



Program Highlights

Technical Program - details on pgs. 12 - 33

The technical program covers over 160 papers, panels and special sessions in five parallel tracks, covering system level design, synthesis, physical design, verification, interconnect, power and IP issues. Highlights include a focus on embedded systems (see right) as well as a number of special sessions with invited paper presentations on the future of nanometer design, visualization and animation in VLSI design, the impact of subwavelength lithography and on closing the gap between full custom design and ASICs.

TUESDAY KEYNOTE
Henry Samueli Co-Chairman and Chief Technical Officer
Broadcom Corporation, Irvine, CA
Tuesday, June 19 - 8:30 AM
Room: Hilton Pavilion (Las Vegas Hilton)

Best Paper Awards

Best Paper Awards of \$1000 each will be announced at the Tuesday morning General Session. Papers eligible for awards in this category are nominated by the Program Committee and selected by a referee process. Awards will be given in each of the following categories:

1. Design Tools
2. Design Methodology (2)
3. Embedded Systems

Ph.D Forum **Tuesday, June 19** - details on pg. 47

A chance for Ph.D students and industry representatives to get together. Students get feedback on their research proposals; industry gets a chance to meet students and preview their work.

Embedded Systems - See sessions: 3, 17, 23, 28, 32, 37, 41, 42, 49

Recognizing the increasing role of embedded software and IP in complex SoC designs we have provided a special focus on embedded systems topics. Over 35 papers and panels will cover topics such as embedded compilation, hardware/software co-design, system modeling and power optimization. In addition, special invited sessions will discuss the critical topic of on-chip communication architectures, as well as provide a real-life practical embedded case study dealing with the implementation of the Bluetooth wireless standard. Also, a panel of experts will examine the multifaceted space of embedded systems and the role of EDA in this space.

THURSDAY KEYNOTE
Willem P. Roelandts President and Chief Executive Officer
Xilinx, Inc., San Jose, CA
Thursday, June 21 - 1:00 PM
Room: N109 - N114

Tutorials - Friday, June 22 - details on pgs. 34 - 39

- 1) Design-for-Test Techniques for SoC Designs
- 2) Interactive Tutorial on Fundamentals of Signal Integrity for High-Speed/High-Density Design
- 3) CAD tools for mixed-signal and RF ICs
- 4) Design-Manufacturing Interface for UDSM Era: Designer and CAD Tool Developer Perspectives
- 5) Low Power Tools and Methodologies for the ASIC Industry
- 6) Field Programmable Devices: Architecture and CAD Tools

Microelectronic System Educators Conference **June 17 - 18** - Las Vegas Hilton, Nevada

For more information, visit www.mseconference.org.



Exhibit Highlights

Exhibit Floor

Monday - Wednesday, June 18-20, 2001 10:00 AM - 6:00 PM

Over 260 EDA, Silicon, IP and Embedded Systems companies participate in the DAC exhibition and demo suites. All exhibits and suites are located in Halls C1-C5 of the Las Vegas Convention Center.

Embedded Systems Showcase

The Embedded Systems showcase, located in Hall C1 offers exhibitors and attendees a highly focused area to display and view tools for the design of embedded systems-on-chip.

Featured Product Segments

- Embedded Systems Hardware: SoC, IP re-use, on-chip buses
- Embedded Systems Software: run-time schedulers, middleware, compilers
- HW/SW Co-Design: specification languages, interfaces and integration, partitioning, synthesis
- Validation: debug, performance estimation and analysis, co-simulation
- Applications: application-architecture interaction, networked and distributed systems, multimedia systems

The latest innovations are at your fingertips with exhibitors highlighting their latest products.

Exhibitor ListingPages 61 - 62
 Exhibitor Presentation SchedulePages 65 - 66
 Exhibitor Presentation Abstracts.....Pages 68 - 91

No badge needed to attend Exhibitor Presentations on Monday, June 18.

Exhibit-Only

- Free Monday Exhibit-Only Passes - register on Sunday or Monday on-site during registration hours.
 Sunday, June 17, 2001 8:00 AM - 4:00 PM
 Monday, June 18, 2001 8:00 AM - 6:00 PM
- \$40 full exhibit-only registration will allow you to attend exhibits Monday through Wednesday.

Exhibit or Presentations - Monday, June 18, 2001

- A full day of 15-minute Exhibitor Presentations - choose from 168 presentations; see pages 65 - 91 for details.

Demo Suites

Monday - Wednesday, June 18-20, 20018:00 AM - 9:00 PM
 Thursday, June 21, 20018:00 AM - 5:00 PM

- Demo Suites will be in Halls C4 & C5 of the Las Vegas Convention Center.
- Exhibiting companies will have the opportunity to give their customers private demos without leaving the Convention Center.
- Demo Suites are available by invitation only.

Demo Suite ListingPage 198
 Demo Suite Map.....Page 197



Conference Information

About the Conference

The 38th Design Automation Conference provides a high-quality program facilitating technology interchange among design automation researchers and developers, the engineers who use DA systems to design, test and manufacture circuits and systems, and the vendors who provide both electronic design automation (EDA) systems and silicon. Five full days of activities are planned. New product introductions and application notes will be highlighted on Monday in the Exhibitor Presentations, and more than 260 companies will exhibit the latest commercially available products Monday through Wednesday.

This year's conference highlights the role of embedded systems in today's electronic design. This is reflected in an "Embedded Systems Showcase" on the exhibit floor, a plenary panel session of top executives on Wednesday on "Embedded System Design: The Real Story", and multiple technical sessions sprinkled throughout the program addressing the design challenges and solutions of embedded systems.

Technical innovations from DA research and development and the use of DA in design of chips and systems will be presented in five parallel sessions, Tuesday through Thursday, in the Technical Program. Two keynote addresses outline the challenges the EDA field is facing: the first one, featured on Tuesday morning, by Henri Samuëli, Co-founder and Chief Technical Officer of Broadcom Corporation, and the second one on Thursday afternoon by Willem Roelandts, President and Chief Executive Officer of Xilinx, Inc.

The Technical Program consists of panel discussions, special sessions, and technical paper sessions. The Design Tools track focuses on new techniques for enhancing the performance and capabilities of EDA tools. The Design Methods track focuses on the results and insights gained by applying EDA tools to actual system designs.

In addition to the Plenary Panel, there are seven other panel discussions covering topics that range from dealing with the challenge posed by FPGAs to ASICs, to the verification of embedded cores, and an analysis of the supply chain in the electronics industry. The program also features 26 invited presentations, covering exciting topics such as the design of Bluetooth chip-sets to "interconnect-networks-on-a-chip". The conference concludes with six full-day tutorials on Friday.

Virtual DAC (www.dac.com)

Virtual DAC offers two powerful on-line tools for attendees to make the most of their time at DAC. The "DAC Floor" is designed to allow attendees to plan the exhibitors they want to visit and to create a floor plan marking the locations of the selected exhibitors. The "DAC Planner" is designed for attendees to plan which technical sessions and other important DAC events they want to attend. Together the two services allow attendees to organize, how they want to utilize their time at DAC.



The 38th Design Automation Conference • June 18 - 22, 2001 • Las Vegas, NV

Workshop for Women in Design Automation

Sunday, June 17 • 8:00am - 4:00pm

Smart Risk Taking = Innovation

Room: N115



WORKSHOP CHAIR:
Mar Hershenson,
CEO, Barcelona Design, Inc.

Creating a climate that embraces risk in order to achieve true innovation is perhaps the most daunting challenge facing today's fast-paced companies. Innovation, by definition, means doing things differently, exploring new territory and taking risks. At this year's Workshop for Women in Design Automation, prominent

EDA industry leaders will divulge their own strategies for developing corporate cultures that encourage and reward smart risk taking to improve product development and delivery. You will leave the Workshop armed with practical knowledge that you can use to make a positive difference in your workplace.



9:00 am - Keynote Address
Lynn LeBlanc, Cadence Design Systems, Inc.
Senior Vice President,
Office of Customer Advocacy

Lynn has twenty years of experience in the technology industry with a reputation for developing highly effective organizations and launching first-to-market technologies. In her current role, Lynn has responsibility for worldwide customer satisfaction for Cadence and directs innovative programs that enhance and strengthen customer partnerships. Prior to her current appointment at Cadence, Lynn held senior management positions at Mentor Graphics, iReady, Ocrel Communications and IBM. In her keynote address, Lynn will share her experiences with creating empowering environments that foster respect, tolerate risk and celebrate success.

**10:15 am - Panel: Embracing the Culture of Risk:
A Mandate for Successful Organizations**

Moderator: *Lynda Kaye*

During this interactive session, panelists will provide insights into the development and management of successful, risk tolerant corporate cultures. They will share personal successes, failures, philosophies and observations and respond to questions from audience members.

Kathleen Doler – Electronic Business Magazine
Deirdre Hanford – Synopsys, Inc.
Penny Herscher – Simplex Solutions, Inc.
Nancy Nettleton – Sun Microsystems
Walden C. Rhines – Mentor Graphics Corp.
Gabriele Saucier – Design and Reuse

ORGANIZERS: *Lynda Kaye* – President, Mango Communications
Luciana Guarnieri – Marketing Manager, Barcelona Design, Inc.

STEERING COMMITTEE: *Karen Bartleson* – Director of Interoperability, Synopsys, Inc.
Marie R. Pistilli – Co-Chair, Board of Directors, MP Associates, Inc.
Ellen J. Yoffa – DAC Executive Committee, EDA Industry Chair

Schedule *(breakfast, lunch and the reception will be in room N119)*

- 8:00 am** Registration and Continental Breakfast
- 9:00 am** Keynote Address: *Lynn LeBlanc*
- 10:00 am** Break
- 10:15 am** Panel: *Embracing the Culture of Risk: A Mandate for Successful Organizations*
- 12:00 pm** Lunch Speaker: *Mar Hershenson From Idea to Start-Up - How to Get There*
- 1:00 pm** Interactive Workshop 1 – *Innovative Marketing*
Leader: *Kuhoo Goyal* - TechBites Interactive
- 1:45 pm** Interactive Workshop 2 – *Risk and Reward for Engineering Organizations*
Leader: *Lori Watrous-de Versterre*, Mentor Graphics Corp.
- 2:30 pm** Interactive Workshop 3 – *New Approaches to Business Development*
Leader: *Leslie Landers*, Intertra, Inc.
- 3:15 pm** Break
- 3:40 pm** Achievement Award Ceremony – Join us as we honor the recipient of this year's *Marie R. Pistilli Women in EDA Achievement Award*.
- 3:55 pm** Closing Remarks: *Mar Hershenson*
- 4:00 pm** Reception: Sponsored by the EDA Consortium



Interoperability Workshop

Sunday, June 17 • 12:00pm - 5:00pm

Room: N117

N115

Interoperability among EDA tools has long been a topic of passionate discussion and many standard file formats have been proposed to help. But, the rapid advance in semiconductor technology combined with the need for more predictable and productive automated design processes are demanding a much tighter coupling of new EDA tools. There is a growing community of technical experts who believe that for EDA to keep pace with semiconductor technology, new more modular applications will need to operate on shared design data in memory. Several EDA companies have announced design systems with suites of tools tightly coupled around their proprietary data models. But to be able to assemble such systems with the best components from multiple suppliers, we will need a standard application programming interface for sharing design data.

This Workshop brings together design system architects from the leading Semiconductor, System and EDA companies to discuss:

- The benefits seen to date from tightly-coupled applications
- The technical issues in achieving tight coupling of tools
- The pressing need for a standard API for accessing design data
- The Open Source Model as a mechanism for achieving and advancing such a standard

WORKSHOP ORGANIZERS: *John Darringer* - Mgr. System-Design, IBM Research
Terry Blanchard - Mgr. VLSI Technology Center, Hewlett-Packard Co.
Greg Spirakis - General Mgr. Design Technology, Intel Corp.

Schedule

12:00pm Lunch (will be in room N108)

1:00pm Welcome and Workshop Objectives: *John Darringer*

1:15pm Session 1 - *Tight Coupling Progress and Issues from the User Community*

Yi-hung Chee - Principal Engineer, CAD Infrastructure, Intel Corp.

Sumit Dasgupta - Dir. of SoC-IP Design Systems, Motorola, Inc.

Jean-pierre Geronimi - Dir. of CAD, ST Microelectronics

2:30pm Session 2 - *Tight Coupling Progress and Issues from the EDA Companies*

Mark Bales - Corporate Fellow, Cadence Design Systems, Inc.

Tim Burks - Dir. of Engineering, Magma Design Automation, Inc.

Raul Campasano - Sr. VP, GM Tool Design Group, Synopsys, Inc.

3:30pm Break

3:45pm Panel: *Can There be a Standard Interface for Tight Coupling?*

Presentation: *The Design API Coalition and Open Source* - Don Cottrell - Si2

Panel members to be selected from workshop speakers and audience.

4:45pm Wrap-up: *John Darringer*

5:00pm Adjourn

Chair: *Terry Blanchard* - Mgr. VLSI Technology Ctr., Hewlett-Packard Co.

Joe Morrell - Sr. Technical Staff, IBM Corp.

Scott Petersen - Dir. Silicon Optimization, LSI Logic Corp.

Jim Wilmore - CAD System Architect, Hewlett-Packard Co.

Chair: *Greg Spirakis* - General Manager Design Technology, Intel Corp.

Greg Dufour - Strategic Technology Advancement, Mentor Graphics Corp.

Vivek Raghavan - Head of Physical Design Products, Avant! Corp.

Bob Shott - Mgr. R&D, Monterey Design Systems

Panel Chair: *Richard Goering* - Editor, EE Times



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Tuesday Keynote - Designing in the New Millennium, It's Even Harder Than We Thought



Henry Samuelli
Co-Chairman and Chief Technical Officer
Broadcom Corporation, Irvine, CA
Tuesday, June 19, 2001, 8:30 am - 10:00 am
Room: Hilton Pavilion (Las Vegas Hilton)

Abstract: System-on-a-chip (SoC) design has taken on a new level of sophistication in the new millennium with the advent of 100 million transistor chips incorporating dozens of blocks of IP originating from a wide variety of internal and external sources. Today's SoC designs incorporate general purpose processor cores, programmable DSP cores, dedicated DSP engines, dedicated protocol engines, large random logic and memory blocks and precision high-speed analog blocks. A cornerstone of Broadcom's strategy in achieving rapid time-to-market lies in the heavy use of design automation tools, augmented with in house customization and methodology development. This talk will give an overview of the challenges the design community will face in the coming years in developing very complex SoCs, and will also discuss Broadcom's EDA strategy to address these problems.

Biography: Henry Samuelli is a co-founder of Broadcom Corporation and has served as Co-Chairman and Chief Technical Officer (CTO) since the company's inception in 1991. As CTO he is responsible for all research and product development activities for the

company. Henry Samuelli has over 20 years experience in the fields of digital signal processing (DSP) and communications systems engineering. He is widely recognized as one of the world's leading experts in the field of broadband communications circuits, having published more than 100 technical papers on the subject. Henry Samuelli also co-founded PairGain Technologies in 1988 and served as Chief Scientist of the company until 1994. He was the principal architect of PairGain's high bit-rate digital subscriber line (HDSL) transceiver. Since 1985, Henry Samuelli has been a professor in the Electrical Engineering Department at UCLA, where he supervises advanced research programs in DSP and broadband communications circuits. He has held various engineering management positions in the Electronics and Technology Division of TRW, where he was responsible for the hardware development of various military satellite and digital radio communications systems. He received a B.S., M.S. and Ph.D. in Electrical Engineering from UCLA in 1975, 1976 and 1980, respectively.



Thursday Keynote - FPGAs Enter the Mainstream



Willem P. Roelandts
President and Chief Executive Officer
Xilinx, Inc., San Jose, CA
Thursday, June 21, 2001, 1:00 pm - 1:45 pm
Room: N109 - N114

Abstract: A few years ago field programmable gate arrays (FPGAs) were expensive, slow and small. But thanks to recent breakthroughs in technology, FPGAs today offer tens of millions of system gates, they operate at 200 MHz or more and they cost less than \$10. Meanwhile, FPGA software tools are faster than ever, compiling million-gate designs in 30 minutes and contributing to significant improvements in the productivity of digital logic designers. Even more FPGA advancements are on the horizon: embedded processors, high-level language support, remotely configurable hardware, and fast serial I/Os. With this accelerating pace of change, the CEO of Xilinx believes it's feasible that programmable logic will be an integral part of all digital electronic products within the next decade.

Biography: Willem P. "Wim" Roelandts has served as president and chief executive officer of Xilinx since January 1996. He is responsible for formulating the company's overall strategy, vision and focus necessary for Xilinx to continue its pace of rapid growth and expansion.

During Roelandts' tenure at Xilinx, revenue has tripled to about \$1.5 billion. Today Xilinx is widely recognized as one of the best managed and most financially sound high technology companies in the world. In 2000, *BusinessWeek* ranked Xilinx the sixth most profitable company in the magazine's listing of the top 100 information technology companies. *FORTUNE* recently added Xilinx to the magazine's coveted list of the top 100 companies to work for. And *Forbes* magazine now includes Xilinx in its list of America's 400 best big companies. Under Roelandts' leadership, Xilinx has also become the leading supplier of programmable logic chips, one of the fastest growing segments of the overall semiconductor industry. Market researcher Dataquest now ranks Xilinx as the sixth largest supplier of custom logic chips in the world.

Since joining Xilinx, Roelandts has played an increasingly active role in industry affairs. He serves on the board of directors of the Semiconductor Industry Association and the Technology Network, and he is president of the Fabless Semiconductor Association. Roelandts also frequently acts as a keynote speaker at industry conferences and trade shows.

Roelandts joined Xilinx after a 30-year career in management at Hewlett-Packard Co. In his last position there, he served as senior vice president and was responsible for all aspects of HP's then \$6 billion worldwide computer systems business, including research and development, manufacturing, marketing, professional services and sales.

Roelandts joined Hewlett-Packard in 1967 as a service engineer in Belgium. He was promoted to customer-engineering/systems engineering manager in 1973. In 1975, he was transferred to HP's former Grenoble (France) Division where he was product support manager, European support center manager and research and development manager. In 1982, Roelandts was named operations manager for the Grenoble Networks Operation. In 1983, he was named RGD manager for HP's Information Networks Division in Cupertino, California. He was promoted to division general manager in 1984, and to general manager for the Information Networks Group in 1985.

Roelandts was elected as HP vice president in 1988 and became general manager of the Computer Systems Group later that year. He was named general manager of the Networked Systems Group in 1990 when HP realigned its computer business activities and was named general manager of the Computer Systems Organization in 1992. He was elected a senior vice president in 1993.

Roelandts was born January 4, 1945, in Lennik, Belgium. He earned his bachelor's degree in electrical engineering from Rijks Hogere Technische School in Anderlecht, Belgium, in 1965.



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Important Information At-A-Glance

	Exhibit Hours: (badge required)	Demo Suite Hours: (by invitation only)
Monday, June 18	10:00 AM to 6:00 PM	8:00 AM to 9:00 PM
Tuesday, June 19	10:00 AM to 6:00 PM	8:00 AM to 9:00 PM
Wednesday, June 20	10:00 AM to 6:00 PM	8:00 AM to 9:00 PM
Thursday, June 21	-	8:00 AM to 5:00 PM

At-Conference Registration Hours

The registration desk will be located in the Grand Concourse Lobby of the Las Vegas Convention Center and will be open at the following times:

Sunday, June 178:00 AM to 4:00 PM	Wednesday, June 207:30 AM to 5:00 PM
Monday, June 188:00 AM to 6:00 PM	Thursday, June 217:30 AM to 3:00 PM
Tuesday, June 197:30 AM to 5:00 PM	Tutorial RegistrationFriday, June 22, 8:00 AM to 1:00 PM

On-Site Information Desk

The information desk is located in the Grand Concourse Lobby. (702) 943-3500

DACnet

DACnet workstations are being provided by Sun Microsystems. DACnet will be located in the Grand Concourse Lobby on the 1st level, the 2nd level in the foyer next to room N245, and the press room.

