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From the Director's Desk

In today's day and age, cyber space provides us with a platform for almost real-time, communication and dissemination of information. Since the last newsletter was published, CESCA has created a [Facebook](#) group to create a social network among CESCA faculty, students, and alumni and friends of CESCA. We also created a [LinkedIn](#) group for the upkeep of the professional contact information of alumni and friends of CESCA. [CESCA](#) website is also going through a revamp under the guidance of Prof. Dong Ha. These three avenues, we believe, would keep us and our supporters and sponsors adequately informed on a regular basis. Like any other print media, all of us who are creating publicity materials, are facing this dilemma about how to balance between the print media, and the cyber based media. Thus the decision by the CESCA faculty was to not do away with the printed newsletter but to reduce the frequency to twice a year, while making CESCA website, Facebook and LinkedIn forums more active. As we are seeing a mass protest and related changes in the political landscapes in



the North Africa and Middle East, which are being said to be at least in part helped by the social media, we believe that the social media does bring about a change in the information dissemination arena. From a top down dissemination as is done by a newsletter, we can allow all participants to update news, upload interesting video, link interesting technology news, etc., in these newly formed cyber social groups for CESCA. I invite any interested reader of this newsletter to look us up on face book, and linked in, and join these groups – and use them as relevant information sharing venues, recruiting portal, and networking opportunities.

As you will read in this issue, CESCA also have taken a step towards video archiving of lectures at the CESCA seminar series through our [Vimeo](#) account, and hence all lectures at weekly CESCA seminars are being archived so that the current students, and even prospective students can view them, and listen to various interesting topics that CESCA faculty and students are working on. This is a positive step in line with the current multimedia cyber enabled educational world. This was made possible by a CESCA student volunteer task force, whose members have been very active in making this a success. More details on this can be found in this newsletter. The notion of volunteering to do something for an organization that is meant to nurture you professionally is a noble idea. During the space race era, the then US president John F. Kennedy had uttered a sound byte –“Ask not what your country can do for you – ask what you can do for your country”. This applies not only in the context of the citizenry of a country, but to the citizenry of any organization whose goals are aligned with the individual professional goals for the citizens, and whose success will succeed its citizens as well. Also, such volunteer groups gain an invaluable experience by participating in tasks in a multicultural team of brilliant minds – an experience to be cherished and is probably relevant in the increasingly global workplace. Therefore, in the next few months, I would like to ask for more volunteer teams from among the ranks of CESCA students and postdoctoral fellows for various tasks such as moderating the face book group, news letter information gathering, CESCA website up keeping, graduate recruiting etc.

As you will read in this issue, CESCA has added three research faculties in the last fall, and this trend will hopefully continue to grow. A good research center needs a large number of senior researchers such as postdoctoral fellows to create a vibrant research environment. I welcome these three new faculties on behalf of entire CESCA faculty, and wish them luck in making significant contribution to the research missions of CESCA, and the individual labs they have joined – as well as their own professional growth.

As you will read -- this past fall and spring, CESCA has had a number of research visitors, who came from many reputed institutes from all over the world, and first hand got a clear picture of CESCA's research portfolio, and CESCA's strengths. This kind of visits helps build our reputation which in turn helps the ranking of our computer engineering degree programs. In the most recent ranking by the US News and World Reports, our Computer Engineering graduate program has been ranked 20, which can further improve over next years if CESCA (and other groups in the department) continue to do good work, graduate more students who are placed in good jobs, raise federal and industrial funds, and publish extensively in good venues. This newsletter will witness that we are doing all that, but I think our potential is much more than what we are currently achieving – I urge all our students, faculty and research associates to give their best in the coming semesters.

CESCA day is coming around the corner – April 30th, 2011 is the date. Prof. Lynn Abbott and Prof. Michael Hsiao are hard at work with logistics. Soon the students will get busy making posters, and getting geared up for this yearly event where we showcase our students' work.

I will write to you again when we publish our mid fall issue. Till then I wish you all great success and good work.

Sandeep Shukla

First CESCA Distinguished Lecture & Visit by Prof. Edward A. Lee



Prof. Lee (C) with CESCA faculty members – visible members in the picture are Prof. Schaumont (L), and Prof. Nazhandali (R).

