



## Fadi Kurdahi Appointed New CECS Director

- Staff

### Highlights

- **New CECS Director**
- **Grad Student Profile: Jurn Gyu Park**
- **Award: Brian Demsky receives NSF award**
- **Project Profile: Patch Mosaic for Fast Motion Deblurring**
- **ESWEEK 2012**

Fadi Kurdahi, Professor of Electrical and Computer Engineering has been named the new CECS Director, effective November 1, 2012.

After 10 successful years at the helm, CECS founding director, Prof. Daniel Gajski has decided to step down from the post to focus his time on developing embedded system on-line education programs. We want to take this opportunity to thank Prof. Gajski for his dedicated and exceptional service. Under his leadership, CECS has evolved from the Irvine Research Unit in Computer Design (IRUCSD) to become an internationally renowned research center in the field of embedded computer systems.



Prof. Kurdahi received his PhD from the University of Southern California in 1987. Since then, he has been a faculty member in the Department of Electrical & Computer Engineering at UCI, where he conducts research in the areas of Computer Aided Design of VLSI circuits, high-level synthesis, and design methodology of large scale systems. He has been an Associate Director for CECS since 2005 and was a founding member of the center. He served as Associate Editor for IEEE Transactions on Circuits and Systems II, Area Editor in IEEE Design and Test for reconfigurable computing, and as program chair, general chair or on program committees for several workshops, symposia and conferences in the area of CAD, VLSI, and system design. He also received the Distinguished Alumnus award from his Alma Mater, the American University of Beirut, in 2008. He is a Fellow of the IEEE and the AAAS.

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# DIRECTOR & STUDENT PROFILE

## CECS Director Fadi Kurdahi (continued from page 1)...

When asked about his vision for the future of CECS, Prof. Kurdahi cited the importance of CECS continually striving to be in the forefront of the exciting technological evolution of embedded electronics and cyber-physical systems, and of forging interdisciplinary partnerships with other centers of excellence across UCI as well as other UC campuses, and potentially other partners worldwide.

Equally important are technology and knowledge transfers, where the center must make aggressive strides. He added that CECS has been a campus-wide leader in introducing on-line learning and on-line courses. The next milestone is to build on this leadership to develop course clusters in embedded systems which will lead to certificate and degree programs.

Please join us in welcoming Prof. Kurdahi as our new director.

## Graduate Student Profile: Jurn Gyu Park



JurnGyu Park is a first year PhD. student in the Information and Computer Science department at UCIrvine. He received his Bachelor's degree in Mechanical & Automotive Engineering from Kookmin University and his Master's degree in Computer Engineering from Yonsei University, Seoul, South Korea in 2001 and 2012 respectively.

From 2002 to 2011, he was a senior researcher and technical lecturer at the Education Division of MDS technology Co. Ltd and presented embedded courses such as ARM Architecture, Linux Kernel, Device Driver, and Android Platform at Samsung and LG electronics since 2006. His previous research was mainly focused on performance and power consumption of embedded GPGPUs considering CUDA/OpenCL. An analytical model for embedded VLIW GPGPU Architectures was proposed and verified on a Cortex-A9 MPCore H/W platform with a Mali-400 GPGPU core and Android 2.3 Gingerbread S/W platform. In September 2012, he joined Prof. Nikil Dutt's Research Group at UCI and currently works with Professor Dutt. His research interests include variability on NAND flash memory storage systems, Linux Kernel, Android platform, and parallel programming on GPGPU systems. He has been working on policy-driven logical volume management on NAND flash filesystem frameworks, which is a system-level solution that opportunistically exploits performance or reliability variation through different logical volume policies.

# AWARD HIGHLIGHT

## Professor Brian Demsky Receives \$500K NSF Award

-Staff

Prof. Brian Demsky has been awarded \$500,000 by the National Science Foundation (NSF) for his research project, "Tool Support for Verifiably-Robust Software". This project will run from October 1, 2012 through September 30, 2015.

### Project Summary:

Society increasingly relies on software for critical roles in which crashes can have serious consequences. For example, it is now commonplace for software-based systems to control the engine and brakes in our cars, fly planes, control power systems, perform surgery, and control medical devices. The negative consequences of failures in these systems range from the simple denial of service to legitimate users through to the destruction of physical systems (with the potential for collateral damage) when their software controls fail. The critical role of software systems has been widely acknowledged by the research community, and researchers have put much effort into improving software. Unfortunately, despite many years of effort from the community, software systems remain fragile and still suffer from catastrophic failures.

