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# SOLID-STATE CIRCUITS

IEEE Solid-State Circuits Society Quarterly Newsletter



## Wooley Named Recipient of IEEE Solid-State Circuits Technical Field Award: Recognized for Pioneering Oversampling Data Converters in Audio

The 2005 IEEE Solid-State Circuits Technical Field Award will be presented to Bruce A. Wooley for “pioneering contributions to integrated electronics for analog-to-digital data conversion in communications systems.” Behzad Rezavi, professor of EE at UCLA commented on Wooley’s accomplishments, “Wooley’s fundamental research on analog-to-digital interfaces and, in

particular, oversampling converters has shaped our thinking and provided analytical tools that now have become an integral part of high-performance design work.”

The oversampling simplifies the choice between what needs to be done in analog, which is more challenging to design, and what needs to be done in digital. Oversampling is used in cell phones, MP3 players, disk-drive electronics, video, wireless, ethernet, medical imaging, and instrumentation. The success of a huge array of pervasive integrated circuit products is due to the clear understanding and application of these concepts.

Also known as sigma-delta modulators, the robust design characteristics provided by oversampling converters eliminate stringent component matching in VLSI. “The technology has revolutionized the world of modern data conversion systems and is vital for low-cost, fully integrated digital communication systems,” said Kambiz Kaviani of Rambus.

Wooley first worked on oversampled sigma-delta converters while at Bell Labs in the late 1970s and early 1980s. His research at Stanford University advanced the state of the art in sigma-delta converters with over a dozen *JSSC* papers on this subject. For example, the 1988 paper with Bernhard Boser describes the design of an audio-frequency sigma-delta A/D converter. The analysis and measured results in



this paper demonstrate that a sigma-delta converter with a second-order switched-capacitor modulator and a one-bit quantizer is not only viable, but is the preferred way to implement audio-frequency A/D converters. Today, the overwhelming majority of data converters for voice and audio applications are oversampled converters based on sigma-delta modulation.

The concept of sigma-delta modulation (also known as delta-sigma modulation) was first published by researchers at the University of Tokyo in 1962. According to David Su of Atheros, “The 1988 article with Boser on oversampling clearly explained how to design it, how to analyze it, and made it seem simple enough that most readers felt they could do it too. Because it wasn’t patented, designers could do it them-

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selves. People didn't have to avoid doing what was explained so clearly. Industry could advance by copying it, adapting it, and improving it." This paper has been widely cited and is recognized as a *JSSC* classic. See the accompanying article on page 5.

Jim Candy, who worked with Wooley in the research division of Bell Labs in the 1980s, remembers that the development division of the company was focusing on switched capacitors because in those days they were easy to make. "The research division was kept purposefully isolated from the development division because we could so easily get dragged into their emergencies and deadlines. We worked on developing a solution using oversampling, which is more accurate. We were trying to get away from analog but we knew we had to have

some. Bruce Wooley provided the design for small analog circuits that we could fabricate alongside the digital in both bipolar and, more often later, in CMOS."

At the time Bell Labs stayed with switched capacitors in its ESS5 switch, which became a workhorse of telecom the following decade. It took the pressure of deadlines to get the development and research division to finally work together. "The switched capacitor solution required all the work in analog and had 2 to the 13th power levels. We had it down to two levels with oversampling. The research effort totaled almost a decade."

### The Legacy

None of the IC experts contacted could comment on Wooley's technical impact without also men-

tioning the legacy of Wooley's students. Dave Hodges, Professor Emeritus at the University of California, Berkeley, said, "At Stanford, he has guided the research of outstanding students who have become leaders in their own right." According to Paul Gray, Executive Vice Chancellor and Provost, University of California, Berkeley, "The students he has mentored over the years have gone on to make many contributions in their own careers. It's great to see this recognition of his outstanding contributions." Some of his graduate students are Bernhard Boser at UC Berkeley, Behzad Rezavi at UCLA, Sha Rabbii and Marc Loinaz at Aeluros, James Pan at Kendin, Jieh-Tsong Wu at the National Chiao Tung University in Taiwan, Katy Falakshahi at New Enterprise Associates, Alirez Shirvani at Stanford, Robert Drost at Sun, and Louis Albert Williams III at Texas Instruments.