Conference Survey

Again this year we would like you to voice your opinion on various aspects of the Conference. DAC is conducting surveys to determine how to best serve your needs. Please take a few moments to participate if you are approached by one of our surveyors. Look for interviewers wearing "???" buttons at various locations around the show. Help make a difference in DAC and receive a surprise gift for participating.

First Aid

There is a first-aid room located in the Grand Concourse Lobby, the phone number is (702) 892-7400. A nurse will be on duty at all times while meetings and exhibits are open. While in the convention center you can dial the ext. 7400 to contact the nurse.

Food Services

Luncheon service is available Monday through Thursday in the Banners Restaurant located in the Grand Concourse Lobby. Additional Food Courts are available in the C2 Exhibit Hall Monday through Wednesday. DAC hosted coffee service will be on the 1st Level outside the N100 series meeting rooms.

Business Services

Located in the Grand Concourse Lobby, the following services will be available: coat and baggage check, fax services, small package shipping, U.S. Stamps, notary service, photocopying, executive conference room rental, computer time rental/secretarial services, supplies.

Videoed Sessions

This year DAC will be recording the following sessions and posting them on the web:

- Tuesday, June 19 - Sessions 2, 7, 12, and the Opening Keynote Speech
- Wednesday, June 20 - Sessions 17, 22, 27, and the Plenary Panel
- Thursday, June 21 - Sessions 31, 36, 41, 46, and the Lunch Keynote



The 38th Design Automation Conference • June 18 - 22, 2001 • Las Vegas, NV

Tuesday, June 19, 2001

8:30
to
10:00



Opening Session and Keynote Speaker (no badge required) Location: Hilton Pavilion (Las Vegas Hilton)

Designing in the New Millennium, It's Even Harder Than We Thought

Henry Samueli - Co-Chairman and Chief Technical Officer, Broadcom Corporation, Irvine, CA

BREAK 10:00 - 10:30					
	Room N111 - N114	Room N109 - N110	Room N115 - N117	Room N119 - N120	Room N107 - N108
	Session 1	Session 2	Session 3	Session 4	Session 5
10:30 to 12:00	PANEL: The Electronics Industry Supply Chain: Who Will do What?	SPECIAL SESSION: Nanometer Futures	System-Level Configurability: Bus Interface and Processor Design	Making Verification More Efficient	SoC and High-Level DFT
LUNCH 12:00 - 2:00					
	Session 6	Session 7	Session 8	Session 9	Session 10
2:00 to 4:00	PANEL: The Next HDL: If C++ is the Answer, What Was the Question?	SPECIAL SESSION: Design for Subwavelength Manufacturability: Impact on EDA	New Ideas in Logic Synthesis	Analog Design and Modeling	Scan-Based Testing
BREAK 4:00 - 4:30					
	Session 11	Session 12	Session 13	Session 14	Session 15
4:30 to 6:00	PANEL: Your Core - My Problem? Integration and Verification of IP	SPECIAL SESSION: Configurable Computing: Reconfiguring the Industry	Interconnect Design Optimization	Power Estimation Techniques	Functional Validation Based on Boolean Reasoning (BDD, SAT)

DAC Cocktail Party at the Las Vegas Convention Center 6:00pm - 7:00pm

Ph.D Forum at the Las Vegas Convention Center 7:00pm - 9:00pm • Room N250

Exhibit Hours 10:00am - 6:00pm / Demo Suite Hours 8:00am - 9:00pm

All Design Methods Sessions are shaded red. Embedded Systems Sessions are shaded grey.





Presenters will be available in rooms N104 and N118 for additional 20-minute question and answer sessions.



- Videoed Session



Wednesday, June 20, 2001

	Room N111 - N114	Room N109 - N110	Room N115 - N117	Room N119 - N120	Room N107 - N108
	Session 16	Session 17	Session 18	Session 19	Session 20
8:30 to 10:00	SPECIAL SESSION: Verification: Life Beyond Algorithms	 SPECIAL SESSION: Dissecting an Embedded System: Lessons from Bluetooth	Algorithmic and Compiler Transformations for High-Level Synthesis	Gate Delay Calculation	Memory, Bus and Current Testing
BREAK 10:00 - 10:30					
Plenary Panel					
10:30 to 12:00	 Embedded System Design: The Real Story Room N109-N114 This panel of senior executives, users and providers of embedded systems will examine this burgeoning and increasingly important space.				
LUNCH 12:00 - 2:00					
	Session 21	Session 22	Session 23	Session 24	Session 25
2:00 to 4:00	PANEL: (When) Will FPGAs Kill ASICs?	 SPECIAL SESSION: Inductance 101 and Beyond	Memory Optimization Techniques for DSP Processors	Technology Dependent Logic Synthesis	Collaborative and Distributed Design Frameworks
BREAK 4:00 - 4:30					
	Session 26	Session 27	Session 28	Session 29	Session 30
4:30 to 6:00	PANEL: When Will the Analog Design Flow Catch Up with the Digital Methodology?	 SPECIAL SESSION: Closing the Gap Between ASIC and Custom: Design Examples	Energy and Flexibility Driven Scheduling	Representation and Optimization for Digital Arithmetic Circuits	Techniques for IP Protection

38th DAC • VIVA Las Vegas Party • 7:30pm - 10:30pm • Hilton Center (Las Vegas Hilton)

 - Videod Session

Exhibit Hours 10:00am - 6:00pm / Demo Suite Hours 8:00am - 9:00pm

All Design Methods Sessions are shaded red. Embedded Systems Sessions are shaded grey.

Presenters will be available in rooms N104 and N118 for additional 20-minute question and answer sessions.



Thursday, June 21, 2001

	Room N111 - N114	Room N109 - N110	Room N115 - N117	Room N119 - N120	Room N107 - N108
	Session 31	Session 32	Session 33	Session 34	Session 35
8:30 to 10:00	SPECIAL SESSION: Visualization and Animation for VLSI Design	Application-Specific Customization for Systems-on-a-chip	Satisfiability Solvers and Techniques	Power and Interconnect Analysis	Domain Specific Design Methodologies
BREAK 10:00 - 10:30					
	Session 36	Session 37	Session 38	Session 39	Session 40
10:30 to 12:00	PANEL: Debate: Who Has Nanometer Design under Control?	Analysis and Implementation for Embedded Systems	Industrial Case Studies in Verification	Integrated High-Level Synthesis Based Solutions	Timing Verification and Simulation
Keynote - <i>FPGAs Enter the Mainstream</i> • 1:00 - 1:45 • Room: N109 - N114 <i>Willem P. Roelandts</i> - President and Chief Executive Officer, Xilinx, Inc.					
	Session 41	Session 42	Session 43	Session 44	Session 45
2:00 to 4:00	SPECIAL SESSION: On-Chip Communication Architectures	Compiler and Architecture Interactions	Timing with Crosstalk	Low Power Design: Systems to Interconnect	Floorplanning Representations and Placement Algorithms
BREAK 4:00 - 4:30					
	Session 46	Session 47	Session 48	Session 49	Session 50
4:30 to 6:00	PANEL: What Drives EDA Innovation?	Signal Integrity: Avoidance and Test Techniques	Novel Approaches to Microprocessor Design and Verification	Scheduling Techniques for Power Management	Novel Devices and Yield Optimization

Demo Suite Hours 8:00am - 5:00pm

- Videod Session

All Design Methods Sessions are shaded red. Embedded Systems Sessions are shaded grey.
Presenters will be available in rooms N104 and N118 for additional 20-minute question and answer sessions.



Topics and Related Sessions

If you are interested in the following topics please see the related sessions below.

Embedded Systems:

Sessions: 3, 12, 17, 23, 28, 32, 37, 41, 42, 49 and the Plenary Panel

System Design & Optimization:

Sessions: 3, 6, 12, 21, 25, 35, 41, Tutorial 6

Logic & High Level Synthesis & Optimization:

Sessions: 8, 18, 24, 27, 29, 33, 35, 36, 39, Tutorial 6

Logic & Functional Verification & Simulation:

Sessions: 4, 15, 16, 33, 38, 48

Timing Verification and Simulation:

Sessions: 19, 40, 43

Electrical Modelling & Simulation:

Sessions: 22, 34, 43, 47

Physical Design:

Sessions: 7, 13, 27, 36, 45

Validation & Test:

Sessions: 5, 10, 20, 48, Tutorial 1, Tutorial 4

Impacts of Advancing Technology:

Sessions: 2, 7, 36, Tutorial 4

Device & Interconnect Modelling:

Sessions: 22, 34, 36, 43, 47, 50, Tutorial 2

Analog and Mixed Signal Design:

Sessions: 9, 26, Tutorial 3

Low Power Design:

Sessions: 14, 34, 44, Tutorial 5

Design Re-use, IP and SoC Issues:

Sessions: 4, 11, 30, Tutorial 1

EDA Industry Issues:

Sessions: 1, 12, 46

EDA Methodologies:

Sessions: 25, 31, 35

Tutorials Friday, June 22, 2001

Tutorials will be held at the Las Vegas Convention Center.

8:00 AM - 1:00 PM Tutorial Registration Open 9:00 AM - 5:00 PM Tutorials
8:00 AM - Continental Breakfast 12:00 Noon - Lunch

Tutorial 1 - Design-for-Test Techniques for SoC Designs

ORGANIZER: Janusz Rajski - Mentor Graphics Corp., Willsonville, OR

Tutorial 2 - Interactive Tutorial on Fundamentals of Signal Integrity for High-Speed/High-Density Design

ORGANIZERS: Andreas Cangellaris - Univ. of Illinois, Urbana, IL
José Schutt-Ainé - Univ. of Illinois, Urbana, IL

Tutorial 3 - CAD Tools for Mixed-Signal and RF ICs

ORGANIZER: Georges Gielen - Katholieke Univ., Leuven, Belgium

Tutorial 4 - Design-Manufacturing Interface for UDSM Era: Designer and CAD Tool Developer Perspectives

ORGANIZER: Andrzej J. Strojwas - Carnegie Mellon Univ., Pittsburgh, PA

Tutorial 5 - Low Power Tools and Methodologies for the ASIC Industry

ORGANIZER: Rakesh Patel - Intel Corp., Santa Clara, CA

Tutorial 6 - Field Programmable Devices: Architecture and CAD Tools

ORGANIZER: Majid Sarrafzadeh - Univ. of California, Los Angeles, CA

Opening Session

Location: Hilton Pavilion (Las Vegas Hilton)

Opening Remarks: Jan Rabaey - General Chair, 38th DAC

Awards Presented By: Steven P. Levitan
ACWSIGDA Representative

Bing Sheu
IEEE/CAS Representative

Opening Keynote Address: Henry Samueli, Co-Chairman and Chief Technical Officer, Broadcom Corporation, Irvine, CA

Awards/Scholarships

P.O. Pistilli Scholarships (ACSEE)

Scholarships will be awarded to five high school students of under-represented minorities who will be pursuing a degree in Electrical Engineering or Computer Science.

Graduate Scholarships

Scholarships will be awarded to five graduate students to support research in Design Automation.

Student Design Contest Award

An award will be presented to the school sponsoring the best entry to the contest.

Best Paper Awards

Best Paper Awards will be given in the following areas:

1. Design Tools
2. Design Methodology (2)
3. Embedded Systems

Individual Awards

2001 IEEE Fellows
CAD Transactions Best Paper Award
VLSI Transactions Best Paper Award
CAS Industrial Pioneer Award
ACWSIGDA Distinguished Service Award
Outstanding Young Author Award
Marie R. Pistilli Women in EDA Achievement Award



Tuesday
June 19

8:30
to
10:00

No badge required



Tuesday
June 19

10:30
to
12:00

All speakers are
denoted in bold

S - denotes
short paper

β - denotes
best paper

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Session 1

rm: N111-N114

PANEL: THE ELECTRONICS INDUSTRY SUPPLY CHAIN: WHO WILL DO WHAT?

CHAIR: Rita Glover - EDA Today, Kingman, AZ

ORGANIZER: Rita Glover

The makeup and relationships within the design supply chain are changing rapidly. One-stop shopping, whereby a system house procures most of its design and fabrication services from a single source, is now being supplemented by a host of outsourcing suppliers. These players are developing online integration platforms for outsourced design engineering, business transactions, and data management. This evolution is being felt by the entire design automation industry, whether it be focused on the electronic design for chips, boards, or systems, or even the mechanical design of their packaging and housing. What are the implications of this trend on cost, demand for services, and time to market? How can all parties ride this wave of the future to achieve the best outcome in terms of collaborative design capabilities and quality of results?

PANELISTS:

Rich Decks - Seagate, Longmont, CO

Rick Cassidy - TSMC, San Jose, CA

Marc Halpern - Gartner Group, Inc., Stamford, CT

Henry Jurgens - Celestica, Toronto, ON, Canada

Richard Kubin - Nortel, Research Triangle Park, NC

Ted Vucurevich - Cadence Design Systems, Inc., San Jose, CA

Session 2

rm: N109-N110

SPECIAL SESSION: NANOMETER FUTURES

CHAIR: Andrew B. Kahng - Univ. of California at San Diego, La Jolla, CA

ORGANIZERS: Andrew B. Kahng, Kurt Keutzer

This session uncovers the cost and quality landmines that are inherent in the technology roadmap for nanometer silicon — and how the EDA and IC industries must plan to respond. The first talk identifies power as the key challenge to all aspects of quality and performance in nanometer technologies. Power-speed tradeoffs are analyzed at device, circuit and other levels. Leakage is the primary challenge to CMOS scaling, and area/delay/cost penalties may block scaling of today's leakage reduction techniques. Finally, power distribution raises issues regarding the viability of packaging and integration strategies. The second talk examines the consequences of production volumes, time-to-market and manufacturability: How will the billions of dollars to be spent on nanometer fablines affect the design-manufacturing interface? How must IC design respond to the future manufacturing cost structure? And how must IC technology roadmaps themselves adapt to nanometer economic realities?

2.1 Future Performance Challenges In Nanometer Design

Dennis Sylvester, Himanshu Kaul - Univ. of Michigan, Ann Arbor, MI

2.2 IC Design In the High-Cost Nanometer Technologies Era

Wojciech Maly - Carnegie Mellon Univ., Pittsburgh, PA

Design Methods Sessions are shaded red. Embedded Systems Sessions are shaded grey.

Session 3

rm:N115-N117

SYSTEM-LEVEL CONFIGURABILITY: BUS INTERFACE AND PROCESSOR DESIGN

CHAIR: Pieter van der Wolf - Philips Research Lab., Eindhoven, The Netherlands

ORGANIZERS: Kees Vissers, Kurt Keutzer

This session presents technologies that enable and exploit system-level configurability, focusing on system bus networks, interfaces, and configurable processors. The first paper presents a novel high-performance protocol for system buses. The second paper addresses the design of interfaces that enable multi-clock and hybrid synchronous / asynchronous systems. The third paper presents tools for the customization of on-chip bus topologies. The last paper presents an approach for estimating design metrics (area, speed, and power), for a configurable processor IP core.

3.1 LOTTERYBUS: A New High-Performance Communication Architecture for System-on-Chip Designs

Kanishka Lahiri - Univ. of California at San Diego, La Jolla, CA

Anand Raghunathan, Ganesh Lakshminarayana - NEC Corp., Princeton, NJ

3.2 Robust Interfaces for Mixed-Timing Systems with Application to Latency-Insensitive Protocols

Tiberiu Chelcea, Steven M. Nowick - Columbia Univ., New York, NY

3.3S Latency-Driven Design of Multi-Purpose Systems-on-Chip

Seapahn Meguerdichian, Milenko Drinic, Darko R. Kirovski - Univ. of California, Los Angeles, CA

3.4S Estimation of Speed, Area, and Power of Parameterizable, Soft IP

Jagesh V. Sanghavi, Albert Wang - Tensilica, Inc., Santa Clara, CA

Session 4

rm: N119-N120

MAKING VERIFICATION MORE EFFICIENT

CHAIR: Masahiro Fujita - Univ. of Tokyo, Tokyo, Japan

ORGANIZERS: Limor Fix, Timothy Kam

With the current limitation in capacity and runtime, verification can be a bottleneck in a design flow. The research presented in this session targets improving the efficiency of verification. The first paper employs multiple engines including BDD-ATPG and 3-value simulation. A novel microprocessor architecture is verified with the proposed design-for-verifiability technique in the second paper. The third paper proposed how various verilog RTL constructs can be symbolically simulated.

4.1 Formal Property Verification by Abstraction Refinement with Formal Simulation and Hybrid Engines

Dong Wang - Carnegie Mellon Univ., Pittsburgh, PA

Pei-Hsin Ho, Jiang Long, James Kukula - Synopsys, Inc., Beaverton, OR

Yunshan Zhu, Tony Ma - Synopsys, Inc., Mountain View, CA,

Robert Damiano - Synopsys, Inc., Beaverton, OR

4.2 Scalable Hybrid Verification of Complex Microprocessors

Maher N. Mneimneh, Fadi A. Aloul, Saugata Chatterjee, Chris Weaver, Kareem A. Sakallah, Todd Austin - Univ. of Michigan, Ann Arbor, MI

4.3 Symbolic RTL Simulation

Alfred Koelbl - Technical Univ. of Munich, Munich, Germany

James Kukula, Robert Damiano - Synopsys, Inc., Beaverton, OR

Session 5

rm: N107-N108

SoC AND HIGH-LEVEL DFT

CHAIR: Yervant Zorian - LogicVision, Inc., San Jose, CA

ORGANIZERS: Anand Raghunathan, Irith Pomeranz

This session starts with a paper addressing issues related to the VSIA/IEEE P1500 standard for SoC testing. The second paper deals with instruction-level DFT to support self-testing of SoC with processor cores. The third paper proposes a BIST-based DFT methodology using RTL testability analysis.

5.1 A Unified DFT Architecture for Use with IEEE 1149.1 and VSIA/IEEE P1500 Compliant to Test Access Controllers

Bulent I. Dervisoglu - Cadence Design Systems, Inc., San Jose, CA

5.2 Instruction-Level DFT for Testing Processor and IP Cores In System-on-a-Chip

WeiCheng Lai, Tim Cheng - Univ. of California, Santa Barbara, CA

5.3 Test Strategies for BIST at the Algorithmic and Register-Transfer Levels

Kelly Ockunzzi - IBM Corp., Burlington, VT

Chris Papachristou - Case Western Reserve Univ., Cleveland, OH



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Session 6

rm: N111-N114

PANEL: THE NEXT HDL: IF C++ IS THE ANSWER, WHAT WAS THE QUESTION?

CHAIR: Rajesh K. Gupta - Univ. of California, Irvine, CA

ORGANIZER: Shishpal Rawat

The focus of this panel is on issues surrounding use of C++ in modeling and the integration of silicon IP and system-on-chip designs. In the last two years there have been several announcements promoting C++ based solutions and of multiple consortia (SystemC, Cynapps, Accellera, SpecC) that represent increasing commercial interest both from tool vendors as well as perhaps expression of genuine needs from design houses. There are, however, serious questions about what value proposition a C++ based design methodology brings to the IC or system designer? What has changed in the modeling technology (and/or available tools) that gives a new capability? Is synthesis the right target? or Validation? Tester modeling or testbench generation? This panel brings together advocates and opponents from the design houses and tool developers to highlight the modeling advances.