On December 10, 2010, CESCA inaugurated its “CESCA Distinguished Lecture Series” by a talk by Prof. Edward A. Lee from the University of California at Berkeley where he is the Robert S. Pepper Distinguished Professor and former chair of the Electrical Engineering and Computer Sciences (EECS) department at U.C. Berkeley. The talk was titled “*Computing Needs Time*”. In the talk Prof. Lee discussed

the design of Cyber-Physical Systems (CPS), integrations of computation and physical processes. The talk examined the obstacles in software technologies that are impeding progress, and explained that to realize the full potential of CPS; we will have to rebuild software abstractions. The seminar was chaired by the ECE Department Head, Dr. Scott Midkiff.

One of the main issues addressed in this talk was that, the real-time systems are pervasive in cyber-physical domain but time is usually a posteriori consideration makes design of predictable, real-time systems harder. Prof. Lee expounded on this problem through examples, and excursion through some of the efforts such as PRET architecture, he illustrated approaches that are being taken by his group as well as others to bring the notion of time as a first class design parameter.

Prof. Lee also met with the CESCA faculty where the faculty gave him a brief overview of the various projects being undertaken at CESCA, the goals and current state of CESCA etc.

About the speaker:

Dr. Edward A. Lee is the Robert S. Pepper Distinguished Professor and former chair of the Electrical Engineering and Computer Sciences (EECS) department at U.C. Berkeley. His research interests center on design, modeling, and simulation of embedded, real-time computational systems. He is a director of Chess, the Berkeley Center for Hybrid and Embedded Software Systems, and is the director of the Berkeley Ptolemy project. He is co-author of five books and numerous papers. He has led the development of several influential open-source software packages, notably Ptolemy and its various spinoffs. His bachelor's degree (B.S.) is from Yale University (1979), his masters (S.M.) from MIT (1981), and his Ph.D. from U. C. Berkeley (1986). From 1979 to 1982 he was a member of technical staff at Bell Telephone Laboratories in Holmdel, New Jersey, in the Advanced Data Communications Laboratory. He is a co-founder of BDTI, Inc., where he is currently a Senior Technical Advisor, and has consulted for a number of other companies. He is a Fellow of the IEEE, was an NSF Presidential Young Investigator, and won the 1997 Frederick Emmons Terman Award for Engineering Education.

CESCA Seminar Series and Video Channel

In fall of 2010, the format for the CESCA seminars was revised. The seminars are now held in a bigger classroom and right before lunch break on Friday's. We hosted 8 seminars which had an average attendance of 40.

The topics in Fall 2010 were:

- Sandeep Shukla (VT) on "*Sequential Code Synthesis from Concurrent Specifications*"
- Mainak Banga (VT) on "*Design-for-Trust: Techniques to Detect Hardware Trojans in 3-PIPs*"
- Xu Guo (VT) on "*Fair and Comprehensive Performance Evaluation of SHA-3 Hardware Implementations*"
- Chaun Han (VT) on "*Optimal Cache-Based Router Repair for Real-Time Traffic*"
- Dong Ha (VT) on "Small Scale Energy Harvesting - Principles, Practices, and Future Trends"
- Alex Jones (U Pitt) on "*Cooperative Design Concepts for Chip Multiprocessors*"
- Phil Nigh (IBM) on "*The Top 10 Semiconductor Trends that are changing the way we Design, Manufacture, Test and Deliver High Quality ICs*"
- Tom Martin (VT) on "*A Case Study of an Interdisciplinary Design Course for Pervasive Computing*"
- Raul Mangharam (UPenn) on "*Closing the Loop with Networked Cyber-Physical Systems*"
- Edward A. Lee (UC Berkeley) on "Computing Needs Time"

CESCA started a Multimedia Task Force, collaboration among CESCA students to video record all CESCA events. The Multimedia Task Force includes Shaver Deyerle, Mahesh Nanjundappa, Nathan Short, Abhranil Maiti, Yi Deng and Ambuj Sinha. Several of the talks done during fall of 2010 are available on the CESCA Video Channel: <http://vimeo.com/channels/cesca>. CESCA also opened a [Facebook](#) page, and [LinkedIn](#) page during the Fall 2010 and Spring 2011 respectively, in order to allow the CESCA faculty and students network better with alumni, make business and job contacts, and also to share interesting information pertaining to embedded systems development and research.