Graduate students remember Wooley reminding them, "You are not here to simply do good research. You are here to *publish* good research." Students came away believing that in circuit design it's important to be useful and relevant. To be useful you have to be articulate so that someone can benefit from your work.

His exacting standards on clear written and verbal communications, his emphasis on teamwork among his students, and his belief in enhancing academic and industry collaboration perhaps provide his most lasting contributions. Even students who did not have Wooley as their primary advisor credit his support as critical in the development of their thesis work and still refer to bound notes from his class ten years later.

Wooley's impact is notable in industry as well. David Soo, president and CEO of Chronitel (a maker of encoders for digital video), credits Wooley's invaluable networking for the success of Chronitel. "Wooley has been with us since our inception, encouraging, helping us find out how

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Contributions for the January 2005 issue of the newsletter **must be received by 1 November 2004** at the SSCS Executive Office.

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things should be done, helping to define products that start with customer requests...and always supporting us, even when the business is tough."

### The Award

The IEEE Solid-State Circuits Technical Field Award was established in 1987 to honor an individual, or team of up to three, for outstanding contributions to solid-state circuits, as exemplified by benefit to



society, enhancement of technology, and professional leadership.

The award consists of a bronze medal, a certificate, and a cash honorarium that will be presented at the ISSCC 7 February 2005. The Solid-State Circuits Award is one of three dozen technical specialties for which IEEE annually recognizes outstanding worldwide contributors. ●

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## Bruce A. Wooley

**B**ruce A. Wooley (S'64-M'70-SM'76-F'82) was born in Milwaukee, Wisconsin, on 14 October 1943. He received his BS, MS, and PhD degrees in electrical engineering from the University of California, Berkeley, in 1966, 1968, and 1970, respectively.

From 1970 to 1984 Dr. Wooley was a member of the research staff at Bell Laboratories in Holmdel, New Jersey. In 1980 he was a visiting lecturer at the University of California, Berkeley. In 1984 he joined the faculty at Stanford University, where he is the Robert L. and Audrey S. Hancock Professor of Engineering and the chair of the Department of Electrical Engineering. At Stanford he served as the senior associate dean of engineering and the director of the Integrated Circuits Laboratory. His research is in the field of integrated circuit design, where his interests include low-power mixed-signal circuit design, oversampling A/D and D/A conversion, circuit design techniques for video and image data acquisition, high-speed embedded memory, high-performance packaging and testing, noise in mixed-signal integrated circuits, and circuits for wireless and wireline communications. He has published more than 140 technical articles and is a coauthor of *The Design of Low-Volt-*

*age, Low-Power Sigma-Delta Modulators* (Kluwer, 1998) and *Design and Control of RF Power Amplifiers* (Kluwer, 2003). He also is a coeditor of *Analog MOS Integrated Circuits, II* (Wiley, 1989).

Dr. Wooley is a Fellow of the IEEE and a past president of the IEEE Solid-State Circuits Society. He has served as the editor of the *IEEE Journal of Solid-State Circuits* and as chair of both the International Solid-State Circuits Conference (ISSCC) and the Symposium on VLSI Circuits. He is also a past chair of the IEEE Solid-State Circuits and Technology Committee, and he has been a member of the IEEE Solid-State Circuits Society Adcom, the IEEE Solid-State Circuits Council, the IEEE Circuits and Systems Society Adcom, the Executive Committee of the ISSCC, and the Executive Committee of the Symposium on VLSI Circuits. He was awarded the University Medal by the University of California, Berkeley, and was an IEEE Fortescue Fellow. He was a recipient of the IEEE Third Millennium Medal and was recognized for his outstanding contributions to the technical papers of the International Solid-State Circuits Conference on the occasion of the conference's fiftieth anniversary. He was also a recipient of the Outstanding Alumnus Award from the EECS Department at the University of California, Berkeley. ●

## Sigma-Delta Converter: How It Works

**O**versampling is the technique of sampling an analog signal at more than twice the highest signal frequency. Operating a converter at a high sampling rate exchanges circuit speed for amplitude resolution. For example, a 3-bit flash analog-to-digital converter consists of seven comparators. An obvious way to increase the converter resolution is to use more comparators. A less obvious but easier approach to improving the converter resolution (for low-frequency signals) is to increase the sampling rate.