PANELISTS:

Gérard Berry - Esterel Technologies,
Villeneuve-Loubet, France

Ramesh Chandra - ST Microelectronics, San Diego, CA

Daniel Gajski - Univ. of California, Irvine, CA

Kris Konigsfeld - Intel Corp., Hillsboro, OR

Patrick Schaumont - IMEC, Leuven, Belgium

Ingrid Verbauwhede - Univ. of California,
Los Angeles, CA

Session 7

rm: N109-N110

SPECIAL SESSION: DESIGN FOR SUBWAVELENGTH MANUFACTURABILITY: IMPACT ON EDA

CHAIR: Robert C. Pack - Cadence Design Systems, Inc., San Jose, CA

ORGANIZERS: Lars Liebman, Andrew B. Kahng

Minimum feature sizes that are much smaller than stepper wavelengths stress the design flow and the design-manufacturing interface as never before. Already, optical proximity correction (OPC), phase-shifting masks (PSM), and pattern density control break traditional flows and reuse paradigms, and dramatically increase design cost. How must EDA change to meet this challenge? The first two papers present experiences and cost-benefit analysis of IDMs who have developed and deployed complete layout and verification methodologies at 150nm and below. The next three papers describe vendor experiences with OPC- and PSM-enabling tools and methodologies. The session will conclude with open Q&A for all presenters.

7.1 Reticle Enhancement Technology: Implications and Challenges for Physical Design

Warren Grobman, Ruoping Wang, Ruiqi Tian, Ertugrul Demircan, Matt Thompson, Chi-Min Yuan - *Mororola DigitalDNA Labs., Austin, TX*

7.2 Enabling Alternating Phase Shifted Mask Designs for a Full Logic Gate Level: Design Rules and Design Rule Checking

Lars Liebmann - *IBM Microelectronics, Hopewell Junction, NY*

Jennifer Lund, Fook-Luen Heng - *IBM Corp., Yorktown Heights, NY*

Ioana Graur - *IBM Microelectronics, Hopewell Junction, NY*

7.3S Layout Design Methodologies for Sub-Wavelength Manufacturing

Michael L. Rieger, Jeffrey P. Mayhew - *Avant! Corp., Beaverton, OR*

Sridhar Panchapakesan - *Avant! Corp., Fremont, CA*

7.4S Production Adoption of OPC and the Impact on Design and Layout

F. M. Schellenberg, N. Cobb, Y. Granik - *Mentor Graphics Corp., San Jose, CA*

L. Capodiecici, R. Socha - *ASML MaskTools, Santa Clara, CA*

7.5S A Practical Application of Full-Feature Alternating Phase-Shifting Technology for a Phase-Aware Standard-Cell Design Flow

Michel Cote, Philippe Hurat, Vinod Malhotra, **Michael Sanie** - *Numerical Technologies, Inc., San Jose, CA*

7.6S Open Session for Q & A

Session 8

rm: N115-N117

NEW IDEAS IN LOGIC SYNTHESIS

CHAIR: Yusuke Matsunaga - Fujitsu Labs. Ltd.,
Kawasaki, Japan

ORGANIZERS: Timothy Kam, Masahiro Fujita

The first paper introduces a new logic synthesis technique considering reliability issues of LSI. The remaining three papers discuss new algorithms in combinational logic synthesis targeting decomposition of incompletely specified logic functions, factoring of read-once functions, and logic synthesis with exclusive-or gates.

8.1 Layout-Driven Hot-Carrier Degradation Minimization Using Logic Restructuring Techniques

Chih-Wei (Jim) Chang, Kai Wang, Malgorzata Marek-Sadowska - Univ. of California, Santa Barbara, CA

8.2 An Algorithm for BI-Decomposition of Logic Functions

Alan Mishchenko - Portland State Univ., Portland, OR
Bernd Steinbach - Freiberg Univ. of Mining and Technology, Freiberg, Germany
Marek Perkowski - Portland State Univ., Portland, OR

8.3 Factoring and Recognition of Read-Once Functions Using Cographs and Normality

Martin C. Golumbic, Aviad Mintz - Bar Ilan Univ., Ramat Gan, Israel
Udi Rotics - Netanya Academic College, Netanya, Israel

8.4 Logic Minimization Using Exclusive OR Gates

Valentina Ciriani - Univ. di Pisa, Pisa, Italy

Session 9

rm: N119-N120

ANALOG DESIGN AND MODELING

CHAIR: Alper Demir - CeLight, Inc., Springfield, NJ
ORGANIZERS: Joel Phillips, Noel Menezes

The first paper in this session presents a working design of a high-speed clock and data recovery circuit for optical networking applications. The remaining papers describe progress in a collection of analog CAD topics — stochastic analysis of data converters, partitioning of mixed-signal designs, and efficient analog symbolic analysis.

9.1 Student Design Contest: Design of Half-Rate Clock and Data Recovery Circuits for Optical Communication Systems

Jafar Savoj, Behzad Razavi - Univ. of California, Los Angeles, CA

9.2 A Novel Method for Stochastic Nonlinearity Analysis of a CMOS Pipeline ADC

David Goren, Israel A. Wagner, Eliyahu Shamsaev - IBM Corp., Haifa, Israel

9.3 Behavioral Partitioning in the Synthesis of Mixed Analog-Digital Systems

Sree Ganesan, Ranga Vemuri - Univ. of Cincinnati, Cincinnati, OH

9.4 Efficient DDD-Based Symbolic Analysis of Large Analog Circuits

Wim Verhaegen, Georges G. Gielen - Katholieke Univ., Leuven, Belgium

Session 10

rm: N107-N108

SCAN-BASED TESTING

CHAIR: T. M. Mak - Intel Corp., Santa Clara, CA
ORGANIZERS: Anand Raghunathan, Tim Cheng

This session deals with issues related to fault coverage improvement, test volume and test time reduction for scan-based designs. The first paper uses limited scan operations to improve random pattern fault coverage. The next three papers describe different compaction techniques. The last paper deals with a compression technique for test data and power reduction.

10.1 Random Limited-Scan to Improve Random Pattern Testing of Scan Circuits

Irith Pomeranz - Purdue Univ., West Lafayette, IN

10.2 Test Volume and Application Time Reduction Through Scan Chain Concealment

Ismet Bayraktaroglu, Alex Orailoglu - Univ. of California at San Diego, La Jolla, CA

10.3 An Approach to Test Compaction for Scan Circuits that Enhances At-Speed Testing

Irith Pomeranz - Purdue Univ., West Lafayette, IN
Sudhakar M. Reddy - Univ. of Iowa, Iowa City, IA

10.4S Generating Efficient Tests for Continuous Scan

Sying Jyan Wang, Sheng Nan Chiou - National Chung-Hsing Univ., Taichung, Taiwan, ROC

10.5S Combining Low-Power Scan Testing and Test Data Compression for System-on-a-Chip

Anshuman Chandra, Krishnendu Chakrabarty - Duke Univ., Durham, NC



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Session 11

rm: N111-N114

PANEL: YOUR CORE - MY PROBLEM? INTEGRATION AND VERIFICATION OF IP

CHAIR: Gabe Moretti - EDN Magazine, Niwor, CO

ORGANIZERS: Nanette Collins, Gabe Moretti, Dave Kelf

As the popularity of reusing existing designs — or Intellectual Property (IP) — continues to grow, design challenges escalate. The most time-consuming and critical part of IP design and reuse is verifying that it will work as designed and as the user intends. Designers are pushing the limits of IP for new, distinctive and innovative applications. With this innovation comes problems that will need creative solutions. Product verification, for example, will become more and more important in ensuring the correctness of designs. Over the years, various solutions have come on the market, all seemingly useful, but none reducing the time or manpower it takes to verify a design. With designs becoming increasingly more complex with each new project and verification consuming up to 70% of a design cycle, something must be done to alleviate the bottleneck. The panel will look at various alternatives for IP verification today, including universal simulation, hardware acceleration, formal verification, and semi-formal verification. Panelists, who are experienced designers and representatives of organizations offering EDA tools to beat the verification bottleneck will work toward identifying the methodology best suited for IP design.

PANELISTS:

Tom Anderson - O-In Design Automation, San Jose, CA

Janick Bergeron - Qualis Design Corp., Lake Oswego, OR

Ashish Dixit - Tensilica, Inc., Santa Clara, CA

Peter Flake - Co-Design Automation, Inc., Los Altos, CA

Tim Hopes - ARM, Maidenhead, UK

Ramesh Narayanaswamy - Tharas Systems Inc., Santa Clara, CA

Design Methods Sessions are shaded red. Embedded Systems Sessions are shaded grey.

Session 12

rm: N109-N110

SPECIAL SESSION: CONFIGURABLE COMPUTING: RECONFIGURING THE INDUSTRY

CHAIR: Diederik Verkest - IMEC, Leuven, Belgium

ORGANIZERS: Diederik Verkest, Kurt Keutzer

Cost effective systems use specialization to optimize factors such as power consumption, processing throughput, flexibility, or combinations thereof. Reconfiguration has been proposed as a mechanism to create run-time specialization. This session will address the concept of reconfiguration at different hierarchical levels, the architectural aspects of reconfigurable computing, the link between application domain and reconfigurability needs, and the design techniques supporting reconfiguration.

12.1 A Quick Safari through the Reconfiguration Jungle

Patrick Schaumont - IMEC, Leuven, Belgium

Ingrid Verbauwhede - Univ. of California, Los Angeles, CA

Kurt Keutzer - Univ. of California, Berkeley, CA

Majid Sarrafzadeh - Univ. of California, Los Angeles, CA

12.2 ReConfigurable Computing In Wireless

Bill Salefski, Levent Caglar - Chameleon Systems, Inc., San Jose, CA

12.3 Hardware/Software Instruction Set Configurability for System-on-Chip Processors

Albert Wang, Chris Rowen, Dror Mayden, Earl Killian - Tensilica, Inc., Santa Clara, CA

Session 13

rm: N115-N117

INTERCONNECT DESIGN OPTIMIZATION

CHAIR: Martin D. F. Wong - Univ. of Texas, Austin, TX

ORGANIZERS: Jason Cong, Louis Scheffer,
Patrick Groeneveld

This session presents various approaches to the design and planning of interconnect. The first two papers deal with global wiring optimization, while the third paper addresses the crosstalk minimization problem. The final paper presents new results on optimal switchbox interconnect design for FPGAs.

13.1 A Practical Methodology for Early Buffer and Wire Resource Allocation

Charles J. Alpert, Jiang Hu - IBM Austin Research Lab., Austin, TX

Sachin S. Sapatnekar - Univ. of Minnesota, Minneapolis, MN

Paul G. Villarrubia - IBM Corp., Austin, TX

13.2S Creating and Exploiting Flexibility in Steiner Trees

Elaheh Bozorgzadeh, Ryan Kastner, Majid Sarrafzadeh - Univ. of California, Los Angeles, CA

13.3S Simultaneous Shield Insertion and Net Ordering for Coupled RLC Nets Under Explicit Noise Constraint

Kevin Lepak, Irwan Luwandi, Lei He - Univ. of Wisconsin, Madison, WI

13.4 On Optimum Switch Box Designs for 2-D FPGAs

Hongbing Fan - Univ. of Victoria, Victoria, BC, Canada

Jiping Liu - Univ. of Lethbridge, Lethbridge, AB, Canada

Yu Liang Wu, Chak Chung Cheung - Chinese Univ. of Hong Kong, Hong Kong, China

Session 14

rm: N119-N120

POWER ESTIMATION TECHNIQUES

CHAIR: Massoud Pedram - Univ. of Southern California, Los Angeles, CA

ORGANIZERS: Donatella Sciuto, Kazutoshi Wakabayashi

The first two papers of the session introduce two models for evaluating power consumption in combinational circuits. The first paper estimates switching activities by capturing complex dependencies among signals using probabilistic techniques. The second paper deals with power sensitivity estimation of a presynthesized circuit. Finally, the third paper considers a different level of abstraction by presenting a software energy estimation methodology considering current consumption.

14.1 Dependency Preserving Probabilistic Modeling of Switching Activity Using Bayesian Networks

Sanjukta Bhanja, Nagarajan Ranganathan - Univ. of South Florida, Tampa, FL

14.2 A Static Estimation Technique of Power Sensitivity in Logic Circuit

Taewhan Kim - KAIST, Taejon, Korea

Kiseok Chung - Intel Corp., Santa Clara, CA

C. L. Liu - National Tsing-Hua Univ., Hsinchu, Taiwan, ROC

14.3 JouleTrack - A Web Based Tool for Software Energy Profiling

Amit Sinha, Anantha P. Chandrakasan - Massachusetts Institute of Tech., Cambridge, MA

Session 15

rm: N107-N108

FUNCTIONAL VALIDATION BASED ON BOOLEAN REASONING (BDD, SAT)

CHAIR: Limor Fix - Intel Semiconductors Ltd., Haifa, Israel

ORGANIZERS: Masahiro Fujita, Timothy Kam

Many tasks in EDA, such as equivalence checking, property checking, logic synthesis, and false path analysis are based on Boolean Function analysis using BDD Technology and SAT solvers. In this session, state of the art SAT solvers will be presented. The benefit of circuit information for optimizing SAT and BDD will be discussed, and the use of symbolic simulation for partial equivalence checking will be demonstrated.

15.1 Effective Use of Boolean Satisfiability Procedures in the Formal Verification of Superscaler and ULIW Microprocessors

Miroslav N. Velev, Randal E. Bryant - Carnegie Mellon Univ., Pittsburgh, PA

15.2 Circuit-Based Boolean Reasoning

Andreas Kuehlmann - Cadence Berkeley Labs., Berkeley, CA

Malay K. Ganai - Univ. of Texas, Austin, TX

Viresh Paruthi - IBM Corp., Austin, TX

15.3 Checking Equivalence for Partial Implementations

Christoph Scholl, Bernd Becker - Univ. of Freiburg, Freiburg, Germany



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Session 16

rm: N111-N114

SPECIAL SESSION: VERIFICATION: LIFE BEYOND ALGORITHMS

CHAIR: Carl Pixley - Motorola, Inc., Austin, TX

ORGANIZER: Carl Pixley

The speakers will address the nuts and bolts of commercial verification projects, describing the various techniques used, the resources required and the effectiveness of different techniques. The general education of engineers in verification is addressed in the final paper.

16.1 Validating the Intel® Pentium® 4 Microprocessor

Bob Bentley - Intel Corp., Hillsboro, OR

16.2 Nuts and Bolts of Core and SoC Verification

Ken Albin - Motorola, Inc., Austin, TX

16.3 Teaching Future Verification Engineers - The Forgotten Side of Logic Development

Bruce Wile - IBM Corp., Poughkeepsie, NY

Fusun Ozguner, Duane Marhefka - Ohio State Univ.,
Columbus, OH

Lyle Hanrahan - IBM Corp., Rochester, MN

Jennifer Strofer - IBM Corp., Austin, TX

Joanne De Groat - Ohio State Univ., Columbus OH

Session 17

rm: N109-N110

SPECIAL SESSION: DISSECTING AN EMBEDDED SYSTEM: LESSONS FROM BLUETOOTH

CHAIR: Jan Rabaey - Univ. of California, Berkeley, CA

ORGANIZERS: Jan Rabaey, Anantha Chandrakasan

Ad-hoc wireless networking based on the Bluetooth Standard is one of the hottest topics in wireless today. The design process and methodology of a leading-edge bluetooth chip set will be presented and analyzed. The tough specifications of Bluetooth and its complexity necessitate advanced design verification and test techniques, which are the focus of this session.

17.1 SoC Integration of Reusable Baseband Bluetooth IP

Barry Clark, Torbjörn Graham - Ericsson Tech. Licensing AB,
Lund, Sweden

17.2 One-Chip Bluetooth ASIC Challenges

Paul van Zeijl - Ericsson EuroLab., Emmen, The Netherlands

Design Methods Sessions are shaded red. Embedded Systems Sessions are shaded grey.

Session 18

rm: N115-N117

ALGORITHMIC AND COMPILER TRANSFORMATIONS FOR HIGH-LEVEL SYNTHESIS

CHAIR: Hiroto Yasuura - Kyushu Univ., Fukuoka, Japan
ORGANIZERS: Kazutoshi Wakabayashi, Rajesh K. Gupta

The quality of synthesized circuits is a major concern for many high-level synthesis solutions. This session addresses techniques that work with HLS algorithms to improve synthesis results. The first paper presents global transformations for controller synthesis. The second and third papers examine techniques using parallelizing compilers that directly effect HLS solutions. The last paper examines arithmetic-level optimizations.

18.1 Transformations for the Synthesis and Optimization of Asynchronous Distributed Control

Michael Theobald, Steven M. Nowick - Columbia Univ., New York, NY

18.2S Speculation Techniques for High Level Synthesis of Control Intensive Designs

Sumit Gupta, Nick O. Savoie, Sunwoo Kim, Nikil Dutt, Rajesh K. Gupta, Alexandru Nicolau - Univ. of California, Irvine, CA

18.3S Parallelizing DSP Nested Loops on Reconfigurable Architectures Using Data Context Switching

Kiran K. Bondalapati - Univ. of Southern California, Los Angeles, CA

18.4 Using Symbolic Algebra in Algorithmic Level DSP Synthesis

Armita Peymandoust, Giovanni De Micheli - Stanford Univ., Stanford, CA

Session 19

rm: N119-N120

GATE DELAY CALCULATION

CHAIR: Satya Pullela - eSilicon Corp., Allentown, PA
ORGANIZERS: Jaijeet Roychowdhury, Joel Phillips

This session has three papers on gate delay calculation. The first paper uses BDDs to quickly explore the space of switching transitions, enabling accurate delay simulation of only a few sets of transitions. The second paper derives an empirical delay model for a NAND gate, accounting for simultaneous switching and relative input positions, and outlines applications to timing analysis and incremental timing refinement. The third paper analyzes the effect of power supply variations on gate delay with three techniques, obtaining increasingly tight upper bounds on worst-case delay.

19.1 Computing Logic-Stage Delays Using Circuit Simulation and Symbolic Elmore Analysis

Clayton B. McDonald, Randal E. Bryant - Carnegie Mellon Univ., Pittsburgh, PA

19.2 A New Gate Delay Model for Simultaneous Switching and Its Applications

Liang-Chi Chen, Sandeep K. Gupta, Melvin A. Breuer - Univ. of Southern California, Los Angeles, CA

19.3 Static Timing Analysis Including Power Supply Noise Effect on Propagation Delay in VLSI Circuit

Geng Bai, Sudhakar Bobba, Ibrahim N. Hajj - Univ. of Illinois, Urbana, IL

Session 20

rm: N107-N108

MEMORY, BUS AND CURRENT TESTING

CHAIR: Magdy S. Abadir - Motorola, Inc., Austin, TX
ORGANIZERS: Irith Pomeranz, Tim Cheng

This session includes a paper on test generation and test scheduling for multiport memories, papers on bus testing and a paper on fault characterization and DFT for CMOS/BiCMOS circuits. In the area of bus testing, the papers cover IDDT testing and the use of embedded processor cores for interconnect crosstalk defects.

20.1 Simulation-Based Test Algorithm Generation and Port Scheduling for Multi-Port Memories

ChiFeng Wu, ChihTsun Huang, KuoLiang Cheng, ChihWea Wang, ChengWen Wu - National Tsing-Hua Univ., Hsinchu, Taiwan, ROC

20.2 Improving Bus Test Via IDDT and Boundary Scan

Shi-yu Yang - Intel Corp., Hillsboro, OR
Chris Papachristou, Massood Tabib-Azar - Case Western Reserve Univ., Cleveland, OH

20.3S Fault Characterizations and Design-for-Testability Technique for Detecting IDDQ Faults in CMOS/BiCMOS Circuits

Kaamran Raahemifar - Ryerson Polytechnic Univ., Toronto, ON, Canada
Majid Ahmadi - Univ. of Windsor, Windsor, ON, Canada

20.4S Testing for Interconnect Crosstalk Defects Using On-Chip Embedded Processor Cores

Li Chen, Xiaoliang Ba, Sujit Dey - Univ. of California at San Diego, La Jolla, CA



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PLENARY PANEL **EMBEDDED SYSTEM DESIGN: THE REAL STORY**

rm: N109-N114

CHAIR: *Alberto L. Sangiovanni-Vincentelli - Univ. of California, Berkeley, CA*

ORGANIZERS: *Randy Harr, Wayne Wolf*

PRESENTERS: *Augusto de Oliveira - Philips Semiconductor, Sunnyvale, CA* *Jim Ready - MontaVista Software, Sunnyvale, CA*
Roger Fordham - Motorola, Inc., Schaumburg, IL *Fabio Romeo - Magneti Marelli, Torino, Italy*
Mark Pinto - Agere Systems, Allentown, PA

Description: Every object in common use tomorrow will have an electronic component that, we hope, will enhance its functionality, its reliability, and its safety. An automobile, a cellular phone, and a home are already complex electronic systems and will become more so. The billion-transistor ASIC complexity that has been touted as the challenge for methodologies and EDA does pale in comparison when mixed with the complexity of embedded systems. Embedded systems are heterogeneous, they are connected to networks, they have multiple and conflicting requirements of cost, performance, functionality, safety, and time to market. Being late to the market for just a few weeks may mean the loss of hundreds of millions of dollars, but being wrong can be tragic.