New Research Projects

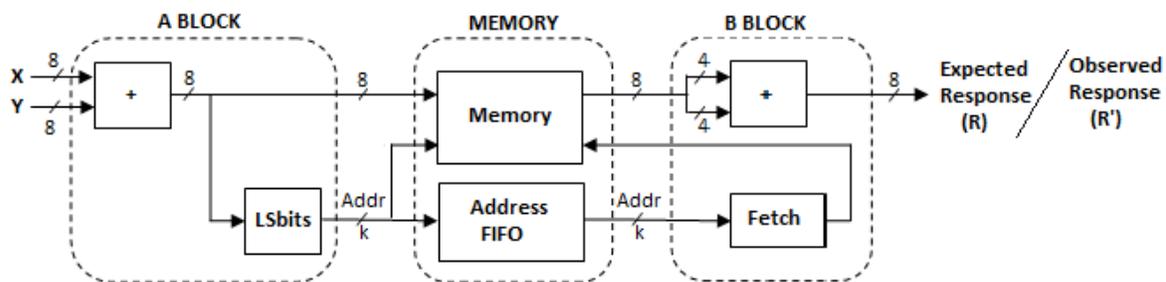
- **Multi-threaded Software Synthesis for Mission Critical Applications from Polychronous specifications**

FERMAT Lab directed by Sandeep Shukla received \$750K for three years from the Air Force Labs in Rome to work on automated synthesis of multi-threaded programs suitable for running on multi-core embedded processors of the near future. The formal specification language defined by the FERMAT lab researchers is called MRICDF (Multi-rate Instantaneous Channel Connected Data Flow) model. In this model one can express concurrent dataflow based algorithms such as control of a power plant, or a trajectory of an UAV (Unmanned Aerial Vehicle), or plain MPEG decoder etc. The concurrency is easy to express in this model of computation because the synchronization is instantaneous, and enforced by the model. In real implementation therefore, one has to synthesize the synchronization code, as well as the various threads of the data flow. The reason for this approach is to change the way programs are specified (Von Neumann sequential model of computation), and how the sequential model is retrofitted to work for concurrent programs – leading to a lot of concurrency errors. The hope is that as programs are modeled in this formal language, we should be able to synthesize code that is correct by construction. The later half of the project has to also guarantee real-time constraints, as well automated fault-tolerance feature synthesis. The project started in November 2010.

- **Collaborative Research: Enhancing Access to the Radio Spectrum (EARS) Workshop**, NSF, April 1, 2010 - March 31, 2011; PI: Jeff Reed; co-PI: Jung-Min Park, Collaboration with Jennifer Bernhard (UIUC, lead PI).

Enhancing Access to the Radio Spectrum (EARS) is a multi-disciplinary activity whose goal is to improve the efficiency with which the radio spectrum is utilized and to improve access to the radio spectrum in support of current and new technologies. Achieving these goals will, among other impacts, improve the availability of wireless broadband to Americans presently without broadband access, as called for in the American Recovery and Reinvestment Act. Because the radio spectrum is a valuable but finite natural resource, improvements in spectrum efficiency will have significant economic impact to the nation and the world. This award funds the first step, which is an invitational workshop that will bring together some of the key researchers and policy makers involved in radio spectrum access. All relevant fields will be represented, including science, engineering, economics, and policy. The output of the workshop will include a vision for the future of radio spectrum access and use, and a prioritized list of research areas that can help achieve that vision.

- **SMT-based Test and Diagnosis for Circuits with Embedded Memories**



A 3-year SRC grant of \$180,000 has been awarded to Michael Hsiao, entitled, “SMT - based Test and Diagnosis for Circuits with Embedded Memories”. Current designs are increasingly having many embedded memories, which make traditional testing and diagnosis methods difficult. LBIST has a number of advantages such as requiring a low-cost ATE, at-speed test, and in-field test/diagnosis. However, the coverage is usually lower than deterministic patterns, and either top-off patterns or additional seeds are

needed to boost the coverage. Hence, there is a need to reduce LBIST reliance on test points to get last mile coverage. In addition, since only a limited number of signatures is produced by LBIST, the observability is greatly reduced, making diagnosis very difficult whenever the observed signature(s) mismatch the expected ones. The anticipated results will include SMT based techniques for such circuits, in addition to extend LBIST effectiveness with deterministic test generation.

- **Ha receives a project in Energy Harvesting**

Ha received a project from ITT Technologies to investigate feasibility of powering up a handheld system of ITT. The objective is to develop an energy harvesting system that utilizes solar, thermal, and vibration energy. The solution should provide power to charge an energy storage (a rechargeable battery / super capacitor) that will provide enough energy to power the system for a minimum of two transmissions. The size of the energy harvesting circuitry should be kept to a minimum, desirably less than one cubic inches



Outdoor test setup for solar energy harvesting on a sunny day

Faculty Highlights

Sandeep Shukla was an invited speaker's at Nokia Forum's educational workshop to talk about his experience in using the Qt library for software and programming education. The conference was held in San Francisco, California in November 2010.