Sigma-delta modulation can be used as an efficient oversampling technique that shapes or rearranges the quantization error in frequency. A sigma-delta converter with a 1-bit quantizer can achieve 16-bit resolution within the audio frequency band when oversampled more than 100 times. Sigma-delta A/D converters employ an analog feedback loop to shape the quantization error away from the signal band of interest. A digital filter can then remove the "out-of-band" quantization error and increase the resolution of the converter.

Sigma-delta converters are popular because of their ease of implementation. These converters can achieve high resolution without precise component matching. ●

**David Su**  
Atheros

## A JSSC Classic Paper: The Simple Model of CMOS Drain Current

In a recent update of the Web list of frequently cited JSSC articles, an April 1990 paper by Takayasu Sakurai and A. Richard Newton on “Alpha-power law MOSFET model and its applications to CMOS inverter delay and other formulas” joined the list of articles cited more than 100 times according to the annual *Journal Citation Reports* published by Thomson ISI. At the time the paper was written, Sakurai had just taken a break

from a seven-year career working on memories at Toshiba to come to the University of California, Berkeley, as a visiting scholar and worked with Richard Newton, the dean of Berkeley’s Electrical Engineering Department. Writing now from the Center for Collaborative Research and the Institute of Industrial Science at the University of Tokyo, Sakurai summarizes the inspiration and impact of this paper.

### Alpha Power-Law MOS Model

This paper contains the first proposal of the alpha power-law MOS model, which is a simple yet practical drain-current model for short-channel MOSFETs. The model has been widely used in circuit designs and circuit behavior modeling. Mathematically, it is so simple that it can be used not only for simulations (1) but also for analytical treatments of circuit behavior. Expressions for power consumption, delay, logical threshold, and other quantities are derived using the model in the paper.

The basic concept is that the drain current of short-channel MOSFETs is proportional to  $(V_{GS} - V_{TH})^\alpha$ , where  $V_{GS}$  is the gate-to-source voltage,  $V_{TH}$  is the threshold voltage, and alpha is a carrier velocity saturation index. It is a natural extension of the historical Shockley model since it coincides with the Shockley model when alpha is set to 2. For the recent short-channel MOSFETs, alpha is typically around 1.3. Before the alpha power-law MOS model, there were many MOS models but they were far more complicated, and manipulating the models analytically did not give fruitful results for circuit designers.

Analytical expressions for the serially connected MOSFET structure, which is the basic structure found in basic NAND and NOR gates, also have been analyzed and delay expressions for the structure have been derived using the model (2). Suppose that  $n$  transistors are connected in series and discharge a load capacitor. The delay ratio of the circuit compared with a single transistor discharging the same load capacitor is reduced as alpha decreases. This means that serial connection in shorter channel devices is not as bad as in longer channel devices. Circuit behavior of more complex circuits, such as SRAM cells and sense amplifiers, also has been analyzed by the model (3).

The conception of the model occurred when I was looking at the measured drain current curve of a 1.2-

$\mu\text{m}$  MOSFET. I noticed that the I-V curve did not show the quadratic dependence as was taught in textbooks. Instead, it showed that the dependence was close to linear. What simple mathematical expression could represent both quadratic and linear dependence? The simplest would be to use  $x^\alpha$ . By plotting measured short-channel MOS I-V curves down to a 0.5- $\mu\text{m}$  channel length, the conjecture was shown to be true. The alpha-power function could fit to the measured curves quite well. Why did I use the Greek character  $\alpha$ ? It was because  $\alpha$  is the first Greek character and most of the other Greek characters were taken by other quantities such as  $\beta$  for  $\beta$  ratio and  $\gamma$  for body bias coefficient.