This research will explore a new approach for creating software systems that are robust to crashes. The approach is inspired by the observation that all too often, software bugs or hardware failures cause even well-tested software to crash by transitioning into problematic states. Once such a crashing transition occurs, software systems can, in general, behave in arbitrary ways. What is even more insidious is that such crashes can be silent until a catastro-



phic failure occurs – there may be no outward symptoms that the correct operation of software can no longer be relied upon.

Previous work on software reliability has largely attempted to show that such crashing transitions can not occur either through extensive testing or formal techniques. This work takes a fundamentally different approach --- it verifies

that the consequences of such crashes have a limited scope in time. Precisely, it verifies that after a bounded time period after a crash, the execution returns to the exact correct state. This property is known in the distributed systems literature as self-stabilization.

This research targets software systems that process streams of inputs and perform actions in response to the inputs – such systems include embedded controllers and multi-media systems. The hypothesis is that formally verifying the robustness of software using type system and static analyses techniques can yield software systems that are substantially more resilient to errors. Our goal is to verify that software systems are self-stabilizing.

We will evaluate the proposed approach by annotating multiple benchmark software systems. We will then simulate a wide range of realistic failures and evaluate the robustness of the benchmark applications. These studies will both quantitatively verify self-stabilize and qualitatively evaluate the effectiveness of self-stabilization for providing robustness in the given application context.

# ESWEEK 2013

## CECS At ESWEEK

Staff



The Center for Embedded Computer Systems (CECS) at the University of California, Irvine continues to play a prominent role at ESWEEK. Embedded Systems Week is an exciting event which brings together conferences, tutorials, and workshops centered on various aspects of embedded systems research and development. Leading conferences in the area take place at the same time and location, allowing attendees to benefit from a wide range of topics covered by these conferences and their associated tutorials and workshops. This year's conference, held on October 7-12, in Tampere, Finland, included the CASES, CODES+ISSS, and EMSOFT conferences. Workshops and Symposia included ESTIMedia, CASA (organized by CECS alum, Aviral Shrivistava), ESTIMedia, RSP, EON, WESS, WESE, MeAOW (co-organized by Prof. Nikil Dutt), and MeCoES.

CECS faculty and alumni played a major role in the success of this seminal event. Professors Alex Orailoglu, Nikil Dutt, Frank Vahid and Tony Givargis served on the CODES+ISSS technical program committee. Prof. Fadi Kurdahi was the session chair for the topic on "Domain- and application-specific design techniques". Prof. Tony Givargis served on the CASES Program Committee. Profs. Nikil Dutt and Tony Givargis also served as members on ESTIMedia Technical Program Committee.

The following technical papers were presented by CECS faculty affiliates and their graduate

students and can be found in the conference proceedings at the cited pages:

*ViPZonE: OS-Level Memory Variability-driven Physical Address Zoning for Energy Savings*, Luis Bathen, Mark Gottscho, Nikil Dutt, Puneet Gupta, Alex Nicolau, CODES+ISSS 2012: 33-42

*A Novel NoC-based Design for Fault-tolerance of Last-level Caches in CMPs*, Abbas Banaiyanmofrad, Gustavo Girao, Nikil Dutt, CODES+ISSS 2012: 63-72

*Synthesis of Custom Networks of Heterogeneous Processing Elements for Complex Physical System Emulation*, Cheng Huang, Bailey Miller, Frank Vahid, Tony Givargis, CODES+ISSS 2012: 215-224

*Revisiting Level-0 Caches in Embedded Processors*, Nam Duong, Taesu Kim, Dali Zhao, Alex Veidenbaum, CASES: 171-180

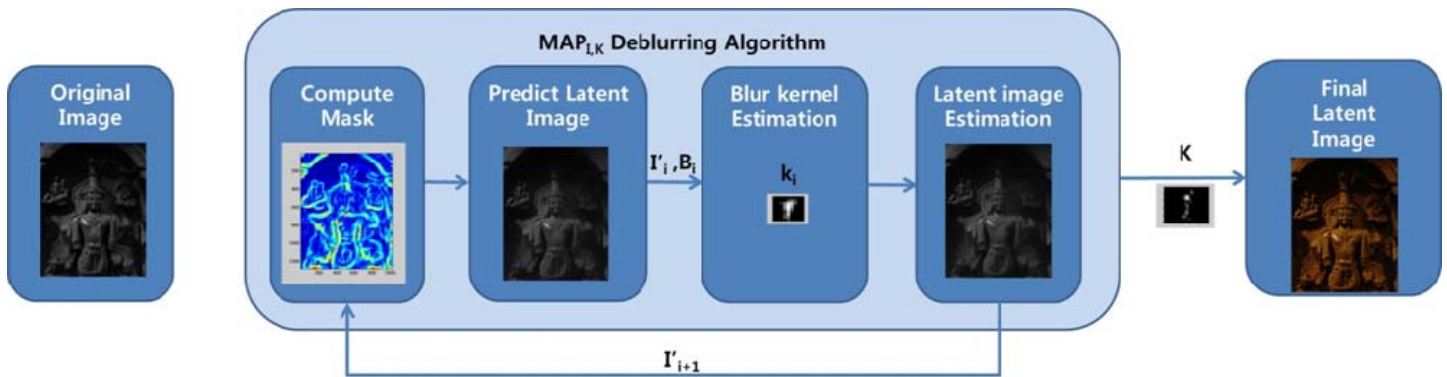
*An Advanced Course Design for Mobile Embedded Software through Android Programming*, Gu-Min Jeong, Dong-Byeong Kang, Sung-Soo Kim, Nikil Dutt, Workshop on Embedded and Cyber-Physical Systems Education (WESE)