The entire electronics industry has been restructuring to face the challenges of embedded system design and production. Less frequently are such designs carried out by a single company. With outsourcing of both design and manufacturing, each contributor focuses on its core competency. Hence, the interfaces among system, IP providers, semiconductor-design companies and manufacturing companies are becoming the pivotal points to understand for the future of the electronics industry.

Several ideas are emerging to cope with complexity, time-to-market and cost of designing these pervasive embedded systems and their integrated circuits. Platform-based design, for example, has become an important design style and, if well implemented, is essential to providing reuse of software and hardware components over two or more possibly disparate design projects as well as a clean interface among system, IP and semiconductor companies. Since the flexibility

of a platform is strictly connected to the re-usability of the programmable and reconfigurable parts, reusable software design, crystal ball architecture selection and complex configuration methods are becoming essential ingredients of embedded system design. Embedded software traditionally has had different characteristics when compared with traditional large software systems encountered in data base applications and computer systems. Real-time reactions to the environment and complex signal processing are typical for most applications of embedded systems such as cellular phones and engine controllers. The real-time requirements pose the most interesting challenges to embedded software design. Indeed the choice of implementation of a function as a hardware module or a software program is the result of trade-offs involving time-to-market, power consumption, performance and cost.

The participants in this panel are among the key enablers of the new embedded system design frontier and will address:

- The issues associated with critical markets now dependent upon embedded systems: automotive, cellular and consumer electronics.
- The embedded software design challenges and trends in view of the latest research and industrial offerings.
- Platform-based design as an effective way of reducing risk and complexity of the overall design process as well as sustaining the electronics supply chain.

Alberto L. Sangiovanni-Vincentelli

Alberto Sangiovanni-Vincentelli is Professor of Electrical Engineering and Computer Sciences at the University of California at Berkeley, where he serves on the Advisory Board of the Lester Center of the Haas School of Business and of the Center for Western European Studies, and is a member of the Berkeley Roundtable of the International Economy. He is a co-founder of Cadence and Synopsys and serves on the boards of a variety of new and established companies. He is author of over 500 papers and eleven books, and is a Fellow of the IEEE and a Member of the National Academy of Engineering.

Augusto de Oliveira

Augusto de Oliveira is currently Chief Architect for the Consumer Systems Business Unit of Philips Semiconductors, responsible for digital video platform software and hardware architectures. He previously held technical and management positions with Philips in Brazil, The Netherlands and the United States, including manager of the Philips MIPS Technology Center and CTO and Systems Development Manager for the Handheld Computing Group. He has also worked at Philips Research and Philips Business Communications.

Roger Fordham

Roger Fordham is Director of Performance Excellence for the Motorola Global Software Group and has the responsibility for advanced software development environments for Motorola's communications businesses and for establishing the software business and engineering culture and development environment in software development centers worldwide. He has worked for Motorola on four continents, establishing and directing the company's software development business and lecturing on software development, engineering, and culture. He is a Fellow of the Institute of Engineers Australia and has been active in national and international software engineering standards activities and educational endeavors.

Mark Pinto

Mark Pinto is Chief Technical Officer of Agere Systems, formerly the Microelectronics Group of Lucent Technologies and is responsible for technology strategy and research activities in electronic and optoelectronic devices, integrated circuit design, and software and systems. He is also Vice President of Platform Technologies, leading the company's efforts to deliver system-on-a-chip hardware cores, communications software elements, development software, methodologies, tools, models and analysis. He has authored more than 150 journal and professional conference papers and has eight patents in semiconductor devices. He is a Fellow of the IEEE.

Jim Ready

Jim Ready is founder, President and CEO of MontaVista Software, which provides the Linux operating system to the embedded systems market through its Hard Hat Linux flagship product, and offers embedded systems expertise to the open source Linux community. He was co-founder and president of Ready Systems, which developed the first commercially viable real time operating system product, and CTO of its successor, Microtec Research, which was later acquired by Mentor Graphics. He has over 25 years of technical and entrepreneurial experience and is a recognized authority in the embedded systems and real-time software industry.

Fabio Romeo

Fabio Romeo is Executive Vice President of Magneti-Marelli, and President and General Manager of the Electronic System Division, which manufactures electronic products for the corporation and develops dashboard and infotelematics products. He previously held positions at Politecnico di Milano and at Honeywell Information Systems, Italy. He has been active in the development of embedded systems for automotive applications, particularly in the definition of design methodologies necessary to guarantee reduced time-to-market, hardware-software independence, and increased quality levels in software and hardware.



Wednesday
June 20

2:00
to
4:00

All speakers are
denoted in bold

S - denotes
short paper

β - denotes
best paper

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Session 21

rm: N111-N114

PANEL: (WHEN) WILL FPGAS KILL ASICS?

CHAIR: Rob A. Rutenbar - Carnegie Mellon Univ., Pittsburgh, PA

ORGANIZER: Rob A. Rutenbar

There was a time in the dim historical past when foundries actually made ASICs with only 5000 to 50,000 logic gates. But FPGAs and CPLDs conquered those markets and pushed ASIC silicon toward opportunities with more logic, volume, and speed. Today's largest FPGAs approach the few-million-gate size of a typical ASIC design, and continue to sprout embedded cores, such as CPUs, memories, and interfaces. And given the risks of non-working nanometer silicon, FPGA costs and time-to-market are looking awfully attractive. So, will FPGAs kill ASICs? ASIC technologists certainly think not. ASICs are themselves sprouting patches of programmable FPGA fabric, and pushing new realms of size and especially speed. New tools claim to have tamed the convergence problems of older ASIC flows. Is the future to be found in a market full of FPGAs with ASIC-like cores? ASICs with FPGA cores? Other exotic hybrids? Our panelists will share their disagreements on these prognostications.

PANELISTS:

Max Baron - Microprocessor Report, Sunnyvale, CA

Thomas Daniel - LSI Logic Corp., Milpitas, CA

Rajeev Jayaraman - Xilinx, Inc., San Jose, CA

Zvi Or-Bach - eASIC, San Jose, CA

Jonathan Rose - Altera Corp., Univ. of Toronto,
Toronto, ON, Canada

Carl Sechen - Univ. of Washington, Seattle, WA

Session 22

rm: N109-N110

SPECIAL SESSION: INDUCTANCE 101 AND BEYOND

CHAIR: Phillip Restle - IBM Corp., TJ Watson Research Ctr.,
Yorktown Heights, NY

ORGANIZERS: Joel Phillips, Noel Menezes

Inductance issues create new signal integrity and delay problems for multigigahertz designs. A basic introduction to the cause and effect of inductance in VLSI circuits is presented along with an industry approach to handling inductance effects in designs. Two final papers present strategies for on-chip inductance modeling.

22.1 Inductance 101: Modeling and Extraction

Michael W. Beattie, Lawrence T. Pileggi - Carnegie Mellon Univ., Pittsburgh, PA

22.2 Inductance 101: Analysis and Design Issues

Kaushik Gala, David Blaauw, Junfeng Wang,
Vladimir Zolotov, Min Zhao - Motorola, Inc., Austin, TX

22.3 Modelling Magnetic Coupling for On-Chip Interconnect

Michael W. Beattie, Lawrence T. Pileggi - Carnegie Mellon Univ., Pittsburgh, PA

22.4 Min/Max On-Chip Inductance Models and Delay Metrics

Yi Chang Lu - Stanford Univ., Stanford, CA
Mustafa Celik, Tak Young - Monterey Design Inc., Sunnyvale, CA
Lawrence T. Pileggi - Carnegie Mellon Univ., Pittsburgh, PA

Design Methods Sessions are shaded red. Embedded Systems Sessions are shaded grey.

Session 23

rm: N115-N117

MEMORY OPTIMIZATION TECHNIQUES FOR DSP PROCESSORS

CHAIR: Daniel Connors - Univ. of Colorado, Boulder, CO
ORGANIZERS: Dirk Grunwald, Marco Di Natale

These papers describe mechanisms to reduce memory size or bandwidth for embedded applications. The first paper presents compiler algorithms to exploit multiword memory transfer. The second shows how to reduce address register changes for common DSPs and the last two papers show how to automatically reduce the total memory needed by applications.

23.1 Utilizing Memory Bandwidth in DSP Embedded Processors

Catherine H. Geborys - Univ. of Waterloo,
Waterloo, ON, Canada

23.2 Address Code Generation for Digital Signal Processors

Sathishkumar Udayanarayanan, Chaitali
Chakrabarti - Arizona State Univ., Tempe, AZ

23.3 Reducing Memory Requirements of Nested Loops for Embedded Systems

J. Ramanujam, Jinpyo Hong - Louisiana State
Univ., Baton Rouge, LA
Mahmut Kandemir - Penn State Univ.,
University Park, PA
Ashish Narayan - Louisiana State Univ.,
Baton Rouge, LA

23.4 Detection of Partially Simultaneously Alive Signals in Storage Requirement Estimation for Data Intensive Applications

Per G. Kjeldsberg - Norwegian Univ. of Science
and Tech., Trondheim, Norway
Francky Catthoor - IMEC, Leuven, Belgium
Einar J. Aas - Norwegian Univ. of Science and
Tech., Trondheim, Norway

Session 24

rm: N119-N120

TECHNOLOGY DEPENDENT LOGIC SYNTHESIS

CHAIR: Peichen Pan - APLUS Design Technologies, Inc.,
Los Angeles, CA

ORGANIZERS: Jason Cong, Malgorzata Marek-Sadowska

This session introduces us to power problems in technology dependent synthesis. The first paper describes an idea to speed up structural mapping. The second paper introduces some of the issues of incorporating domino circuitry in technology mapping. Latch and latency control and optimization during wave steering is the topic of the third paper. Paper four describes the problem of two level clustering in the context of FPGA synthesis.

24.1 A New Structural Pattern Matching Algorithm for Technology Mapping

Min Zhao - Motorola, Inc., Austin, TX
Sachin S. Sapatnekar - Univ. of Minnesota,
Minneapolis, MN

24.2 Technology Mapping for SOI Domino Logic Incorporating Solutions for the Parasitic Bipolar Effect

Srirang K. Karandikar, Sachin S. Sapatnekar -
Univ. of Minnesota, Minneapolis, MN

24.3 Latency and Latch Count Minimization in Wave Steered Circuits

Amit Singh, Arindam Mukherjee, Malgorzata
Marek-Sadowska - Univ. of California,
Santa Barbara, CA

24.4 Performance-Driven Multi-Level Clustering with Application to Hierarchical FPGA Mapping

Jason Cong, Michail Romesis - Univ. of
California, Los Angeles, CA

Session 25

rm: N107-N108

COLLABORATIVE AND DISTRIBUTED DESIGN FRAMEWORKS

CHAIR: Satish Venkatesan - Intel Corp., Santa Clara, CA
ORGANIZERS: Noel Menezes, Vivek Tiwari

The use of collaborative frameworks for expediting design tasks is receiving increased attention due to the increasing complexity of current ICs. The first paper deals with a novel approach to design process management while the second paper presents a universal client with a user-configurable GUI for distributed design. A collaborative framework for training and design, and an object-oriented framework for specification and synthesis are described in the final papers.

25.1 Application of Constraint-Based Heuristics in Collaborative Design

Juan Antonio Carballo - IBM Austin Research
Lab., Austin, TX
Stephen W. Director - Univ. of Michigan,
Ann Arbor, MI

25.2 A Universal Client for Distributed Networked Design and Computing

Franc Brglez, Hemang Lavana - N. Carolina
State Univ., Raleigh, NC

25.3 Hypermedia-Aided Design

Darko R. Kirovski, Miodrag Potkonjak, Milenko
Drinic - Univ. of California, Los Angeles, CA

25.4 A Framework for Object Oriented Hardware Specification, Verification, and Synthesis

Tommy Kuhn, Tobias Oppold, Markus Winterholer,
Wolfgang Rosenstiel - Univ. of Tuebingen,
Tuebingen, Germany
Marc Edwards - Cisco Systems,
Research Triangle Park, NC
Yaron Kashai - Verisity Design, Inc.,
Mountain View, CA



Wednesday
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4:30
to
6:00

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S - denotes
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24

Session 26

rm: N111-N114

PANEL: WHEN WILL THE ANALOG DESIGN FLOW CATCH UP WITH DIGITAL METHODOLOGY?

CHAIR: Georges Gielen - Katholieke Univ., Leuven, Belgium

ORGANIZERS: Mike Sottak, Mike Murray, Linda Kaye

Despite the fact that more and more electronic design is comprised of analog and mixed signal content, the design flows and methodologies in this area are lagging behind the pace of innovation in digital design. For sure, analog designers are in shorter supply, but this only makes the need for improvements and efficiency that much greater. Only of late have we seen production-worthy attempts at functions such as analog synthesis and optimization reach the market. What is needed in today's analog design flow? What are the key technologies that are missing? How does the existing "food chain" need to work together to drive greater efficiencies? A distinguished panel of suppliers and users will analyze these issues and project future trends.

PANELISTS:

Mar Hershenson - Barcelona Design, Sunnyvale, CA

Ken Kundert - Cadence Design Systems, Inc., San Jose, CA

Phillipe Magarshack - ST Microelectronics, Crolles, France

Akira Matsuzawa - Matsushita, Osaka, Japan

Ronald Rohrer - Neolinear, Inc., Pittsburgh, PA

Ping Yang - TSMC, Richardson, TX

Session 27

rm: N109-N110

SPECIAL SESSION: CLOSING THE GAP BETWEEN ASIC AND CUSTOM: DESIGN EXAMPLES

CHAIR: Bryan Ackland - Agere Systems, Holmdel, NJ

ORGANIZER: Kurt Keutzer

A significant performance gap exists between integrated circuits designed in a custom methodology, and those designed in an ASIC (RTL synthesis) methodology. DAC hosted a session last year that focused on techniques to bridge this gap. This year's session looks at real circuit examples that have successfully done so.

27.1 Achieving 550Mhz in an ASIC Methodology

D.G. Chinnery, Bora Nikolic', Kurt Keutzer - *Univ. of California, Berkeley, CA*

27.2 A Semi-Custom Design Flow in High-Performance Microprocessor Design

Gregory A. Northrop, Pong-Fei Lu - *IBM Corp., TJ Watson Research Ctr., Yorktown Heights, NY*

27.3 Reducing the Frequency Gap Between ASIC and Custom Designs: A Custom Perspective

Stephen E. Rich, Matthew J. Parker, Jim Schwartz - *Intel Corp., Hillsboro, OR*

Design Methods Sessions are shaded red. Embedded Systems Sessions are shaded grey.

Session 28

rm: N115-N117

ENERGY AND FLEXIBILITY DRIVEN SCHEDULING

CHAIR: Marco Di Natale - Univ. of Pisa, Pisa, Italy
ORGANIZERS: Donatella Sciuto, Luciano Lavagno

This session looks at several applications of static scheduling in the context of real time embedded systems. The first paper presents a voltage scheduling algorithm based on static timing analysis that controls the supply voltage to exploit all available slack. The second paper takes battery characterization into account to optimally schedule tasks in a real time embedded system. The third paper discusses how to implement new functionality on an already existing system such that running applications are not disturbed.

28.1 Low-Energy Intra-Task Voltage Scheduling Using Static Timing Analysis

Dongkun Shin, Jihong Kim - Seoul National Univ., Seoul, Korea
Seongsoo Lee - Ewha Woman's Univ., Seoul, Korea

28.2 Battery-Aware Static Scheduling for Distributed Real-Time Embedded Systems

Jiong Luo, Niraj K. Jha - Princeton Univ., Princeton, NJ

28.3 An Approach to Incremental Design of Distributed Embedded Systems

Paul Pop, Petru Eles, Traian Pop, Zebo Peng - Linköping Univ., Linköping, Sweden

Session 29

rm: N119-N120

REPRESENTATION AND OPTIMIZATION FOR DIGITAL ARITHMETIC CIRCUITS

CHAIR: Miodrag Potkonjak - Univ. of California, Los Angeles, CA

ORGANIZERS: Kazutoshi Wakabayashi, Rajesh K. Gupta

Optimization of arithmetic operations is crucial for many signal processing applications and more generally for datapath circuits in broader applications. The first paper in this session presents a novel signal representation for carry-save arithmetic optimizations across register boundaries. The second paper examines precision and signal clustering for improved data path designs. The last paper presents an approach for digital filter synthesis using the minimal signed digit representations.

29.1 Signal Representation Guided Synthesis Using Carry-Save Adders For Synchronous Data-Path Circuits

Zhan Yu - Univ. of California, Los Angeles, CA
Meng-Lin Yu - Lucent Technologies, Holmdel, NJ
Alan N. Willson Jr. - Univ. of California, Los Angeles, CA

29.2 Improved Merging of Datapath Operators Using Information Content and Required Precision Analysis

Anmol Mathur, Sanjeev Saluja - Cadence Design Systems, Inc., San Jose, CA

29.3 Digital Filter Synthesis Based on Minimal Signed Digit Representation

In Cheol Park, Hyeong Ju Kang - KAIST, Taejeon, Korea

Session 30

rm: N107-N108

TECHNIQUES FOR IP PROTECTION

CHAIR: Ian R. Mackintosh - Sonics Inc., Mountain View, CA
ORGANIZERS: Kenji Yoshida, Majid Sarafzadeh

The first three papers propose three new techniques for enabling watermarking of hardware IP. They introduce a technique for public authentication of hardware IP, an optimal watermarking technique with respect to credibility and a watermarking technique for partitioning. The last paper introduces a technique for measuring how many IC's are produced for a given licensed design.

30.1 Publicly Detectable Techniques for the Protection of Virtual Components

Gang Qu - Univ. of Maryland, College Park, MD

30.2 Watermarking of SAT Using Combinatorial Isolation Lemmas

Rupak Majumdar - Univ. of California, Berkeley, CA
Jennifer L. Wong - Univ. of California, Los Angeles, CA

30.3S Watermarking Graph Partitioning Solutions

Greg Wolfe, Jennifer L. Wong, Miodrag Potkonjak - Univ. of California, Los Angeles, CA

30.4S Hardware Metering

Farinaz Koushanfar - Univ. of California, Berkeley, CA
Gang Qu - Univ. of Maryland, College Park, MD



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8:30
to
10:00

All speakers are
denoted in bold

S - denotes
short paper

β - denotes
best paper

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Session 31

rm: N111-N114

SPECIAL SESSION: VISUALIZATION AND ANIMATION FOR ULSI DESIGN

CHAIR: Chandu Visweswariah - IBM Corp., TJ Watson Research Ctr., Yorktown Heights, NY

ORGANIZERS: Chandu Visweswariah, Majid Sarrafzadeh

This visually rich session will demonstrate the use of modern visualization and animation for dealing with large amounts of data to generate intuition about circuit behavior, large layouts or complex algorithms. These visualization methods are surprisingly accessible and easy to use. Eye-popping animation and visualization methods for understanding DSM interconnects, clock distribution networks, large VLSI layouts and various CAD-related algorithms will be shown.