Shukla is the program committee chair of two conferences to take place very soon. He is a co-chair of the program committee of the ESLsyn conference to be held in San Diego in June, 2011. He is also the program chair of the IEEE HLDVT (High Level Design Validation and Test) to be held in Napa valley in November 2011. Shukla just finished co-editing a special issue on multicore processors and transaction level modeling challenges there in for the IEEE Design & Test's May-June issue. Other editorial activities that kept him busy are associate editorships of IEEE Transactions on Computers, IEEE Design & Test, and IEEE Embedded System Letters. Shukla will also be an expert panelist at the ACM/IEEE Design Automation Conference talking on whether ESL verification is a dream or reality.

Dong Ha joins the "Center for Energy Harvesting Materials and Systems" (CEHMS) to excel his research in energy harvesting. CEHMS brings together diverse expertise in energy harvesting area from multiple departments of two universities, Virginia Tech and University of Texas at Dallas. CEHMS focuses energy harvesting from various ambient energy sources such as light, temperature gradient, wind, and vibrations at nano - macro scale. The Center becomes an NSF I/UCRC (Industry/University Cooperative Research Center) officially in January, 2011, and Ha, as an active member of CEHMS, focuses on IC design for low-power energy harvesting below 1 mW.

Ha taught graduate course “*RF IC Design*” in Fall of 2010. The course was taught in Blacksburg for the first half of the semester, which was also televised to VT campus (VT-MENA) in Egypt. He later travelled to Alexandria, Egypt in the mid-October and continued to teach the course from Egypt for the rest of the semester. A total of 25 graduate students were enrolled in the course from Blacksburg and VT-MENA campuses. During his stay in Egypt, he helped VT-MENA to improve VLSI and IC Design program. He and his wife returned to US in December before the recent revolution started.



Alexandria University, Alexandria in Egypt, where VT-MENA is co-located

Patrick Schaumont is Program Chair for the 4th International Symposium on Hardware Oriented Security and Trust.

Michael Hsiao gave an invited talk at AFRL (Air Force Research Laboratory) Industry Day On Supply Chain Management Tools, Aug 17, 2010. Title of the talk was, “Supply Chain Management Tools for Ensuring Security and Trust in Hardware, Firmware, and Software”

Hsiao begins a 3-year term serving as an Associate Editor for the ACM Transactions on Design Automation of Electronic Systems.

Hsiao, et. al. have filed patent for their work on delay fault coverage enhancement. L.-T. Wang, M. S. Hsiao, H.-J. Chao, Z. Jiang, S. Wu, J. Yan, “METHOD AND APPARATUS FOR DELAY FAULT COVERAGE ENHANCEMENT,” US Patent Application 20100138709.

CESCA Visitors

During the Fall 2010, and early Spring 2011, CESCA has had a number of research visitors who visited from various countries around the world, as well as from other institutes in the US and Canada. Dr. Aboudlaye Gamatie' from CNRS, France visited in September 2010. Dr. Jens Brandt from University of Kaiserslautern visited in October 2010, and Mike Gemund from University of Kaiserslautern visited in November 2010. Dr. Hiren Patel, a CESCA alumni – currently a faculty at University of Waterloo, Canada visited for two weeks in December 2010. Prof. Nandini Mukheerjee, the director of the center for mobile and distributed computing, Jadavpur University, India also visited CESCA. In addition we had visitors from University of Pennsylvania, University of Pittsburg, University of California at Berkeley, SUNY Albany, Air Force Research Labs, GE Energy, Office of the Deputy Secretary of Defense, IBM research, Samsung, etc, visiting us in connection with the CESCA seminar series.

New CESCA Research Faculty

Three new postdoctoral researchers have joined CESCA in October 2010. Dr. Jing Huang joined the project from the Office of the Secretary of Defense focussing on automated verification of component interface compatibility through behavioral type checking. Dr. Huang completed his PhD from Iowa State University, and worked as a postdoctoral researcher briefly in the same university. His work has been on automated theorem proving and other formal techniques for program verification – particularly in the automotive domain. Dr. Julien Ouy has joined the AFRL project on correct by construction of multi-threaded code generation from polychronous models. Dr. Ouy finished his Ph.D from University of Rennes, through his work at INRIA, France, and worked as a postdoctoral fellow at INRIA for almost 3 years. He brought a lot of experience on synchronous programming, polychronous modeling, and formal techniques for embedded software generation. Dr. Yi Deng came with sponsorship from the People's Republic of China as an exchange visiting researcher. His expertise from Beijing Institute of Technology where he finished his PhD and served as postdoctoral fellow is in embedded systems design methodology. He has experienced a lot of real hardware/software co-design on real embedded platforms. Currently he is working on IEC61850 – substation automation standard in smart grid, and network architecture design for wide area measurements in smart grids.