When the model was first introduced, it was purely empirical and mathematical, without physical background. After a while, however, the physical interpretation of the alpha-power dependency was investigated by multiple authors (4, 5) and it was determined that the origin of the alpha-power dependence is based on mobility degradation at high electric fields. Efforts also have been made to connect the exponential dependence of subthreshold current,  $I_{SUB}$ , and the alpha-power dependence of on current,  $I_{ON}$  as follows, where  $s$  signifies subthreshold swing (6):

$$I_{ON} = I_0(S\alpha)^{-\alpha}(V_{GS} - V_{TH})^\alpha, I_{SUB} = I_0 e^{-\alpha} e^{\frac{V_{GS}-V_{TH}}{s}}$$

In the paper the method to extract alpha from the I-V curves is also discussed. But with each generation of technology advances since 1990,  $V_{DD}$  has been decreased, and alpha is now almost fixed at about 1.3. This may be a result of the electric field being almost constant in these devices, which leads to nearly constant carrier velocity saturation.

Since the alpha-power model reproduces the voltage dependence of the drain current of MOSFETs very well, being independent from structures and materials of MOSFETs, it is often used to predict the scaling trend of

VLSIs. Now that sub-volt design is becoming mainstream, the voltage dependence of CMOS gate delay is of great importance. By using the model, the delay is proportional to the following quantity:

$$\text{delay} \propto \frac{V_{DD}}{(V_{DD} - V_{TH})^\alpha}$$

This relationship is often used to estimate delay trends for the future and it also is used for circuit designs where the  $V_{DD}$  and  $V_{TH}$  are varied in time. These variable  $V_{DD}$  and  $V_{TH}$  designs are getting a mainstream design style to cope with the ever-increasing dynamic and leakage power consumption of LSIs. The body bias effect is important in variable  $V_{TH}$  design and the body bias effect of serially connected MOSFETs is also analyzed by the alpha-power model (7). Since the model is very simple and comprehensive, it will continue to be used in estimating behavior of MOSFET circuits. ●

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## A JSSC Classic Paper: Sigma-Delta Converters

The 1988 classic paper by Bernhard E. Boser and Bruce A. Wooley, "The design of sigma-delta modulation analog-to-digital converters," joins the Web list of frequently cited articles from the *JSSC* ([sscs.org/jssc/top-cites.htm](http://sscs.org/jssc/top-cites.htm)). The list contains *Journal* articles that have been cited more than 100 times according to the recently updated *Scientific Index* published by Thomson ISI. There are only 26 articles on this list out of over 7,000 *JSSC* published articles, making it a *singular* honor to be included.

The December 1988 paper provides a classic and clear explanation of why Nyquist sampling theory alone is insufficient for efficient analog-to-digital

converters, beginning with, "The oversampled A/D converter architecture offered a means of exchanging resolution in time for amplitude, in order to avoid the difficulty of implementing complex precision analog circuits."

The article is described in the accompanying article on the IEEE Solid-State Circuit Award to Wooley and has been referenced in the *JSSC*, the *Transactions Circuits and Systems II: Analog and Digital Signal Processing*, the *IEEE Transaction on Computer-Aided Design of Integrated Circuits and Systems*, and the *IEEE Transaction on Instrumentation and Measurement*. ●

## Congratulations New Senior Members

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# Inaugural Issue of *Journal of Display Technology* Scheduled for September 2005



Jointly sponsored by seven IEEE Societies and the Optical Society of America, the *Journal of Display Technology (JDT)* is a new archival journal devoted to the timely dissemination of new results and discussions in all aspects of display technologies, from understanding the basic science and engineering of devices, to device design and fabrication, to system design, applications, and human-factors topics. Clearly, these topics span many disciplines, and this journal will bridge, for the first time, these multidisciplinary themes. Papers are solicited in all areas of display technology including:

- Display systems and engineering
- Materials and components
- Optical design
- Lighting technologies

- Display drivers and interfaces
- Display packaging
- Manufacturing technology
- Reliability and testing
- Applications

The inaugural issue of the *JDT* is scheduled for September 2005. The mid-year introduction in 2005 will be followed by quarterly publication in 2006. The member prices for the introductory year will be \$13 for online, \$14 for print, and \$17 for both in 2005, reflecting just two issues printed in the launch year. Subscriptions will be available during the 2005 renewal period this fall. In 2006, when four issues will be printed, subscription rates will be adjusted. A wide circulation is assured because approximately 900 libraries worldwide subscribe to IEEE periodical

packages that will contain the IEEE/OSA *Journal of Display Technology*. Additionally, OSA will include *JDT* as an offering in its top-ranked Optics InfoBase.