31.1 Technical Visualizations in ULSI Design

Phillip Restle - IBM Corp., TJ Watson Research Ctr., Yorktown Heights, NY

31.2 Using Texture Mapping with Mipmapping to Render a ULSI Layout

Jeffrey M. Solomon, **Mark A. Horowitz** - Stanford Univ., Stanford, CA

31.3 Web-Based Algorithm Animation

Marc Najork - Compaq Systems Research Ctr., Palo Alto, CA

Session 32

rm: N109-N110

APPLICATION-SPECIFIC CUSTOMIZATION FOR SYSTEMS-ON-A-CHIP

CHAIR: Kees Vissers - Trimedia Technologies Inc., Milpitas, CA

ORGANIZERS: Kurt Keutzer, Dirk Grunwald

This session examines a number of ways in which systems-on-a-chip can be adapted or customized for particular applications. The first paper looks at tailoring processor architectures for media applications. The second looks at exploring a family of multiprocessor architectures for communication problems. The third paper looks at customizations for power management.

32.1 Speeding Up Control-Dominated Applications through Microarchitectural Customizations in Embedded Processors

Peter Petrov, **Alex Orailoglu** - Univ. of California at San Diego, La Jolla, CA

32.2 Automatic Generation of Application-Specific Architectures for Heterogeneous Multiprocessor System-on-Chip

Damien Lyonnard, **Sungjoo Yoo**, **Amer Baghdadi**, **Ahmed A. Jerraya** - TIMA Lab., Grenoble, France

32.3 Dynamic Voltage Scaling for Portable Systems

Tajana Simunic - Stanford Univ., Stanford, CA

Design Methods Sessions are shaded red. Embedded Systems Sessions are shaded grey.

Session 33

rm: N115-N117

SATISFIABILITY SOLVERS AND TECHNIQUES

CHAIR: Karem Sakallah - Univ. of Michigan, Ann Arbor, MI
ORGANIZERS: Andrew B. Kahng, Kurt Keutzer, Limor Fix

Boolean satisfiability techniques have been used successfully in a variety of EDA applications such as formal verification, testing and timing analysis. This session presents new and advanced satisfiability solvers and techniques that dramatically advance the performance of Boolean Satisfiability engines, and extend their scope to incremental formulations.

33.1 Engineering a (Super?) Efficient SAT Solver

Matthew W. Moskewicz - Univ. of California, Berkeley, CA
Conor F. Madigan - Massachusetts Institute of Tech., Boston, MA
Ying Zhao, Lintao Zhang, Sharad Malik - Princeton Univ., Princeton, NJ

33.2 Dynamic Detection and Removal of Inactive Clauses in SAT with Application In Image Computation

Aarti Gupta - NEC USA, Princeton, NJ
Anubhav Gupta - Carnegie Mellon Univ., Pittsburgh, PA
Zijiang Yang, Pranav N. Ashar - NEC USA, Princeton, NJ

33.3S SATIRE: A New Incremental Satisfiability Engine

Jesse P. Whittemore - Univ. of Michigan, Ann Arbor, MI
Joonyoung Kim - Intel Corp., Hillsboro, OR
Karem A. Sakallah - Univ. of Michigan, Ann Arbor, MI

33.4S A Framework for Low Complexity Static Learning

Emil I. Gizardski, Hideo Fujiwara - Nara Institute of Science and Tech., Ikoma, Japan

Session 34

rm: N119-N120

POWER AND INTERCONNECT ANALYSIS

CHAIR: L. Miguel Silveira - INESC/IST, Lisboa, Portugal
ORGANIZERS: Joel Phillips, Mustafa Celik

This session features papers in power issues — energy dissipation of interconnect, power network analysis and optimization. A final contribution presents a method for high-frequency inductance calculations.

34.1 Fast Power/Ground Network Optimization Based on Equivalent Circuit Modeling

X.-D. Sheldon Tan - Altera Corp., San Jose, CA
C.-J. Richard Shi - Univ. of Washington, Seattle, WA

34.2S An Interconnect Energy Model Considering Coupling Effects

Taku Uchino, Jason Cong - Univ. of California, Los Angeles, CA

34.3S Efficient Large-Scale Power Grid Analysis Based on Preconditioned Krylov-Subspace Iterative Methods

Tsung-Hao Chen, Charlie Chung-Ping Chen - Univ. of Wisconsin, Madison, WI

34.4S Using Conduction Modes Basis Functions for Efficient Electromagnetic Analysis of On-Chip and Off-Chip Interconnect

Luca Daniel, Alberto L. Sangiovanni-Vincentelli - Univ. of California, Berkeley, CA
Jacob K. White - Massachusetts Institute of Tech., Cambridge, MA

34.5S Analysis of Non-Uniform Temperature-Dependent Interconnect Performance in High Performance ICs

Amir H. Ajami - Univ. of Southern California, Los Angeles, CA
Kaustav Banerjee - Stanford Univ., Stanford, CA
Massoud Pedram - Univ. of Southern California, Los Angeles, CA
Lukas P.P.P. van Ginneken - Magma Design Inc., Cupertino, CA

Session 35

rm: N107-N108

DOMAIN SPECIFIC DESIGN METHODOLOGIES

CHAIR: Yosinori Watanabe - Cadence Berkeley Labs., Berkeley, CA

ORGANIZERS: Anand Raghunathan, Shin-ichi Minato

In this session, we explore design methodologies that focus on specific application domains. The paper attacks the following three domain instances: direct digital frequency synthesizers for communication systems, symmetric block ciphers for cryptographic analysis, Viterbi decoders and IIR filters in DSPs. These case studies will hint at new methodologies for designing real-life applications.

35.1 VHDL Based Design and Design Methodology for Reusable High Performance Direct Digital Frequency Synthesis

Ireneusz Janiszewski, Bernhard Hoppe, Hermann Meuth - FH Darmstadt, Darmstadt, Germany

35.2 Concurrent Error Detection Schemes for Side-Channel Fault-Analysis of 128-bit Symmetric Block Ciphers

Ramesh Karri, Kaijie Wu, Piyush Mishra - Polytechnic Univ., Brooklyn, NY
Yongkook Kim - IBM Corp., Poughkeesie, NY

35.3 MetaCores: Design and Optimization Techniques

Seapahn Meguerdichian, Farinaz Koushanfar - Univ. of California, Los Angeles, CA
Advait Mogre, Dusan Petranovic - LSI Logic Corp., Milpitas, CA
Miodrag Potkonjak - Univ. of California, Los Angeles, CA



Thursday
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10:30
to
12:00

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S - denotes
short paper

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Session 36

rm: N111-N114

PANEL: DEBATE: WHO HAS NANOMETER DESIGN UNDER CONTROL?

CHAIR: Andrew B. Kahng - Univ. of California at San Diego, La Jolla, CA
ORGANIZER: Ding Sheu

As fabrication technology moves to 100 nm and below, profound nanometer effects become critical in developing silicon chips with hundreds of millions of transistors. Both EDA suppliers and system houses have been re-tooling, and new methodologies have been emerging. Will these efforts meet the challenges of nanometer silicon such as performance closure, power, reliability, manufacturability, and cost? Which aspects of nanometer design are, or are not, under control? This session will consist of a debate between two teams of distinguished representatives from EDA suppliers and system design houses. Which side has the right answers and roadmap? You and a panel of judges will decide!

PANELISTS:

Shekhar Borkar - Intel Corp., Hillsboro, OR
Ed Cheng - Synopsys, Inc., Mountain View, CA
John Cohn - IBM Corp., Essex Junction, VT
Nancy Nettleton - Sun Microsystems, Mountain View, CA
Lou Scheffer - Cadence Design Systems, Inc., San Jose, CA
Sang Wang - Nassda Corp., Santa Clara, CA

Session 37

rm: N109-N110

ANALYSIS AND IMPLEMENTATION FOR EMBEDDED SYSTEMS

CHAIR: Grant Martin - Cadence Design Systems, Inc., San Jose, CA
ORGANIZERS: Dirk Grunwald, Kurt Keutzer, Luciano Lavagno

This set of papers describes system level design tools and design flows for system design, performance trade offs and power estimation. The first paper uses simulink for rapid design of data-dominated applications. The remaining papers provide power models using automatic formalisms and the other using a combination of design captive and application characteristics.

37.1 A Hardware/Software Co-Design Flow and IP Library Based on Simulink

Leonardo Reyneri, Francesco Cucinotta, **Alessandro Serra** - Politecnico di Torino, Turin, Italy
Luciano Lavagno - Univ. di Udine, Udine, Italy

37.2 System-Level Power/Performance Analysis for Embedded Systems Design

Amir Nandi, **Radu Marculescu** - Carnegie Mellon Univ., Pittsburgh, PA

37.3 High-Level Software Energy Macro-Modeling

Tat K. Tan - Princeton Univ., Princeton, NJ
Anand Raghunathan, Ganesh Lakshminarayana - NEC USA, Princeton, NJ
Niraj K. Jha - Princeton Univ., Princeton, NJ

Design Methods Sessions are shaded red. Embedded Systems Sessions are shaded grey.

Session 38

rm: N115-N117

INDUSTRIAL CASE STUDIES IN VERIFICATION

CHAIR: Carl Pixley - Motorola, Inc., Austin, TX
ORGANIZERS: Anand Raghunathan, Carl Pixley

Verification is well-known to be one of the most expensive, delaying and critical aspects of the design process. We present three industrial case studies that illustrate novel approaches to integrating functional verification techniques: simulation, emulation and formal verification.

38.1 Model Checking of S3C2400X Industrial Embedded SoC Product

Hoon Choi, Byeongwee Yun, Yuntae Lee, Hyunglae Roh - Samsung Electronics, Yongin, Korea

38.2 Semi-Formal Test Generation with Genevele

Julia Dushina, Mike Benjamin - ST Microelectronics, Bristol, UK
Daniel Geist - IBM Corp., Haifa, Israel

38.3 A Transaction-Based Unified Simulation/Emulation Architecture for Functional Verification

Murali Kudluga - IKOS Systems, Inc., Waltham, MA
Soha Hassoun - Tufts Univ., Medford, MA
Charles Selvidge - IKOS Systems, Inc., Waltham, MA
Duaine Pryor - IKOS Systems, Inc., Cupertino, CA

Session 39

rm: N119-N120

INTEGRATED HIGH-LEVEL SYNTHESIS BASED SOLUTIONS

CHAIR: Kazutoshi Wakabayashi - NEC Corp., Kawasaki, Japan

ORGANIZERS: Kazutoshi Wakabayashi, Rajesh K. Gupta
The focus of this session is on design flows that seek to integrate high-level synthesis into physical design. The first paper presents integration of HLS with power-net design targeted for mixed signal ICs. The second paper considers HLS with placement targeted for reconfigurable computing architectures. The last paper explores design exploration using multiple HLS tools.

39.1 Integrated High-Level Synthesis and Power-Net Routing for Digital Design under Switching Noise Constraints

Alex Daboli - State Univ. of New York, Stony Brook, NY

Ranga Vemuri - Univ. of Cincinnati, Cincinnati, OH

39.2 Integrating Scheduling and Physical Design into a Coherent Compilation Cycle for Reconfigurable Computing Architectures

Kia Bazargan - Univ. of Minnesota, Minneapolis, MN
Seda Ogrenici, Majid Sarrafzadeh - Univ. of California, Los Angeles, CA

39.3 Statistical Design Space Exploration for Application-Specific Unit Synthesis

Davide Bruni - Univ. di Bologna, Bologna, Italy
Alessandro Bogliolo - Univ. di Ferrara, Ferrara, Italy
Luca Benini - Univ. di Bologna, Bologna, Italy

Session 40

rm: N107-N108

TIMING VERIFICATION AND SIMULATION

CHAIR: Ashok Vittal - Synopsys, Inc., Mountain View, CA
ORGANIZER: Narendra Shenoy

This session deals with various aspects of timing issues including analysis, optimization, characterization and modeling for simulation that arise in EDA. Paper one describes techniques to support efficient verification with complex timing variations. Optimizing for crosstalk effects is the subject of paper two. Paper three is relevant in the context of sub-circuit characterization. Paper four deals with scheduling and synchronization for multiple clock domains.

40.1 Static Scheduling of Multiple Asynchronous Domains for Functional Verification

Murali Kudluga, Charles Selvidge - IKOS Systems, Inc., Waltham, MA
Russell G. Tessier - Univ. of Massachusetts, Amherst, MA

40.2S Functional Correlation Analysis in Crosstalk Induced Critical Paths Identification

Tong Xiao - Sun Microsystems, Inc., Palo Alto, CA
Malgorzata Marek-Sadowska - Univ. of California, Santa Barbara, CA

40.3S An Advanced Timing Characterization Method Using Mode Dependency

Hakan Yalcin, Robert Palermo, Mohammad S. Mortazavi - Cadence Design Systems, Inc., San Jose, CA

Cyrus S. Bamji - Canesta Inc., Santa Clara, CA
Karem A. Sakallah, John P. Hayes - Univ. of Michigan, Ann Arbor, MI

40.4 Fast Statistical Timing Analysis By Probabilistic Event Propagation

Jing-Jia Liou, Kwang-Ting Cheng - Univ. of California, Santa Barbara, CA
Sandip Kundu - Intel Corp., Austin, TX
Angela Krstic - Univ. of California, Santa Barbara, CA



Thursday
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2:00
to
4:00

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β - denotes
best paper

30

Session 41

rm: N111-N114

SPECIAL SESSION: ON-CHIP COMMUNICATION ARCHITECTURES

CHAIR: Anand Raghunathan - NEC USA C&C Research Lab., Princeton, NJ
ORGANIZERS: Anand Raghunathan, Sharad Malik

Designing a high quality communication architecture is increasingly becoming critical to meeting performance, power, and turn around time constraints in the design of System-on-Chips. This special session consists of invited presentations from designers of on-chip communication architectures used today, as well as researchers involved in developing architectures and design methodologies of the future. The first presentation will highlight the role played by on-chip communication architectures in system design, describe the challenges involved, and present a communication-based design paradigm. The second presentation will describe how micro-network based architectures can be used to implement communication between SoC components. The third presentation will provide a design example from the domain of high-performance network processors, focusing on the challenges involved in on-chip communication, and how they are addressed. The final presentation will examine technology trends and their implications on on-chip communication architecture design, arguing the case for the use of packet-switched on-chip networks.

41.1 Addressing the System-on-a-Chip Interconnect Woes Through Communication-Based Design

Jan Rabaey, Alberto L. Sangiovanni-Vincentelli - *Univ. of California, Berkeley, CA*

Sharad Malik - *Princeton Univ., Princeton, NJ*

Kurt Keutzer - *Univ. of California, Berkeley, CA*

41.2 MicroNetwork-Based Integration for SOCs

Drew Wingard - *Sonics, Inc., Mountain View, CA*

41.3 On-Chip Communication Architecture for OC-768 Network Processors

Faraydon Karim, Anh Nguyen - *ST Microelectronics, San Diego, CA*

Sujit Dey, Ramesh Rao - *Univ. of California at San Diego, La Jolla, CA*

41.4 Route Packets, Not Wires: On-Chip Interconnection Networks

William Dally - *Stanford Univ., Stanford, CA*

Session 42

rm: N109-N110

COMPILER AND ARCHITECTURE INTERACTIONS

CHAIR: Stephen Neuendorffer - *Univ. of California, Berkeley, CA*
ORGANIZERS: Donatella Sciuto, Marco Di Natale

The efficient use and simulation of architecture components requires a fine tuning of the compiler algorithms or even a tight integration between components and compiler design. This session contains four papers spanning from compiler optimization techniques for reducing data transfers in clustered VLIW architectures to compiler-controlled scratch-pad memory management, to fast simulation of fixed point systems through code transformation.

42.1 Dynamic Management of Scratch-Pad Memory Space

Mahmut T. Kandemir - *Penn State Univ., University Park, PA*

J. Ramanujam - *Louisiana State Univ., Baton Rouge, LA*

Mary Jane Irwin, Vijaykrishnan Narayanan, Ismail Kadayif, Amisha Parikh - *Penn State Univ., University Park, PA*

42.2 Clustered ULIW Architectures with Predicated Switching

Margarida F. Jacome, Gustavo A. de Veciana, Sarish

Pillai - *Univ. of Texas, Austin, TX*

42.3 High-Quality Operation Binding for Clustered ULIW Datapaths

Viktor S. Lapinskii, Margarida F. Jacome, Gustavo A. de Veciana - *Univ. of Texas, Austin, TX*

42.4 Fast Bit-True Simulation

Holger Keding, Martin Coors, Olaf Luethje, Heinrich Meyr - *Integrated Signal Processing Systems, Aachen, Germany*

Session 43

rm: N115-N117

TIMING WITH CROSSTALK

CHAIR: Sachin S. Sapatnekar - Univ. of Minnesota, Minneapolis, MN

ORGANIZERS: Jaajeet Roychowdhury, Mustafa Celik

This session deals with the impact of crosstalk on timing. The first paper uses a theoretical approach to analyze some practical issues such as convergence. The second paper introduces a new driver model for accurate coupled noise modeling and then discusses worst case alignment. The third paper uses functional information to eliminate false coupling interactions to avoid pessimistic delay calculation. The last paper proposes a post-layout optimization technique to reduce coupling induced delay.

43.1 Timing Analysis with Crosstalk as Fixpoints on Complete Lattice

Hai Zhou, Narendra Shenoy, William Nicholls - Synopsys, Inc., Mountain View, CA

43.2 Driver Modeling and Alignment for Worst-Case Delay Noise

Supamas Sirichotiyakul, David Blaauw, Chanhee Oh - Motorola, Inc., Austin, TX
Rafi Levy - Motorola, Inc., Herzlia, Israel
Vladimir Zolotov, Jingyan Zuo - Motorola, Inc., Austin, TX

43.3 False Coupling Interactions in Static Timing Analysis

Ravishankar Arunachalam, Ronald D. Blanton, Lawrence T. Pileggi - Carnegie Mellon Univ., Pittsburgh, PA

43.4 Coupling Delay Optimization by Temporal Decorrelation using Dual Threshold Voltage Technique

Kiwook Kim, Seong Ook Jung - Univ. of Illinois, Urbana, IL
Prashant Saxena - Intel Corp., Portland, OR
Chaung Laung Liu - National Tsing-Hua Univ., Hsinchu, Taiwan, ROC
Sung Mo Kang - Univ. of Illinois, Urbana, IL

Session 44

rm: N119-N120

LOW POWER DESIGN: SYSTEMS TO INTERCONNECT

CHAIR: Vivek Tiwari - Intel Corp., Santa Clara, CA

ORGANIZERS: Ingrid Verbauwhede, Tadahiro Kuroda

Low Power design needs to be addressed at all levels. At the system level, the first paper presents a generalized approach to the concept of partitioning the input space and applying specific optimizations to the partitions for overall energy reduction. The issue of energy consumption in DSM interconnects has gained attention recently. The next three papers present an introduction and different approaches to the problem. The final paper describes the circuit design of an adiabatic multiplier.

44.1 Input Space Adaptive Design: A High-Level Methodology for Energy and Performance Optimization

Weidong Wang - Princeton Univ., Princeton, NJ
Ganesh Lakshminarayana, Anand Raghunathan - NEC USA, Princeton, NJ

Niraj K. Jha - Princeton Univ., Princeton, NJ

44.2 A2BC: Adaptive Address Bus Coding for Low Power Deep Sub-Micron Designs

Joerg Henkel - NEC USA, Princeton, NJ

44.3S Coupling-Driven Bus Design for Low-Power Application-Specific Systems

Youngsoo Shin, Takayasu Sakurai - Univ. of Tokyo, Tokyo, Japan

44.4S Modeling and Minimization of Interconnect Energy Dissipation in Nanometer Technologies

Clark N. Taylor, Sujit Dey, Yi Zhao - Univ. of California at San Diego, La Jolla, CA

44.5 Student Design Contest: A True Single-Phase 8-bit Adiabatic Multiplier

Suhwan Kim - IBM Corp., Yorktown Heights, NY
Conrad H. Ziesler, Marios C. Papaefthymiou - Univ. of Michigan, Ann Arbor, MI

Session 45

rm: N107-N108

FLOORPLANNING REPRESENTATIONS AND PLACEMENT ALGORITHMS

CHAIR: Ralph H.J.M. Otten - Delft Univ. of Technology, Delft, The Netherlands

ORGANIZERS: Louis Scheffer, Patrick Groeneveld

The first two papers offer improved representations for floorplanning, offering faster incremental updates and capable of handling a wider variety of block shapes and constraints. The next two papers are improvements of partitioning based placement, providing better quality of results in wire length and timing. The final paper takes a novel approach, using system level power considerations to drive partitioning and placement.

