee, Samsung Electronics

Fully Automated PLL Compiler Generating Final GDS from Specification .......................................................... 437
Toru Nakura and Kunihiro Asada, The University of Tokyo

AFD-Based Method for Signal Line EM Reliability Evaluation .............................................................................. 443
Zhong Guan and Malgorzata Marek-Sadowska, University of California, Santa Barbara

SESSION 6C: Sensors for IOT
Chair: Kamesh Gadepally, GigaCom Semiconductor
Co-Chair: Charles Augustine, Intel

A Smart ECG Sensor with In-Situ Adaptive Motion-Artifact Compensation for Dry-Contact Wearable Healthcare Devices .................................................................................................................. 450
Shuang Zhu, Jingyi Song, Balaji Chellappa, Ali Enteshari, Tuo Shan, Mengxun He, Yun Chiu, University of Texas at Dallas

Making Unreliable Chem-FET Sensors Smart via Soft Calibration ........................................................................... 456
Fatih Karabacak, Uwadiae Obahiagbon, Umit Ogras, Sule Ozev, Jennifer Blain Christen, Arizona State University

Novel Design of a Silicon Photodetector and its Integration in a 4×4 CMOS Pixel Array ........................................... 462
Hari Shanker Gupta¹, Satyajit Mohapatra², Nihar R. Mohapatra², K D Sharma³, ¹Space Applications Centre, ¸Indian Institute of Technology, Gandhinagar, ¸Indian Institute of Technology, Bombay

Time-Division Multiple Access Based Intra-body Communication for Wearable Health Tracker ........ 468
Tan Chee Phang¹, Mohammad Harris Mokhtar⁵, Mohd Nazim Mohtar¹, Fakhir Zaman Rokhani¹, ¹University Putra Malaysia, ⁵Telecom Research