Manuscripts can be submitted electronically for peer review through IEEE's Manuscript Central starting 1 November 2004 or, before then, by submitting via e-mail the entire paper (text, abstract, keywords, references, figures, and author biographies) in a single Word or .pdf file, along with a cover letter containing author contact information, to Linda Matarazzo, Manager, IEEE LEOS Editorial Office, l.matarazzo@ieee.org (phone +1 732 562 3910; fax +1 732 981 1138).

The *JDT* will utilize "rapid-posting," that is, as soon as an article is edited for publication, the staff-formatted version will be posted in Xplore®. When *JDT* is printed, the version with page numbers and issue ID suitable for citation referencing will replace the earlier online pre-print copy.

## Shin-Tson Wu Named Editor-in-Chief of *JDT*



Shin-Tson Wu will be the first Editor-in-Chief of the new IEEE/OSA *Journal of Display Technology* and will form his editorial board this fall. Dr. Wu is the

Provost-Distinguished Professor of Optics at the College of Optics and Photonics, University of Central Florida (UCF). Prior to joining UCF in 2001, Dr. Wu worked at Hughes Research Laboratories (Malibu, California) for 18 years. He received his PhD from the Center for Laser Studies, University of Southern California, and his BS in physics from National Taiwan University.

Dr. Wu's entire career has been devoted to liquid-crystal display science, technology, and electro-optics. His major contributions are in projection liquid crystal displays,

wide-view and fast-response liquid-crystal televisions, transreflective liquid crystal displays for cell phones, and high birefringence liquid crystals for tunable photonic devices. Several of his inventions are implemented in commercial products. His studies at UCF, concentrate in five areas: liquid-crystal displays, liquid crystal materials, foveated imaging, bio-photonics, and optical communications. His research group consists of two professors, seven research scientists and thirteen PhD students.

Dr. Wu is a Fellow of the IEEE, SID, and OSA. He is a recipient of the IEEE Outstanding Engineer Award, SID Special Recognition Award, ERSO (Taiwan) Special Achievement Award, Hughes team achievement award, and Hughes Research Labs outstanding paper award. Dr. Wu has co-authored two books: *Reflective Liquid Crystal Displays* (Wiley, 2001), and *Optics and Nonlinear Optics of Liquid Crystals* (World Scientific, 1993), four book chapters, over 200 journal papers, 60 invention

disclosures, and 150 conference presentations.

Dr. Wu has been serving as a Technical Advisory Committee member for steering Taiwan's display industry for more than a decade. Most of Taiwan's display engineers benefit directly or indirectly from Prof. Wu's seminars or training courses. Dr. Wu is serving as a conference co-chair for the IEEE/LEOS (Display), CLEO (Display and Solid State Lighting), and MRS (Liquid Crystal Materials) conferences. ●

## 2004 Compound Semiconductor Integrated Circuit Symposium (CSICS)

The wireless and optical fiber markets are roaring back to life. The lifeblood of these markets has been the high-performance integrated circuits typically made in compound semiconductor technology. GaAs, SiGe, InP, SiC, and, more recently, GaN and antimonides have been making impressive strides in performance, availability, and features. However, the recent market lull has given RF CMOS a chance to make inroads into some areas that were previously the sole purview of III-V semiconductors. The Compound Semiconductor Integrated Circuit Symposium (formerly the Gallium Arsenide Symposium—GaAs IC) offers attendees the opportunity to stay abreast of these developments in critical compound semiconductor technology and circuit techniques. This year, our 26th, the symposium will be held 24–27 October in Monterey, California, its home away from home, in the Portola Plaza Hotel overlooking Monterey Bay. The Symposium will be held at the same location as CS-Max, with a unified CS-Week 2004 Technology Exhibition. CS-Max will offer a distinct manufacturing-oriented technical program 27–30 October, following the CSICS technical program.