45.1 TCG: A Transitive Closure Graph-Based Representation for Non-Slicing Floorplans

Jai-Ming Lin, Yao-Wen Chang - National Chiao Tung Univ., Hsinchu, Taiwan, ROC

45.2 Floor planning with Abutment Constraints and L-Shaped/T-Shaped Blocks Based on Corner Block List

Yuchun Ma, Xianlong Hong, Sheqin Dong, Yici Cai - National Tsing-Hua Univ., Beijing, China
Chung-Kuan Cheng - Univ. of California at San Diego, La Jolla, CA

Jun Gu - Science and Tech. Univ. of Hong Kong, Hong Kong, China

45.3S Improved Cut Sequences for Partitioning Based Placement

Patrick H. Madden, Mehmet C. Yildiz - State Univ. of New York, Binghamton, NY

45.4S Timing Driven Placement using Physical Net Constraints

Bill M. Halpin - Intel Corp., Santa Clara, CA / Syracuse Univ., Syracuse, NY

C. Y. Roger Chen - Syracuse Univ., Syracuse, NY
Naresh K. Sehgal - Intel Corp., Santa Clara, CA

45.5 From Architecture to Layout: Partitioned Memory Synthesis for Embedded Systems-on-Chip

Luca Benini - Univ. di Bologna, Bologna, Italy
Luca Macchiarulo, Alberto Macii, Enrico Macii, Massimo Pondino - Politecnico di Torino, Torino, Italy



Thursday
June 21

4:30
to
6:00

All speakers are
denoted in bold

S - denotes
short paper

β - denotes
best paper

32

Session 46

rm: N111-N114

PANEL: WHAT DRIVES EDA INNOVATION?

CHAIR: Steve Schulz - Texas Instruments, Dallas, TX

ORGANIZER: Georgia Marszalek

If EDA technology innovation drives return on investment, what drives innovation? Is it tied to the semiconductor retooling cycle? To productivity requirements? To Moore's Law? Or is there something more fundamental that we are missing? What driving forces could result in a \$30 billion EDA industry, and what role will innovation play? Will the industry provide the needed breakthroughs for their customers, or seek instead the lowest common denominator user? Will designers "roll their own" tools or seek common solutions? How does EDA innovation track with the semiconductor business cycle? Does a slowdown accelerate or depress creation of new tools and new designs? Panelists will discuss the forces at work in the EDA industry of tomorrow.

PANELISTS:

John Darringer - IBM Corp., Yorktown Heights, NY

Greg Hinckley - Mentor Graphics Corp., Wilsonville, OR

George Janac - InTimeSoftware, Inc., Cupertino, CA

Handel Jones - International Business Strategies, Los Gatos, CA

Greg Spirakis - Intel Corp., Santa Clara, CA

Karen Vahra - Magma Design Automation, Inc., Cupertino, CA

Session 47

rm: N109-N110

SIGNAL INTEGRITY: AVOIDANCE AND TEST TECHNIQUES

CHAIR: Anirudh Devgan - IBM Corp., Austin, TX

ORGANIZERS: Chandu Visweswariah, Kenji Yoshida

Inductive effects in interconnect are a major source of headaches for state-of-the-art digital designs. Inductive effects cause nasty timing and noise problems and threaten to be show-stoppers. This session features three innovative techniques to solve, avoid or test for these problems.

47.1 Built-In Self-Test for Signal Integrity

Mehrdad Nourani, *Amir Attarha* - Univ. of Texas at Dallas, Richardson, TX

β 47.2 Analysis of On-Chip Inductance Effects using a Novel Performance Optimization Methodology for Distributed RLC Interconnects

Kaustav Banerjee - Stanford Univ., Stanford, CA

Amit Mehrotra - Univ. of Illinois, Urbana, IL

47.3 Modeling and Analysis of Differential Signaling for Minimizing Inductive Cross-Talk

Yehia M. Massoud, *Jamil Kawa*, *Don MacMillen* - Synopsys, Inc., Mountain View, CA

Jacob K. White - Massachusetts Institute of Tech., Cambridge, MA

Design Methods Sessions are shaded red. Embedded Systems Sessions are shaded grey.

Session 48

rm: N115-N117

NOVEL APPROACHES TO MICROPROCESSOR DESIGN AND VERIFICATION

CHAIR: Derek Beatty - Motorola, Inc., Austin, TX

ORGANIZERS: Carl Pixley, Shin-ichi Minato

This session covers novel approaches to the correct design and verification of complex microprocessors, including automatic design of interlock and forwarding logic, generation of test programs to exercise complex corner cases, and verification techniques for the error logic.

48.1 Automated Pipeline Design

Daniel Kroening, Wolfgang Paul - Univ. of Saarland, Saarbruecken, Germany

48.2 A New Verification Methodology for Complex Pipeline Behavior

Kazuyoshi Kohno, Nobu Matsumoto - Toshiba Corp., Kawasaki, Japan

48.3 Pre-Silicon Verification of the Alpha 21364 Microprocessor Error Handling System

Richard Lee, Benjamin Tsien - Compaq Computer Corp., Palo Alto, CA

Session 49

rm: N119-N120

SCHEDULING TECHNIQUES FOR POWER MANAGEMENT

CHAIR: Donatella Sciuto - Politecnico di Milano, Milano, Italy

ORGANIZERS: Diederik Verkest, Luciano Lavagno

Power constraints become increasingly important in embedded systems. This session presents new scheduling techniques for power management under different circumstances. The first paper presents a technique to determine voltage settings for a variable voltage processor. The second paper introduces a formal model of distributed multimedia systems that enables determining an optimal power management policy. The third paper looks at power aware scheduling in the context of mission critical systems.

β 49.1 Energy Efficient Fixed-Priority Scheduling for Real-Time Systems on Variable Voltage Processors

Gang Quan, Xiaobo (Sharon) Hu - Univ. of Notre Dame, Notre Dame, IN

49.2 Dynamic Power Management in a Mobile Multimedia System with Guaranteed Quality-of-Service

Qing Wu, Massoud Pedram, Qinru Qiu - Univ. of Southern California, Los Angeles, CA

49.3 Power-Aware Scheduling under Timing Constraint for Mission-Critical Embedded Systems

Jinfeng Liu, Pai H. Chou, Nader Bagherzadeh - Univ. of California, Irvine, CA

Session 50

rm: N107-N108

NOVEL DEVICES AND YIELD OPTIMIZATION

CHAIR: Chandu Visweswariah - IBM Corp., TJ Watson Research Ctr., Yorktown Heights, NY

ORGANIZERS: Chandu Visweswariah, Ralph H.J.M. Otten

How soon will novel devices revolutionize integrated circuits? What can we do about falling yields due to mismatch and intra-chip variations? This session takes a shot at answering these questions. It begins with description of novel 3-dimensional SOI devices and then a novel MEMS accelerometer for mouse applications. Finally, yield optimization due to mismatch problems is addressed.

50.1 Exploring SOI Device Structures and Interconnect Architectures for 3-Dimensional Integration

Rongtian Zhang, Kaushik Roy, Cheng Kok Koh, David B. Janes - Purdue Univ., West Lafayette, IN

50.2 Student Design Contest: Two-Dimensional Position Detection System with MEMS Accelerometer for MOUSE Applications

Seungbae Lee, Gi-Joon Nam, Junseok Chae, Hanseup Kim, Alan J. Drake - Univ. of Michigan, Ann Arbor, MI

50.3 Mismatch Analysis and Direct Yield Optimization by Spec-Wise Linearization and Feasibility-Guided Search

Frank Schenkel, Michael Pronath - Tech. Univ. of Munich, Munich, Germany
Stephan Zizala, Robert Schwenker, Helmut Graeb - Infineon Technologies, Munich, Germany
Kurt Antreich - Tech. Univ. of Munich, Munich, Germany



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Tutorial 1

Friday, June 22

Tutorials will be held at the Las Vegas Convention Center.

8:00 AM - 1:00 PM Tutorial Registration Open

9:00 AM - 5:00 PM Tutorials

8:00 AM - Continental Breakfast - Room N246, N250

12:00 Noon - Lunch - Room N246, N250

DESIGN-FOR-TEST TECHNIQUES FOR SoC DESIGNS

rm: N115 - N117

ORGANIZER: *Janusz Rajski* - Mentor Graphics Corp., Willsonville, OR

PRESENTERS: *Janusz Rajski* - Mentor Graphics Corp., Willsonville, OR

Alfred Crouch - Motorola, Inc., Austin, TX

Geir Eide - Mentor Graphics Corp., Willsonville, OR

Audience: Designers of complex systems-on-a-chip and ASICs, IP core providers, SoC integrators, system architects, and design managers interested in learning about state-of-the art DFT technology, practices and automation tools.

Description: Complex SoC designs contain millions of gates of logic and, in some cases, hundreds of embedded memories. In a complex SoC design process, Design-for-Test is one of the crucial components that determine the time to market, product quality, and its manufacturing cost. This tutorial aims to jump start the designer to new levels of practical test expertise by presenting DFT methodologies, solutions, and technological advancements for addressing today's toughest DFT issues. The tutorial briefly introduces basic DFT concepts and techniques, and focuses on practical issues such as: IP core design guidelines that enable test reuse, DFT for complex SoC designs, embedded memory test, at-speed test, and DFT integration into the design flow. More specifically the tutorial presents in detail structural Design-for-Test methodologies based on scan, i.e. scan cell design, scan operation, scan chain optimization, multiple clock domains, test logic, test points, basic concepts of Logic BIST, and boundary scan. Automatic test

pattern generation (ATPG) creates high quality, compact test patterns in a fully automated manner. The highlights of the section addressing ATPG include: design rules checking, random and deterministic test pattern generation, pattern compression techniques, test pattern verification, combinational and sequential pattern types, and at-speed test.

A special section of the tutorial is devoted to testing of embedded memories. It reviews: memory types, fault models, test algorithms, and test methods (Memory BIST and Vector translation).

The final section focuses on core test and SoC test integration. This chapter covers DFT in the design cycle, scan insertion flow, physical aspects of SoC DFT, test wrappers for IP cores, design guidelines and recommendations for test reuse, hierarchical test pattern generation, test access mechanisms, test scheduling, SoC test integration and verification. Important concepts and methodologies are illustrated by practical applications and case studies.



Tutorial 2

Friday, June 22

INTERACTIVE TUTORIAL ON FUNDAMENTALS OF SIGNAL INTEGRITY FOR HIGH-SPEED/HIGH-DENSITY DESIGN

rm: N109 - N110

ORGANIZERS: *Andreas Cangellaris* - Univ. of Illinois, Urbana, IL
José Schutt-Ainé - Univ. of Illinois, Urbana, IL
PRESENTERS: *Andreas Cangellaris* - Univ. of Illinois, Urbana, IL
Alina Deutsch - IBM Corp., Yorktown Heights, NY
Umberto Ravaioli - Univ. of Illinois, Urbana, IL
José Schutt-Ainé - Univ. of Illinois, Urbana, IL

Audience: PCB and chip designers who want to gain familiarity with signal integrity issues at high-speeds and who want to develop a more practical approach for designing high-speed modules and high-density chips. Knowledge of basic transmission line theory will be helpful.

Description: With the advent of fast processors and high frequency communication networks, the demand for more accurate computer-aided design (CAD) tools has increased dramatically. Faster signals and higher packing density have exacerbated the noise issues in state-of-the-art IC and package designs. This course will offer an in-depth understanding of the fundamental mechanisms that govern broadband signal transmission in interconnect structures at the different levels of integration. Signal transmission attributes and proper interconnect modeling on-chip and off-chip will be explained and demonstrated through the use of JAVA applets that will be made available to the course participants.

Particular emphasis will be placed on the present-day on-chip wiring design practices and the unique properties of on-chip lossy transmission lines. The deficiencies of RC-circuit-representation-based designs and tools will be highlighted through relevant examples. The shortcomings of some of the RLC-based available tools will also be explained. It will be shown that frequency-dependent resistive and inductive effects (R(f)L(f)C-circuit-representation) are especially important for crosstalk, common-mode noise, and clock skew. Guidelines will be given for design, technology scaling, device sizes used, noise containment, length tradeoffs, clock distribution, operating temperature, and bandwidth improvement. The need for multi-variable performance-driven routers based on worst-case delay, propagated rise-time, and crosstalk will be explained in order to make adequate use of available technologies.



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Tutorial 3

Friday, June 22

CAD TOOLS FOR MIXED-SIGNAL AND RF ICs

rm: N111 - N112

ORGANIZER: *Georges Gielen* - Katholieke Univ., Leuven, Belgium
PRESENTERS: *Georges Gielen* - Katholieke Univ., Leuven, Belgium
Rob A. Rutenbar - Carnegie Mellon Univ., Pittsburgh, PA
Jaijeet Roychowdhury - CeLight, Inc., Springfield, NJ
Francois Clement - Simplex Solutions Inc., Grenoble, France

Audience: Practicing analog, RF and mixed-signal designers who want to learn about the new techniques and methodologies that could boost their design quality and productivity. CAD professionals responsible for implementing or maintaining analog, RF or mixed-signal tools or flows. Anyone with interests in practical RF or mixed-signal ICs.

Description: The growth of wireless services and other telecom applications increases the need for low-cost highly integrated solutions with very demanding performance specifications. This requires the development of intelligent front-end architectures that circumvent the physical limitations posed by the technology. In addition, with the evolution towards ultra deep submicron CMOS technologies, the design of complex systems on a chip (SoC) will emerge which are increasingly mixed-signal designs. The desire to do hand-crafted, one-transistor-at-a-time analog design is increasingly at odds with the current time-to-market constraints and hence the need for more analog design productivity, practical circuit and layout synthesis, and reliable verification at all levels of the mixed-signal hierarchy.

This tutorial will present the recent progress and current state of the art in design tools and methodologies for complex mixed-signal designs as well as for RF IC design. Different aspects will be covered by the different presenters, ranging from techniques and methodologies for analog synthesis both at architectural, circuit and layout level, as well as the recent progress in simulation and modeling for RF designs, as well as methods to analyze substrate noise couplings in mixed-signal ICs. The techniques will be addressed from a designer point of view, so that the attendees can assess how the techniques could be integrated to improve their current design practice.

The tutorial is divided in 4 parts. The first part will describe tools for designing analog building blocks. The second part will present tools for high-level design and simulation of mixed-signal systems. The third part will describe modeling and simulation techniques for RF circuits. The final part will describe methods for the analysis of substrate noise coupling problems in mixed-signal ICs.



Tutorial 4

Friday, June 22

DESIGN-MANUFACTURING INTERFACE FOR UDSM ERA: DESIGNER AND CAD TOOL DEVELOPER PERSPECTIVES

rm: N113 - N114

ORGANIZER: *Andrzej J. Strojwas* - Carnegie Mellon Univ., Pittsburgh, PA
PRESENTERS: *Wojciech Maly* - Carnegie Mellon Univ., Pittsburgh, PA
Dennis Ciplickas - PDF Solutions Inc., San Jose, CA
Sani Nassif - IBM Austin Research Lab., Austin, TX
Andrzej J. Strojwas - Carnegie Mellon Univ., Pittsburgh, PA

Audience: The subtitle of this tutorial is: "What every designer and CAD tool developer should know about the implications of the Ultra Deep Submicron reality on the gigascale product design, verification and manufacturability". It is intended for all system and IC designers, CAD tool developers and university researchers. No IC technology/manufacturing background is required as a prerequisite.

Description: In this age of multi-billion dollar IC fablines and increased time-to-market pressures, achieving profitable production in the shortest possible time becomes an absolutely necessary condition for success. Increasing the initial yield and the rate of the yield ramp has the biggest impact on the product profitability. This task is especially challenging given the disaggregation of semiconductor industry, i.e., emergence of fabless companies and increasing role of foundries in manufacturing. This complex interface between "mother nature", represented by manufacturing process, and the design domain, focused more and more on higher levels of design abstraction, cannot be covered by a simple set of layout design rules and SPICE files to represent all essential relationships. The purpose of this tutorial is to depict a reality of the design-manufacturing interface in a manner useful to IC designers and CAD tool developers.

We will start by presenting an overview of trends in semiconductor industry focusing on the accelerated roadmap which leads to further miniaturization and the increasing role of manufacturing fluctuations. In the big picture, the most important link between design and manufacturing is quantified via manufacturing yield, which must be maximized during IC fabrication but is strongly determined by the design decisions made at all design abstraction levels. Therefore, manufacturing-aware design flow must rely on a spectrum of yield models. We will review in detail such models in the first part of the tutorial.

However, yield modeling cannot be useful if the models are not tuned to process reality and therefore cannot capture IC design sensitivity to process imperfections. To address this issue, the next part of our tutorial will be devoted to process/design characterization techniques/strategies via a comprehensive set of characterization vehicles to identify the key yield loss reasons (systematic, parametric, random defects). We will then discuss abstraction of manufacturability/reliability design rules including sub-wavelength lithography (OPC, PSM) and realistic worst-case SPICE files. These DFM interface capabilities will re-define the design flow and will pose new requirements on the EDA tools. They will enable much more predictive design synthesis and much more realistic verification of the system before its manufacturing. The bulk of our tutorial will propose such a design flow utilizing this DFM interface. We will focus on the following key tasks: technology choice (including monolithic vs. MCM, forecasting of performance, yield ramp-up and cost), high level design decisions using technology abstraction (choice of IP cores, IP migration vs. re-synthesis, etc.), estimation/optimization of timing, signal integrity and power, taking into account manufacturing fluctuations, circuit design optimization for SoC - including mixed-signal components (design centering, timing optimization) and layout optimization (including pre-tapeout optimization and post-tapeout transformations such as model-based OPC).

We will conclude the tutorial by discussing the technical and organizational challenges that must be overcome to successfully implement this new design-manufacturing interface.



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Tutorial 5

Friday, June 22

LOW POWER TOOLS AND METHODOLOGIES FOR THE ASIC INDUSTRY

rm: N119 - N120

ORGANIZER: *Rakesh Patel* - Intel Corp., Santa Clara, CA
PRESENTERS: *Enrico Macii* - Politecnico di Torino, Torino, Italy
Jerry Frankil - Sequence Design Inc., Acton, MA
Renu Mehra - Synopsys, Inc., Mountain View, CA
Mike Lee - Incentia Design Systems, Inc., Santa Clara, CA
Roberto Zafalon - ST Microelectronics, Agrate Brianza, Italy

Audience: This tutorial is primarily intended for ASIC designers, planners and project managers who are looking for practical solutions for reducing power in their designs. The focus is on power-aware design flows/methodology based on CAD solutions that are available today. It is hoped that attendees will come away with an understanding of the issues, tradeoffs and benefits of low power tools and will be able to effectively apply this knowledge to their designs and design flows.

Description: Power has been trending higher on the list of design constraints and today it is at or near the top across all computing platforms - whether this be laptops, cell-phones, hand-held PDAs, rack-mounted web-servers, routers, or big-iron servers in a backroom. Power is no longer a concern for only the thermally constrained high-performance (high-power) systems and energy-constrained low-power hand-held/portable systems. An ever-growing number of ASIC designs in all domains (chipsets, graphics, networking, media-processing, communication, etc.) are now faced with tight power budgets. Designers, many of whom are confronting this challenge for the first time, are looking for solutions they can use. There is large body of literature now on low power techniques, algorithms and tools, but this is not directly applicable to designers who do not have the luxury of creating or optimizing their own libraries, incorporating the latest modeling advance into their power estimation tools, or extending their synthesis tools with

the latest algorithms. For these designers, what works are: a) best-known methods for optimizing their logic - RTL description, either manually or through automation; b) ready-made estimation tools than can provide early feedback during the RTL-phase; c) estimation tools that provide feedback during or after synthesis and that can be used to direct the synthesis tools; and d) optimization algorithms built into the synthesis solutions.