Dr. Jing Huang



Dr. Julien Ouy



Dr. Yi Deng



CESCA Picnic of 2010 was held at Nellie's Cave Park in Blacksburg, on Oct 2nd, 2010.



Student News

Who graduated?

Name	Degree	Where they will go
Mainak Banga	Ph.D	Intel
Maheshwar Chandrasekar	Ph.D	Intel
Karthik Channakeshava	Ph.D	Nokia
Nikhil Rahagude	M.S	Real Intent
Jatin S. Thakkar	M.S	Duetsche Bank

Internship stories

- Shaver Deyerle is co-oping Qualcomm Inc. in San Diego, CA for Spring 2011.
- Na Kong worked as a co-op student for Texas Instruments during fall semester of 2010.
- Mahesh Nanjundappa worked at Intel at Parsippany, NJ as Graduate Technical Intern from May 18th-Dec 31st 2010. His team is Intel Wall Street Lab, Financial Engineering Services. He is part of a software team working on Linux and Windows software for high performance financial computing. His responsibilities include research and development of new financial software that can be used as benchmarks and in turn that can help in providing key traces for architects. He returned to school in spring semester of 2011.
- Bijoy Jose worked at the Software Services Group of Intel at Folsom as a Graduate Technical Intern from May 18th-Dec 31st 2010. He worked on multi-threaded enabling of media codecs, optimization of software applications using streaming SIMD instructions and power analysis of software applications. He returned to school in spring semester of 2011.
- Shravan Garlapati is on internship with Siemens (NJ) during spring semester of 2011.
- Bin Xue is interning with NVIDIA Corporation during spring semester of 2011.
- Kaushik Mukunda is an intern with Rockwell Collins for fall semester of 2010. He returned to school in spring of 2011.
- Supratik Misra interned Intel Corporation during fall semester of 2010 and is continuing the internship during spring of 2011.
- Kanu Priya is interning with Apple Inc during spring semester of 2011. In her position, she works closely with RF and antenna design engineers, mechanical and industrial designers and EMC engineers to integrate antenna design in different Apple products. The focus of internship is augmentation of their measurement systems which includes writing and verifying RF test and measurement software.

Publications

- Bin Xue; Shukla, S.K.; , "Optimization of back pressure and throughput for latency insensitive systems," *Computer Design (ICCD), 2010 IEEE International Conference on* , vol., no., pp.45-51, 3-6 Oct. 2010