*Software Controlled Memories for Scalable Many-Core Architectures*, Luis Angel D. Bathen, Nikil Dutt, RTCSA 2012: 1-10

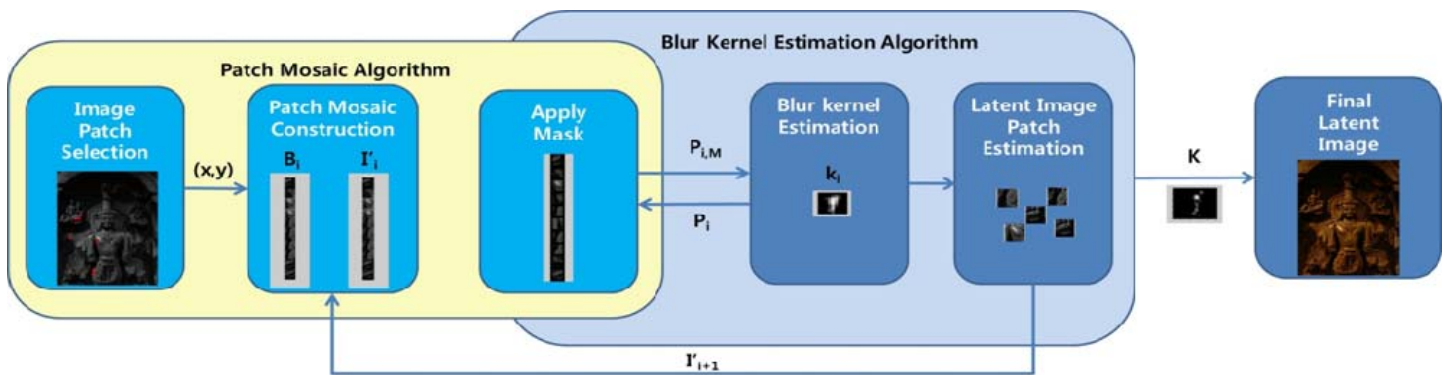
## Patch Mosaic for Fast Motion Deblurring

-Hyeoungho Bae, Charles Fowlkes, Pai Chou

**Objective:** To use a mosaic image patches composed of the most informative edges found in the original blurry image for the purpose of estimating a motion blur kernel with minimum computational cost.



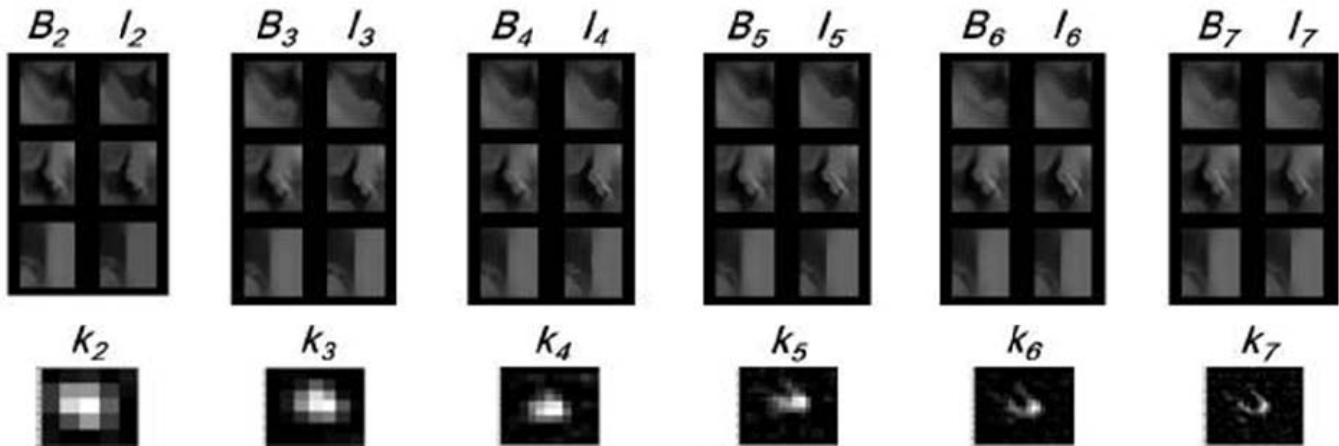
(a) Conventional MAP<sub>i,k</sub> blind motion deblurring algorithm