The tutorial is structured to provide information on the state of the art in all these domains. It will start by motivating the need of industrial design frameworks (i.e., combination of design techniques and CAD tools) that explicitly address power minimization. A possible design flow for low-power ASICs will be proposed next. A discussion on how the existing CAD technology is able to support the proposed flow will close the first part. The second part will focus on RT level and gate level power estimation and optimization techniques, commercially available power management solutions and future directions for industrial low power solutions. The third part will focus on recent power optimization techniques in logical and physical synthesis. The last part of the tutorial will provide an industrial design perspective. It will provide examples of applications of the above tools and techniques to real designs. Both power estimation and power optimization experiments and results will be presented and discussed in detail.



Tutorial 6

Friday, June 22

FIELD PROGRAMMABLE DEVICES: ARCHITECTURE AND CAD TOOLS

rm: N107 - N108

ORGANIZER: *Majid Sarrafzadeh* - Univ. of California, Los Angeles, CA

PRESENTERS: *Jason Cong* - Univ. of California, Los Angeles, CA

Alireza Kaviani - Xilinx, Inc., San Jose, CA

Eyal Odiz - Synplicity, Inc., Menlo Park, CA

Majid Sarrafzadeh - Univ. of California, Los Angeles, CA

Audience: Architects, CAD tool developer and users of Field Programmable Devices (FPDs). Researchers interested in learning fundamental problems associated with FPDs. Managers interested in learning more about these devices.

Description: Field Programmable Devices (FPDs) represent an exciting technology that is affecting the way digital circuitry is designed. By offering the advantages of faster time to market and ease of design changes, FPDs have become increasingly popular among the designers in both small and large companies. The purpose of this tutorial is to provide an overview of FPD architecture and related CAD techniques in order to provide a clear understanding of both their capabilities and shortcomings.

We start by presenting a short history, starting from the original simple PLAs to today's complex commercial FPDs. After understanding the basics of various FPD architectures we move on to explain more advanced features of recent FPGAs, such as special-purpose circuitry for arithmetic applications, memory blocks, clock management, and I/O features. We demonstrate examples of those features in VirtexII and APEX, which are the most recent products from two of the largest FPD

vendors. Then we look into the near future of commercial products, which involves integrating a microprocessor on FPGAs. The integration of FPGAs and microprocessors on the same chip will potentially expand the current FPD market to embedded systems by creating new applications. In addition, this new product might provide a suitable platform for configurable computing, which requires a successful marriage between two established programmable technologies: reconfigurable hardware and microprocessors. Next, we conclude this part of the tutorial by providing the highlights of the recent academic research efforts dedicated to the architecture of programmable devices with the goal of improving their speed-performance and area-efficiency.

Finally, we review recent synthesis and physical design of FPDs. We review state-of-the-art logic synthesis, technology mapping, placement with wirelength, congestion, and timing optimization followed by routing methodologies. In particular we focus on CAD methodologies that are of interest in dealing with very large FPDs.



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Technical Program Committee

Mustafa Celik

Monterey Design Systems
894 Ross Dr., Ste. 100
Sunnyvale, CA 94089
(408) 548-4663
celik@mondcs.com

Kwang-Ting (Tim) Cheng

Univ. of California
Dept. of ECE
Santa Barbara, CA 93106
(805) 893-7294
timcheng@ece.ucsb.edu

Jason Cong

Univ. of California
Dept. of CS, 4651 Boelter Hall
Los Angeles, CA 90095
(310) 206-2775
cong@cs.ucla.edu

Marco Di Narale

Univ. of Pisa
Dept. of Computer Engineering
Scuola Superiore S. Anna
via Carducci, 40
Pisa, 56100 Italy
+(39) 050-883453
marco@sssup.it

Limor Fix

Intel Semiconductors Ltd.
Future CAD Tech.
MTM Industrial Ctr., PO Box 498
Haifa, 31000 Israel
+(972) 4-865-5256
fixl@iil.intel.com

Masahiro Fujita

Univ. of Tokyo
Dept. of EE
7-3-1 Hongo, Bunkyo-Ku
Tokyo, 113-8656 Japan
+(03) 5841-6764
fujita@ee.t.u-tokyo.ac.jp

John Glossner

IBM Corp., TJ Watson Research Ctr.
Rte. 134 / PO Box 218
Yorktown Heights, NY 10598
(914) 945-2719
glossner@us.ibm.com

Patrick Groeneveld

Magma Design Automation, Inc.
2 Results Way
Cupertino, CA 95014
(408) 864-2045
patrick@magma-da.com

Dirk Grunwald

Univ. of Colorado
Dept. ECE, Campus Box 425
Boulder, CO 80309-0425
(303) 492-1135
grunwald@cs.colorado.edu

Rajesh K. Gupta

Univ. of California
Dept. of ICS, 444 CS
Irvine, CA 92697
(949) 824-8052
rgupta@ics.uci.edu

Andrew B. Kahng

Univ. of California at San Diego
Dept. of CSE
MC: C014
La Jolla, CA 92093-0114
(858) 822-4884
abk@cs.ucsd.edu

Timothy Y. Kam

Intel Corp.
Strategic CAD Labs., JF4-211
5200 NE Elam Young Pkwy.
Hillsboro, OR 97124-6497
(503) 264-7536
tkam@ichips.intel.com

Kurt Keutzer

Univ. of California
Dept. of EECS, Cory Hall 566
Berkeley, CA 94720-1770
(408) 982-9446
keutzer@eecs.berkeley.edu

Tadahiro Kuroda

Keio Univ.
Dept. of EE
Hiyoshi 3-14-1, Kohoku-ku
Yokohama, 223-8522 Japan
+(81) 45-566-1534
kuroda@elec.keio.ac.jp

Luciano Lavagno

Politecnico di Torino
Dip. di Elettronica
Corso Duca degli Abruzzi 24
Torino, 10129 Italy
+(39) 564-4150
lavagno@uniud.it

Mary Ann Maher

MEMSCAP Inc.
180 Grand Ave.
Oakland, CA 94612
(510) 444-5269
maryann@memscap.com

Malgorzata Marek-Sadowska

Univ. of California
Dept. of ECE, Engr. I
Santa Barbara, CA 93106
(805) 893-2721
mms@ece.ucsb.edu

Noel Menezes

Intel Corp.
2111 NE 25th Ave., MS: JF4-211
Hillsboro, OR 97124
(503) 264-8259
noel.menezes@intel.com

Shin-ichi Minato

NTT Network Innovation Labs.
1-1 Hikarinooka
Yokosuka-shi, 239-0847 Japan
+(81) 468-59-3021
minato@ieee.org



Technical Program Committee

Ralph H.J.M. Otten
Delft Univ. of Tech.
ITS/ENS
Mekelweg 4
Delft, CD 2628
The Netherlands
+(31) 15-278-1600
otten@cas.et.tudelft.nl

Joel R. Phillips
Cadence Berkeley Labs.
2670 Seely Rd., MS:11B2
San Jose, CA 95134
(408) 944-7983
jrp@cadence.com

Carl Pixley
Motorola, Inc.
7700 W. Parmer Ln., MD: PL29
Austin, TX 78729
(512) 996-4464
carl.pixley@motorola.com

Irith Pomeranz
Purdue Univ.
1285 EE Bldg.
West Lafayette, IN 47907
(765) 494-3357
pomeranz@ecn.purdue.edu

Miodrag Potkonjak
Univ. of California
Depr. of CS, 3532G Boelter Hall
Los Angeles, CA 90095-1596
(310) 825-0790
miodrag@cs.ucla.edu

Anand Raghunathan
NEC USA, CGC Research Labs.
4 Independence Way
Princeton, NJ 08540
(609) 951-2967
anand@csl.nj.nec.com

Jaijeet Roychowdhury
55 River Dr. S., Apr. 1409
Jersey City, NJ 07310
(201) 876-9474
jaijeet@yahoo.com

Majid Sarrafzadeh
Univ. of California
Depr. of CS, 3532C Boelter Hall
Los Angeles, CA 90095-1596
(310) 794-4303
majid@cs.ucla.edu

Louis Scheffer
Cadence Design Systems, Inc.
555 River Oaks Pkwy.
MS: 2B2
San Jose, CA 95134
(408) 944-7114
lou@cadence.com

Donatella Sciuto
Politecnico di Milano
Dip. di Elettronica e Informazione
P.zza L. da Vinci 32
Milano, 20133 Italy
+(39) 2-2399-3662
sciuto@eler.polimi.it

Narendra Shenoy
Synopsys, Inc.
18th Main, 6th Block Koramangala
Bangalore, 560095 India
+(91) 80-552-2201
nshenoy@synopsys.com

Vivek Tiwari
Intel Corp.
3600 Juliette Ln., MS: SC12-603
Santa Clara, CA 95052
(408) 765-0589
vivek.tiwari@intel.com

Ingrid Verbauwhede
Univ. of California
Depr. of EE
7440B Boelter Hall, Box 951594
Los Angeles, CA 90095-1594
(310) 794-5209
ingrid@ee.ucla.edu

Diederik Verkest
IMEC
Kapeldreef 75
Leuven, B-3001 Belgium
+(32) 0-16 281 594
verkest@imec.be

Kees A. Vissers
TriMedia Technologies, Inc.
1840 McCarthy Blvd.
Milpitas, CA 95035
(408) 922-4599
kees.vissers@trimedia.com

Chandu Visweswariah
IBM Corp., TJ Watson Research Ctr.
Rte. 134 and Taconic
Yorktown Heights, NY 10598
(914) 945-3124
chandu@watson.ibm.com

Kazutoshi Wakabayashi
NEC Corp.
CGC Media Research Labs.
4-1-1 Miyozaki, Miyamae-ku
Kawasaki, 216-8555 Japan
+(81) 44-856-2134
wakaba@ccm.cl.nec.co.jp

Kenji Yoshida
Semiconductor Tech.
Academic Research Ctr. (STARC)
7F Onarimon BN Bldg.
16-10, Shimbashi 6-Chome, Minato-ku
Tokyo, 105-0004 Japan
+(03) 3436-0520
yoshida@starc.or.jp



Technical Program Committee

PANEL SUB-COMMITTEE:

Dennis Brophy
Model Technology Inc.
10450 SW Nimbus Ave., Bldg. R-B
Portland, OR 97223-4347
(503) 526-1694
dennisb@model.com

Nanette V. Collins
Consultant
37 Symphony Rd., Unit A
Boston, MA 02115
(617) 437-1822
nanette@nvc.com

William H. Joyner, Jr.
Semiconductor Research Corp.
Box 12053
Research Triangle Park, NC 27709
(919) 941-9472
joyner@src.org

Andrew B. Kahng
Univ. of California at San Diego
Dept. of CSE, MC: C014
La Jolla, CA 92093-0114
(858) 822-4884
abk@cs.ucsd.edu

Mike Murray
Acuson Corp.
1220 Charleston Rd.
Box 7393, MS: E-1
Mountain View, CA 94039-7393
(650) 694-5876
mikem@acuson.com

Shishpal S. Rawat
Intel Corp.
1900 Prairie City Rd.
MS: FM5-108
Folsom, CA 95630
(916) 356-6639
shishpal.s.rawat@intel.com

Rob A. Rutenbar
Carnegie Mellon Univ.
2118 Hammerschlag Hall
5000 Forbes Ave.
Pittsburgh, PA 15213-3890
(412) 268-3334
rutenbar@ece.cmu.edu

STUDENT DESIGN CONTEST JUDGES

Steven P. Levitan
Univ. of Pittsburgh
Dept. of EE, 348 Benedum Engr. Hall
Pittsburgh, PA 15261
(412) 648-9663
steve@ee.pitt.edu

Bryan Ackland
Agere Systems
101 Crawfords Corner Rd., Rm. 4E-508
Holmdel, NJ 07733-1900
(732) 949-7248
bda@agere.com

Don Bouldin
Univ. of Tennessee
Dept. of EE, 1508 Middle Dr.
Knoxville, TN 37996-2100
(423) 974-5444
bouldin@microsys0.engr.utk.edu

Richard Gammack
Compaq Computer Corp.
334 South St.
Shrewsbury, MA 01545
(508) 841-2452
richard.gammack@compaq.com

Kumaravel Jagasivamani
Qualcomm
BB-229C
5775 Morehouse Dr.
San Diego, CA 92121-1714
(858) 845-7421
kjagasiv@qualcomm.com

Grant Martin
Cadence Design Systems, Inc.
555 River Oaks Pkwy.
Bldg. 11, MS: 4B1
San Jose, CA 95134
(408) 894-2986
gmartin@cadence.com

Steve Maciejewski
Advanced Micro Devices
3625 Peterson Way, MS: 363
Santa Clara, CA 95051
(408) 774-7763
stevenj.maciejewski@amd.com

Jeff Parkhurst
Intel Corp.
1900 Prairie City Rd., MS: FM5-108
Folsom, CA 95630
(916) 356-6639
jeff.parkhurst@intel.com

Frank Sweeney
Dallas Semiconductor
4401 S. Belwood Pkwy., Bldg. K
Dallas, TX 75244-3292
(972) 371-6566
fsweeney@dalsemi.com

Maruthy Vadam
Qualcomm
BB-227V
5775 Morehouse Dr.
San Diego, CA 92121-1714
(858) 845-8055
mvedam@qualcomm.com



Exhibitor Liaison Committee

David Blaauw
Technical Program Co-Chair
Motorola, Inc.
7700 W. Parmer Ln., Bldg. C
MD; PL29
Austin, TX 78729
(512) 996-7378
blaauw@udsl.sps.mot.com

Deborah Chalmers
Innoveda, Inc.
2077 Gateway Pl., Ste. 400
San Jose, CA 95110
(408) 487-4829
dchalmers@innoveda.com

Sue Drouin
Mentor Graphics Corp.
8005 SW Boeckman Rd.
Wilsonville, OR 97070-7777
(503) 685-1183
sue_drouin@mentorg.com

Larry Eberle
EDA Consortium Representative
Synopsis, Inc.
700 E. Middlefield Rd.
Mountain View, CA 94043-4033
(650) 584-4418
leberle@synopsys.com

Ion Getreu
Publicity Chair
Cadence Design Systems, Inc.
13221 SW 68th Pkwy., Ste. 200
Portland, OR 97223
(503) 968-4809
getreu@cadence.com

Dave Guinther
Avant! Corp.
Front End Div.
101 Billerica Ave., Bldg. 5
N. Billerica, MA 01862
(978) 436-9909
daveg@avantcorp.com

William H. Joyner, Jr.
Panels Chair
Semiconductor Research Corp.
PO Box 12053
Research Triangle Park, NC 27709
(919) 941-9472
joyner@src.org

Peter Kalenak
Numerical Technologies, Inc.
70 W. Plumeria Dr.
San Jose, CA 95110
(408) 273-4316
pkalenak@numeritech.com

Darby Mason-Merchant
Xilinx, Inc.
2100 Logic Dr.
San Jose, CA 95124
(408) 879-5228
darby@xilinx.com

Mark Miller
Synchronicity, Inc.
153 Monaco Ctr.
Pleasanton, CA 94566
(408) 817-9600
mark@synchronicity.com

Jan Rabaey
General Chair
Univ. of California
Dept. of EECS, Cory Hall
Berkeley, CA 94720
(510) 666-3111
jan@eecs.berkeley.edu

Gary Smith
Dataquest
251 River Oaks Pkwy.
San Jose, CA 95134
(408) 468-8271
gary.smith@dataquest.com

Lee Wood
Exhibit Manager
MP Associates, Inc.
5305 Spine Rd., Ste. A
Boulder, CO 80301
(303) 530-4333
lee@dac.com

Ellen J. Yoffa
EDA Industry Chair
IBM Corp./TJ Watson Research Ctr.
PO Box 218, Rm. 39-153
Yorktown Heights, NY 10598
(914) 945-3270
yoffa@watson.ibm.com



Awards

2001 DAC Best Paper Awards

This year, awards are made for the best papers in three categories. Winners were determined from detailed reviews of the accepted papers in the technical sessions. Each award is accompanied by a plaque. The awards are given by ACM/SIGDA (Special Interest Group on Design Automation), IEEE/CAS (Institute of Electrical and Electronics Engineers/Circuits and Systems Society) and EDA Consortium (Electronic Design Automation Consortium).

• DESIGN TOOLS

- Paper 13.1 *A Practical Methodology for Early Buffer and Wire Resource Allocation*
Charles J. Alpert - IBM Austin Research Lab., Austin, TX
Jiang Hu - IBM Corp., Austin, TX
Paul G. Villarrubia - IBM Corp., Austin, TX
Sachin S. Sapatnekar - Univ. of Minnesota, Minneapolis, MN

• DESIGN METHODOLOGY

- Paper 20.2 *Improving Bus Test via IDDT Testing and Boundary Scan*
Chris Papachristou - Case Western Reserve Univ., Cleveland, OH
Massood Tabib-Azar - Case Western Reserve Univ., Cleveland, OH
Shiyu Yang - Intel Corp., Hillsboro, OR

- Paper 47.2 *Analysis of On-Chip Inductance Effects using a Novel Performance Optimization Methodology for Distributed RLC Interconnects*
Kaustav Banerjee - Stanford Univ., Stanford, CA
Amit Mehrotra - Univ. of Illinois, Urbana, IL

• EMBEDDED SYSTEMS

- Paper 49.1 *Energy Efficient Fixed-Priority Scheduling for Real-Time Systems on Variable Voltage Processors*
Gang Quan - Univ. of Notre Dame, Notre Dame, IN
Sharon Hu - Univ. of Notre Dame, Notre Dame, IN

2001 IEEE Fellows

- **Jason Cong** - Univ. of California, Los Angeles, CA
For contributions to the computer-aided design of integrated circuits, especially in physical design automation, interconnect optimization, and synthesis of field-programmable gate-arrays.
- **Mossoud Pedram** - Univ. of Southern California, Los Angeles, CA
For contributions to the theory and practice of low-power design and CAD.

CAD Transactions Best Paper Award

- **Shigeru Yamashita** - NTT Communication Science Labs., Kyoto, Japan
 - **Hiroshi Sawada** - NTT Communication Science Labs., Kyoto, Japan
 - **Akira Nagoya** - NTT Network Innovation Labs., Kanagawa, Japan
- For the paper: *SPFD: A New Method to Express Functional Flexibility*
IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, vol. 19, no. 8, pp. 840-849, August 2000.

ULSI Transactions Best Paper Award

- **Rajamohana Hegde** - Univ. of Illinois, Urbana, IL
 - **Naresh R. Shanbhag** - Univ. of Illinois, Urbana, IL
- For the paper: *Toward Achieving Energy Efficiency in Presence of Deep Submicron Noise*
IEEE Transactions on Very Large Scale Integration (VLSI) Systems, vol. 8, no. 4, pp. 379-391, August 2000.

Outstanding Young Author Award

- **Manish Pandey** - Silicon Access Networks, Inc., San Jose, CA
- For the paper: *Exploiting Symmetry when Verifying Transistor-Level Circuits by Symbolic Trajectory Evaluation*
IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, vol. 18, no. 7, pp. 918-935, July 1999.



Awards

CAS Industrial Pioneer Award

- **Aart de Geus** - Chairman and CEO, Synopsys, Inc., Mountain View, CA
For pioneering logic synthesis.

Marie R. Pistilli Women in EDA Achievement Award

- **Deirdre Hanford** - Senior VP, Business & Market Development, Synopsys, Inc., Mountain View, CA
For her significant contributions in helping women advance in the field of DA technology.