- Hua Lin, Santhoshkumar Sambamoorthy, Sandeep Shukla, James Thorp, Lamine Mili, "Power System and Communication Network Co-Simulation for Smart Grid Applications," Second IEEE PES Innovative Smart Grid Technologies Conference (ISGT). January, 2011, Anaheim, USA.
- Yi Deng, S. Garlapati, Hua Lin, S. Sambamoorthy, S. Shukla, J. Thorp and L. Mili, "Visual Integrated Application Development for Substation Automation Compliant to IEC 61850," 2011 PAC World Conference. June, 2011, Dublin, Ireland.
- Hua Lin, Santhoshkumar Sambamoorthy, Sandeep Shukla, James Thorp, Lamine Mili, "Ad-Hoc vs. Supervisory Wide Area Backup Relay Protection Validated On Power/Network Co-Simulation Platform," 17th Power Systems Computation Conference (PSCC). August, 2011, Stockholm, Sweden.
- Garlapati, S.; Hua Lin; Sambamoorthy, S.; Shukla, S.K.; Thorp, J.; , "Agent Based Supervision of Zone 3 Relays to Prevent Hidden Failure Based Tripping," *Smart Grid Communications (SmartGridComm), 2010 First IEEE International Conference on* , vol., no., pp.256-261, 4-6 Oct. 2010
- Garlapati, S.; Shukla, S.K.; Thorp, J.; , "An algorithm for inferring master agent rules in an agent based robust Zone 3 relay architecture," *North American Power Symposium (NAPS), 2010* , vol., no., pp.1-5, 26-28 Sept. 2010
- Bijoy A. Jose, Manuj Sabharwal and Abhishek Agrawal, Power implications of high resolution timer tick settings, Proc. of 1st International Conference on Energy Aware Computing, Egypt December 2010.
- Sumit Ahuja, Wei Zhang, Avinash Lakshminarayana, Sandeep K. Shukla: Power Aware High Level Synthesis of Hardware Coprocessors. *J. Low Power Electronics* 6(3): 376-389 (2010)
- N. Kong, D.S. Ha, A. Erturk, and D.J. Inman, "Resistive Impedance Matching Circuit for Piezoelectric Energy Harvesting," *Journal of Intelligent Material Systems and Structures*, Vol. 21, No. 13, pp. 1293 – 1302, September, 2010.
- M. Chandrasekar and M. S. Hsiao, "A novel learning framework for state space exploration based on search state extensibility relation," *Proceedings of the IEEE VLSI Design Conference*, January 2011.
- M. Chandrasekar and M. S. Hsiao, "Fault collapsing using a novel extensibility relation," *Proceedings of the IEEE VLSI Design Conference*, January 2011.
- S. Prabhakar, R. Sethuram, and M. S. Hsiao, "Trace buffer-based silicon debug with lossless compression," *Proceedings of the IEEE VLSI Design Conference*, January 2011.
- N. Goel, M. S. Hsiao, N. Ramakrishnan, and M. J. Zaki, "Mining complex boolean expressions for sequential equivalence checking," *Proceedings of the IEEE Asian Test Symposium*, December 2010.
- S. Krishnamoorthy, M. S. Hsiao, and L. Lingappan, "Tackling the path explosion problem in symbolic execution-driven test generation," *Proceedings of the IEEE Asian Test Symposium*, December 2010.
- N. Rahagude, M. Chandrasekar, and M. S. Hsiao, "DFT + DFD: an integrated method for design for testability and diagnosability," *Proceedings of the IEEE Asian Test Symposium*, December 2010.
- M. Li and M. S. Hsiao, "FSimGP2: an efficient fault simulator with GPGPU," *Proceedings of the IEEE Asian Test Symposium*, December 2010.
- S. Garlapati, M. S. Hsiao, and L. Nazhandali, "Sharing of logic and test TSVs for testing of 3DICs," *Proceedings of the IEEE International Workshop on Testing Three-Dimensional Stacked Integrated Circuits*, November 2010.
- N. P. Kozievitch, R. da S. Torres, S.H. Park, E. A. Fox, N. Short, A. L. Abbott, S. Misra, and M. Hsiao, "Rethinking fingerprint evidence through integration of very large digital libraries," *Proceedings of the Workshop on Very Large Digital Libraries*, September 2010.
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- X. Guo, S. Huang, L. Nazhandali, P. Schaumont, "Fair and Comprehensive Performance Evaluation of 14 Second Round SHA-3 ASIC Implementations", NIST 2nd SHA-3 Candidate Conference, Santa Barbara, CA, August 2010.
- Z. Chen, A. Sinha, P. Schaumont, "Implementing Virtual Secure Circuit using a Custom-Instruction Approach," International Conference on Compilers, Architecture and Synthesis for Embedded Systems (CASES 2010), Scottsdale, AZ, October 2010.
- M. Gora, A. Maiti, P. Schaumont, "A Flexible Design Flow for Software IP Binding in FPGA," IEEE Transactions on Industrial Informatics, 5(4):719-728, November 2010.
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- Michael B. Henry, Robert Lyerly, Leyla Nazhandali, Adam Fruehling, Dimitrios Peroulis, "MEMS-Based Power Gating for Highly Scalable Periodic and Event-Driven Processing," VLSI Design, International Conference on, pp. 286-291, 2011 24th International Conference on VLSI Design, 2011
- Vignesh Vivekraj, Leyla Nazhandali, "Feedback Based Supply Voltage Control for Temperature Variation Tolerant PUFs," VLSI Design, International Conference on, pp. 214-219, 2011 24th International Conference on VLSI Design, 2011
- Dinesh Ganta, Vignesh Vivekraj, Kanu Priya, Leyla Nazhandali, "A Highly Stable Leakage-Based Silicon Physical Unclonable Functions," VLSI Design, International Conference on, pp. 135-140, 2011 24th International Conference on VLSI Design, 2011

Books Published

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Book Chapter

- Bijoy A. Jose and Sandeep Shukla, "MRICDF: A polychronous model for embedded software synthesis", chapter in *Synthesis of Embedded Software – frameworks and methodologies for correctness by construction*, ISBN 978-1-4419-6399-4, Springer, 2010.