(b) Patch Mosaic based motion deblurring algorithm

**Algorithm Overview:** Patch Mosaic Algorithm (yellow box) can be plugged into several blind motion deblurring algorithm without significant modification.

## Patch Mosaic for Fast Motion Deblurring (cont. from page 5)



(a) Patch mosaic during the kernel estimation



(b) The original blurry image

(c) The estimated latent image

(a) The patch mosaic and estimated blur kernel during the iteration, (b) The original blurry image, and (c) The estimated latent image using our Patch Mosaic based algorithm

**Performance:** Our algorithm reduces the image data used for the blur kernel estimation down to 30%. The time consumption for estimating latent image (2256 by 1504 color image) is 14.9sec for Matlab script, which is 24% faster than our image patch based fast motion deblurring algorithm.

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Mehryar Rahmatian, Hessam Kooti, Ian G. Harris, Elaheh Bozorgzadeh, “**Hardware-assisted Detection of Malicious Software in Embedded Systems**,” IEEE Embedded Systems Letters, ESL: 94-97, December 2012

Giovanni Ansaloni, Kazuyuki Tanimura, Laura Pozzi, Nikil Dutt, “**Integrated Kernel Partitioning and Scheduling for Coarse-Grained Reconfigurable Arrays**,” IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems 31(12): 1803-1816, December 2012

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Zhiming Chen, Chun-Cheng Wang, Payam Heydari, “**A BiCMOS W-Band 2x2 Focal-Plane Array with On-chip Antenna**,” IEEE Journal of Solid-State Circuits 47(10): 2355-2371, October 2012

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Frederick C. Harris Jr., Jeffrey L. Krichmar, Hava T. Siegelmann, Hiroaki Wagatsuma, "**Guest Editorial: Biologically Inspired Human-Robot Interactions - Developing More Natural Ways to Communicate with our Machines,**" IEEE Transactions on Autonomous Mental Development 4 (3):190-191, September 2012

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Mishari Al Mishari, Paolo Gasti, Naveen Nathan, Gene Tsudik, "**Optimizing Bi-directional Low-Latency Communication in Named Data Networking**," The Computing Research Repository, CoRR abs: 1207.7085, July 2012

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Freddy Bolanos, Jose Edison Aedo, Fredy Rivera, Nader Bagherzadeh, "**Mapping and Scheduling in Heterogeneous NoC through Population-Based Incremental Learning**," The Journal of Universal Computer Science 18(7): 901-916, 2012

Kazuyuki Tanimura, Nikil D. Dutt, "**HDRL: Homogeneous Dual-Rail Logic for DPA Attack Resistant Secure Circuit Design**," Embedded Systems Letters 4(3): 57-60, 2012

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Myoung-Seo Kim, Jean-Luc Gaudiot, "**Design of Configurable Pin Control Block for Multimedia System-on-a-Chip**," The International Conference on IT Convergence and Security, ICITCS 2012: 805-812, Pyeong Chang, Korea, December 5-7, 2012

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Mehryar Rahmatian, Hessam Kooti, Ian G. Harris, Elaheh Bozorgzadeh, “**Minimization of Trojan Footprint by Reducing Delay and Area Impact,**” IEEE International Symposium on Defect and Fault Tolerance in VLSI and Nanotechnology Systems (DFTS), Austin, TX, October 3-5, 2012

Mehryar Rahmatian, Hessam Kooti, Ian G. Harris, Elaheh Bozorgzadeh, “**Adaptable Intrusion Detection using Partial Runtime Reconfiguration,**” The 30<sup>th</sup> IEEE International Conference on Computer Design, ICCD 2012: 147-152, Montreal, Quebec, Canada, September 30-October 3, 2012

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Alex Veidenbaum, Nectarios Koziris, Toshinori Sato, Avi Mendelson, “**Topic 4: High-Performance Architecture and Compilers,**” The International European Conference on Parallel and Distributed Computing, Euro-Par 2012: 204-205, Rhodes Island, Greece, August 27-31, 2012

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*Center for Embedded Computer Systems, University of California, Irvine*



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Synopsys Inc., Fremont,  
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