The P. O. Pistilli Scholarship for Advancement in Computer Science and Electrical Engineering Undergraduate Scholarships

The objective of the P. O. Pistilli Scholarship program is to increase the pool of professionals in Electrical Engineering, Computer Engineering and Computer Science from under-represented groups (women, African American, Hispanic, Native American, and physically challenged). In 1989, ACM Special Interest Group on Design Automation (SIGDA) began providing the program. Beginning in 1993, the Design Automation Conference provided the funds for the scholarship and SIGDA continues to administer the program for DAC. DAC normally funds two or more \$4000 scholarships, renewable up to 5 years, to graduating high school seniors. In 1999 the IEEE Circuits and Systems Society also began to sponsor these scholarships. The 2001 winners will be announced at the Conference. The 2000 winners were:

2000 DAC P. O. Pistilli ACSEE Undergraduate Scholarships

Julian Virgil Dawson, Navarre, FL - attending Georgia Institute of Tech.
Nelson Ramirez, Homestead, FL - attending Univ. of Miami
Lillian Jane Chu, Victorville, CA - attending Stanford Univ.
Sarah Briana Solter, Coleta, CA - attending Stanford Univ.
You-Chen Tao, Torrance, CA - attending Univ. of California, Berkeley

For more information about the P. O. Pistilli scholarship, please contact Dr. Cherrice Traver, EE/CS Dept., Union College, Schenectady, NY 12308. email: traver@union.edu

Design Automation Conference Graduate Scholarships Awards

Each year the Design Automation Conference sponsors several \$24,000 scholarships to support graduate research and study in Design Automation (DA), with emphasis in "design and test automation of electronic and computer systems". Each scholarship is awarded directly to a university for the Faculty Investigator to expend in direct support of one or more DA graduate students.

The criteria for granting such a scholarship expanded in 1996 to include financial need. The criteria are: the academic credentials of the student(s); the quality and applicability of the proposed research; the impact of the award on the DA program at the institution; and financial need. Preference is given to institutions that are trying to establish new DA research programs.

Information on next year's DAC scholarship award program will be available on the DAC web page at: <http://www.dac.com>.

The Association for Computing Machinery/Special Interest Group on Design Automation (ACM/SIGDA) Distinguished Service Award

Robert Grafton - National Science Foundation

For contributions to the EDA profession through his many years as the Program Director of NSF's Design, Tools, and Test Program of the Computer, Information Sciences & Engineering Directorate. In this position, he provided supervision, mentorship, and guidance to several generations of EDA tool designers and builders funded by grants from the National Science Foundation.



Awards

DAC 2001 Student Design Contest Winners

Operational Category

1st Place \$4,000

(session 44.5) **A True Single-Phase 8-bit Adiabatic Multiplier**
Suhwan Kim, Conrad H. Ziesler, Marios C. Papaefthymiou -
Univ. of Michigan

2nd Place (tie) \$2,500

(session 9.1) **Design of Half-Rate Clock and Data Recovery
Circuits for Optical Communication**
Jafar Savoj, Behzad Razavi - Univ. of California, Los Angeles

2nd Place (tie) \$2,500

**Optimal Design of a Low Power, Low Noise 3.4 GHz
CMOS Downconverter**
Peter J. Vancorenland, Geert Van der Plas, Michiel Steyaert,
Willy Sansen - Katholieke Univ., Leuven, Belgium

Honorable Mention

**\$500 A 1.8 GHz CMOS Cellular Transceiver Front-End: From Integrated
Circuit to Integrated System Design**
Michiel Steyaert, Bram De Muer, Johan Janssens, Marc Borremans -
Katholieke Univ., Leuven, Belgium

Conceptual Category

1st Place \$4,000, Best Paper \$1,000

(session 50.2) **Two-Dimensional Position Detection System
with MEMS Accelerometer for MOUSE Applications**
Seungbae Lee, Gijoon Nam, Junseok Chae, Hanseup Kim,
Alan J. Drake - Univ. of Michigan

2nd Place \$2,500

**A Configurable, Algorithm-Specific Processor for Real-Time
Wavelet-Based Video**
Li Ding, Yi Li, Richard B. Brown - Univ. of Michigan

3rd Place \$1,500

**VLSI Implementation of Binaural Spatializer Using FIR Head-Related
Transfer Function (HRTF)**
NamSung Kim, Jiyoun Kim, Mingyu Cho, TaeYoung Choi, Trevor Mudge -
Univ. of Michigan

**\$500 HiPAR-DSP 16: VLSI-Design of a Second Generation
Programmable Parallel Multimedia-DSP**

Willm Hinrichs, Jens Peter Wittenburg, Hanno Lieske, Helge Kloos, Lars
Friebe, Peter Pirsch - Univ. of Hannover, Germany



Birds of a Feather / Additional Meetings

Birds-Of-a-Feather (BOF) Meetings

DAC will provide conference rooms for informal groups to discuss items of common technical interest. These very informal non-commercial meetings, held after hours, are referred to as "Birds-of-a-Feather". All BOF meetings are held at the Las Vegas Hilton, Wednesday, June 20, 2001, 6:00PM - 7:30PM. DAC will facilitate common interest group meetings to discuss DA related topics. To arrange a BOF meeting contact the DAC office at mpa@dac.com or sign up at the Information Desk at-conference. A room will only be assigned if ten or more people sign up. A viewgraph projector and screen will be provided on request. Check DACnet and the Birds-of-a-Feather board at the Information Desk.

BOF: High Level Modeling for Validation

The term "high level model" is highly overloaded; some of the intended uses of such an "HLM" include high level synthesis, a "live design model", or a performance model enhanced with functionality. The proposed topic adds another dimension: that of validation (i.e., "How do we use an HLM for better validation?").

This session targets validators and EDA tool developers as well as those interested in modeling languages. The goal is to discuss issues related to the need to address the potential increase in the gap between design complexity and the power of validation tools to "cover" it, the *features* of a modeling language (e.g., abstraction, non-determinism, object orientation etc., without getting into a language war) that are desirable from a validation perspective, and possible solutions.

ACM/SIGDA Ph.D Forum and SIGDA Member Meeting

ACM/SIGDA will hold a semi-annual meeting after the cocktail party on Tuesday evening, June 19, 2001, from 7:00PM to 9:00PM in room N250. A light dinner will be served. The primary focus of the meeting will be the fourth annual Ph.D. Forum. The meeting is open to all members of the DA community.

The Ph.D. Forum, hosted by SIGDA, aims to strengthen the ties between academic research and industry. During the SIGDA meeting, students will use posters to discuss their Ph.D. thesis work with interested attendees. This session will provide the students an opportunity to receive feedback on their work. It also previews academic work-in-progress to the DA community. For more information about the Forum, please visit <http://www.sigda.acm.org/Programs/PHDForum>. SIGDA members and non-members are invited.

VSIA's Luncheon

June 20, 2001, 12.00 p.m. - 2.00 p.m.

Las Vegas Convention Center, Room N246

The complexity of silicon designs is increasing dramatically. The industry-wide challenge is to bridge the gap between the millions of transistors that can be integrated on one chip and the productivity of the design engineer of System on Chip (SOC) devices. The VSI Alliance works with its member companies to provide solutions for many engineering design issues that are keeping the Electronics Industry from implementing system-level ICs in a timely and cost effective manner. The Virtual Socket Interface Alliance (VSIA) invites you to attend a luncheon event at this year's Design Automation Conference (DAC). This meeting will discuss VSIA's methodologies, solutions, technical status and progress to help the industry attack this problem. Other program features include an update on VSIA's On-line Compliance program and Adoption examples. The program will conclude with a discussion on VSIA Quality Group's metric and future plans.



The 38th Design Automation Conference • June 18 - 22, 2001 • Las Vegas, NV

39th DAC Call for Papers

39th DESIGN AUTOMATION CONFERENCE®

Ernest N. Morial Convention Center, New Orleans, LA • June 10-14, 2002

DAC is the premier conference devoted to Design Automation (DA) and the application of DA tools in designing electronic systems. Five types of submissions are invited: regular papers, special topic sessions, panels, tutorials, and student design contest entries. Panel and tutorial suggestions should be submitted electronically to: www.dac.com NO later than November 1, 2001, 5:00 PM MST. Other submissions should be submitted electronically to: www.dac.com NO later than December 7, 2001, 5:00 PM MST.

Requirements for Submission

All DAC Submissions must be made electronically using PDF format. Reference the DAC web page (www.dac.com) for instructions on electronic submissions. Please submit 2 files: 1) an abstract of approximately 60 words clearly stating the significant contribution, impact and results of the submission. 2) the paper itself in double column format with a minimum 10pt font, not to exceed 8-pages including all figures, tables and references (format templates are available on the DAC website). Submissions exceeding the 8 page limit, fonts smaller than 10pt, or identifying the authors or their affiliations will be automatically rejected.

The following information will be needed when submitting your paper:

- Name, affiliation, and complete address for each author
- A designated contact person including his/her phone #, fax #, and email address
- A designated presenter, should the paper be accepted
- A list of topic numbers preceded by the letter T (Tools Track), M (Methods Track), or E (Embedded Systems Topic) ordered by relevancy, most clearly matching the content of the paper
- The following statement: "All appropriate organizational approvals for the publication of this paper have been obtained. If accepted, the author(s) will prepare the final manuscript in time for inclusion in the Conference Proceedings and will present the paper at the Conference".
- Authors of accepted papers must sign a copyright release form for their paper. Authors must also provide MP Associates a copy of their presentation materials and grant permission for the publication of the presentation and presentation materials on the DAC web site.

To permit a blind review, do not include name(s) or affiliation(s) of the author(s) on the manuscript, abstract or bibliographic citations. The papers will be reviewed as finished papers. Preliminary submissions will be at a disadvantage. Notice of acceptance will be mailed to the contact person by March 8, 2002.

Panels, Tutorials, Special Topic Sessions

Panel and tutorial suggestions should not exceed two pages in length and should describe the topic and intended audience. They should include a list of suggested participants. Tutorial suggestions must include a bulleted outline of covered topics. DAC reserves the right to restructure and modify submitted panel and tutorial suggestions, including moderators and participants. Panel and tutorial suggestions must be electronically submitted **NO later than November 1, 2001 (5:00pm MST)**.

Special Topic Sessions may be either independent papers with a common theme or a set of closely related papers describing an overall system. In both cases, independent reviews of each paper and evaluation of the session as a whole will be used to select sessions. Suggestions for Special Topic Sessions should be submitted along with the list of papers to be included in the session and should describe the session's theme. These submissions must be electronically submitted **NO later than December 7, 2001 (5:00pm MST)**.

Student Design Contest

Submissions of original electronic designs (circuit or system), developed at universities and research organizations after June 2000 and resulting in operational implementations are invited. Submissions should contain the title of the project, a 60-word abstract and a complete description of the design, not exceeding 4000 words in text. The submission should clarify the originality, distinguishing features, and the measured performance metrics of the design. Proof-of-implementation in the form of die or board photographs and measurement data is a must. Submitted designs should not have received awards in other contests. Submissions will be reviewed by a special committee of experts. Selected designs will be presented and exhibited at the conference.

Topics of Interest

Authors are invited to submit original technical papers describing recent and novel research or engineering developments in all areas of design automation. Topics of interest include, but are not limited to the listing on the following page.

39th DAC Call for Papers



Design Tools Track

The Design Tools track (T) is devoted to contributions to the research and development of design tools and their supporting algorithms. Focus is on innovation of specific modeling, analysis and optimization techniques.

- T0.1 Fundamental CAD Algorithms, e.g., BDDs, graph coloring, partitioning
- T1.1 Electrical-level circuit and timing simulation
- T1.2 Discrete simulation
- T1.3 Static timing analysis and timing verification
- T1.4 Power estimation
- T2.1 Testing, fault modeling and simulation, TPG, test validation and DFT
- T2.2 Design and implementation verification (excluding layout verification)
- T3.1 Floorplanning and placement
- T3.2 Global and detailed routing
- T3.3 Module generation and compaction, transistor sizing and cell library optimization, layout verification

- T4.1 Technology-independent, combinational logic synthesis
- T4.2 Technology-dependent logic synthesis, library mapping, interactions between logic design and layout
- T4.3 Sequential and asynchronous logic synthesis and optimization
- T4.4 System, logic and physical synthesis techniques for reconfigurable computing
- T4.5 High-level synthesis
- T5.1 Interconnect and package modeling and extraction
- T5.2 Signal integrity and reliability analysis
- T5.3 Analog and mixed-signal design tools and RF
- T5.4 Microsensor and microactuator design tools
- T5.5 Statistical design and yield maximization
- T6.1 IP protection and watermarking techniques for designs, tools, and algorithms
- T6.2 Frameworks, intertool communication, WWW-based tools and databases

Design Methods Track

The Design Methods track (M) deals with innovative methodologies for the design of electronic circuits and systems, as well as creative experiences with design automation in state-of-the-art designs. Submissions for this track will be judged on how innovatively tools are combined into a new methodology that is effectively applied to real-world design problems. Papers focusing on algorithmic advances in modeling, analysis and optimization should be submitted to the Design Tools Track.

Design methodologies and case studies for specific design tasks

- M1.1 Design entry and specification
- M1.2 Electrical-level simulation and modeling
- M1.3 Discrete simulation and modeling
- M1.4 Static timing and performance analysis
- M1.5 Functional design verification
- M1.6 Testing, test generation and debugging
- M1.7 Physical design, module generation, design for manufacturing

- M1.8 Logic synthesis, including interaction with physical synthesis
 - M1.9 High-level and architectural synthesis
- Design methodologies and case studies for specific application domains and platforms**
- M2.1 Overall design flows and methodologies for specific design applications
 - M2.2 Configurable computing, FPGAs and rapid prototyping
 - M2.3 Deep sub-micron: signal integrity, interconnect modeling and extraction
 - M2.4 High-performance design: timing, clocking and power distribution
 - M2.5 Low power design
 - M2.6 Analog, mixed signal, and RF design
 - M2.7 Process technology development, extraction, modeling and new devices
 - M2.8 MEMS, sensors, actuators
- Integration and management of DA systems**
- M3.1 Management of DA systems, design interfaces, standards
 - M3.2 Distributed, networked, and collaborative design
 - M3.3 Intellectual property, design re-use and design libraries

Embedded Systems Topics:

Embedded Systems are characterized by mixed hardware and software components with limited processing, I/O and storage resources. The increasing role played by software components and their associated support introduces a host of new system design issues. To focus on these, the 39th DAC will have embedded systems sessions covering both the "tools" and the "methods" aspects of the following topics:

- E1 Low-power design: compilation, scheduling and partitioning
- E2 Embedded software: retargetable compilation, memory/cache optimization, real-time single-processor scheduling
- E3 HW/SW co-design: specification, modeling, co-simulation and performance analysis, system-level scheduling and partitioning
- E4 Hardware and software platform design: IP-based design, communication design, embedded HW
- E5 Case studies



The 38th Design Automation Conference • June 18 - 22, 2001 • Las Vegas, NV

Sponsorship

The 38th Design Automation Conference is sponsored by the **ACM/SIGDA** (Association for Computing Machinery/Special Interest Group on Design Automation), **IEEE/CAS** (Institute of Electrical and Electronics Engineers/Circuits and Systems Society), and the **EDA Consortium** (Electronic Design Automation Consortium). Membership information is available at the ACM and IEEE booths.

Free IEEE and CAS Membership Promotion at the 38th DAC
Promo Code – XZZ0301 • The IEEE Circuits and Systems Society is offering free membership to IEEE and the CAS Society during the 38th DAC advance and at-conference registration. The only stipulations are that you must be a first-time applicant and join both the IEEE and the CAS Society. Please use the IEEE/CAS Society membership application form found on the opposite page. If you sign up for free membership, which is valid for the remainder of the year 2001, you may also apply for the conference reduced registration rate. If you choose to register on-site, you must stop by the IEEE or CAS information booths to apply for free membership BEFORE you proceed to conference registration. This will allow you to register for the conference at the reduced rate.

Note: If you pay for DAC registration before you apply for your free IEEE/CAS membership, you will be unable to receive a refund for the difference between member and non-member registration fees, although you will still be able to take advantage of all the other benefits of IEEE/CAS membership.

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IEEE Circuits and Systems Society

The IEEE Circuits and Systems (CAS) Society is one of the largest societies within IEEE and in the world devoted to the analysis, design, and applications of circuits, networks, and systems. It offers its members an extensive program of publications, meetings and technical and educational activities, encouraging an active exchange of information and ideas. The Society's peer reviewed publication activities include: Trans. on CAD; Trans. on CAS-Part I (Fundamentals); Trans. on CAS-Part II (Analog & Digital Signal Processing); Trans. on VLSI; Trans. on CAS for Video Technology; and the new Transactions on Multimedia which is co-sponsored with IEEE sister societies. CAS also sponsors or co-sponsors a number of international conferences, which include the Design Automation Conference (DAC), the Int'l Conference on Computer-Aided Design (ICCAD) and the Int'l Symposium on Circuits & Systems (ISCAS). A worldwide comprehensive program of advanced workshops including a new series on "Emerging Technologies in Circuits and Systems", as well as our continuing education short courses bring to our worldwide membership the latest developments in cutting-edge technologies of interest to industry and academia alike.

The IEEE/CAS Society has been serving its membership for over 50 years with such member benefits as:

- Discounts on all Society publications, conferences and workshops (including co-sponsored and sister society publications and conferences)
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- Opportunity to read and review papers, write articles and participate in the Society's government
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EDA Consortium

Founded in 1989, the EDA Consortium is an international association of companies engaged in the development, manufacture and sale of electronic design automation (EDA) tools and services. The Consortium is comprised of a Board of Directors of industry CEOs with active committees and a supporting staff. EDA Consortium seeks to identify and address issues that are common to its members and the community they serve. The Consortium's mission is to support the health of the EDA industry.

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- Sponsoring DAC (USA) and DATE (Europe)
- Publishing the MSS (Market Statistics Service)
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SIGDA/DAC University Booth

Each year SIGDA organizes the University Booth. The booth is an opportunity for university researchers to display their results and to interact with visitors from industry. Priority is given to presentations that complement the conference technical program. Demos that highlight benchmark results are also encouraged. The Design Contest winners will give demonstrations presenting their designs at the University Booth, Tuesday, 12:00PM - 2:00PM. The schedule of presentations will be published at the conference and will also be available on the SIGDA website. We thank the Design Automation Conference for its continued support of this project.



Proceedings

ACM/SIGDA (Association for Computing Machinery/Special Interest Group on Design Automation) and the Design Automation Conference will jointly publish the proceedings of DAC'01 on CD-ROM. Papers can be accessed using Adobe Acrobat Reader 4.0 (included on the CD-ROM). DAC Proceedings will also be available on the World Wide Web after the conference.

A compendium CD-ROM containing the conference proceedings from the previous year is published annually, beginning with the Compendium'94 (containing DAC, EURO-DAC, and ICCAD). Compendium'99 contains ASP-DAC'99, DAC'99, DATE'99, ICCAD'99 and proceedings from four symposia (FPGA'99, ISLPED'99, ISPD'99, and ISSS'99). Compendium'00 will include ASP-DAC'00, DATE'00, DAC'00, ICCAD'00, FPGA'00, ISPD'00, ISLPED'00, CODES'00, and ISSS'00. SIGDA conference proceedings on CD-ROM and Compendium CD-ROMs are available from ACM. Stop by the ACM Booth for further information.

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TODAES will be your pulse in the rapidly changing field of design technology of electronic systems. TODAES will keep you current in the areas of system design, high level synthesis, physical layout, design verification, system reliability, and high performance circuits. TODAES subscriptions are available in three formats: print (includes an annual CD-ROM), online, or both.

38th DAC Proceedings

The 38th DAC proceedings will contain 160 papers, panels, and special invited presentations. DAC is offering each conference and student registrant the proceedings in both the hardbound edition and the CD-ROM edition. Should you wish to purchase any additional copies you may do so at the ACM booth for \$50.00. After the conference, mail orders should be sent to ACM; approximate cost after conference is \$70 for members, and \$140 for non-members. ACM should be contacted before placing your order to determine cost and availability of the proceedings. The address is:

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