If you work with or are interested in compound semiconductor technology and multi-GHz circuits and want to keep abreast of developments in your specialty or in competing tech-

nologies, then this is the conference for you. Exciting new developments from a variety of compound semiconductor disciplines will be presented. Our new name reflects the diversity of materials technology that currently exists and is of interest to our attendees. There are papers on GaN, SiC, SiGe, InP, and, of course, GaAs as well as other less widespread technologies. Once again, there is a tremendous amount of activity in the wireless and optical communication areas, as well as a strong showing in defense electronics. For the first time we will hold an entire technical session on circuits with data rates beyond 100 Gb/s. In keeping with our long tradition as a forum for microwave, millimeter wave, and multi-Gb/s circuits—not just as a showcase for GaAs or InP—we will hold an entire session on Si-based transceivers and have our first-ever presentation on 40-Gb/s CMOS.

The technical program for CSICS consists of one day of Short Courses given by noted experts and three days of invited and contributed technical presentations in the areas of compound semiconductor technology, RF devices and circuits, and digital/OEIC circuits. There are more than 64 technical papers, five panel sessions, an industry exhibit, and two Short Courses: “Power amplifier technologies and markets for compound semiconductors” and “High-speed data convert-

ers.” We will also be offering our annual introductory-level class “Basics of compound semiconductor ICs.” This year we have invited 22 papers on a wide range of important topics from device engineering to circuit application using advanced compound to other related semiconductor technologies. In addition, we will continue the tradition of including important “late breaking news” papers.

It is no surprise that Monterey is a favorite venue among our attendees. The Portola Plaza Hotel (formerly the DoubleTree) is located on beautiful Monterey Bay and is within walking distance of numerous shops and galleries, Fisherman's Wharf, Cannery Row, and, for the more physically fit, the Monterey aquarium. Attendees and guests can enjoy the fresh seafood, play golf at one of seventeen world-class courses, or just enjoy Monterey—one of the most picturesque towns along California's coast. The more adventurous can seek out some of the spectacular scenery along the California coast just a short drive south of Monterey at Big Sur.

For registration and other information please visit our Web site at [www.csis.org](http://www.csis.org). We hope that you will join us in Monterey in October. ●

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# Tsividis Recognized with the IEEE Undergraduate Teaching Award

Yannis Tsividis of Columbia University will be recognized in 2005 with the IEEE Undergraduate Teaching Award “for superlative teaching that has inspired the imagination and nurtured the intellect of undergraduates in electrical engineering.”

“Tsividis’s contributions to undergraduate teaching and advising are legendary at Columbia. They are felt in the classroom teaching, in major curricular revisions and enhancements, in writings about effective teaching, and in authorship of well-regarded textbooks,” said Tony F. Heinz, department chair at Columbia University.

Fellow Columbia faculty member Ken Shepard agrees. “Tsividis sets the ‘gold standard’ for what it means to be a faculty member with a truly integrated approach to research and teaching.” He serves “as a role model for young faculty in the department. He is always brimming with new ideas, energy, and excitement and has the ability in every situation to ask the questions that expose the fundamental principle in whatever you are doing.”

Bob Meyer, University of California, Berkeley, notes that Tsividis is “always meticulously prepared as a lecturer. He takes his audiences through difficult material in a way that makes the subject seem easy. He is a student of his field in the broadest sense of the word, always looking for new and better ways to tie the basic concepts together for his audience while providing rigorous in-depth treatment of his subject.”

Heinz continues, “His student evaluations are remarkable especially when one considers that Tsividis typically offers the tough introductory courses for the major that students often find to be somewhat of a shock. Tsividis does not get these superb evalua-



tions by lowering standards. Rather, he really makes the students learn by the remarkable clarity of his lectures, by the enthusiasm that he conveys for the subject, and—frankly—by his personal insistence that the students really understand the material. It is this combination that makes the students so devoted to him.”

In 2003 Tsividis received Columbia’s Presidential Award for Outstanding Teaching. “Given the size of the university, the competition for this award is fierce. To have a chance of winning, the case must be absolutely overwhelming and must rest on widespread support of students who are willing to write in support of the nomination,” commented Heinz. Meyer recalls, “Even early in his career as a graduate student at the University of California at Berkeley, Tsividis displayed his talent and passion for teaching when he was awarded the Outstanding Teaching Assistant Award in 1972 and 1975.” Since joining the faculty of the Electrical Engineering Department of Columbia University in 1976, he has won the Great Teacher Award (1999), the Distinguished Faculty Teaching Award (1998), and the Presidential Award for Outstanding Teaching (2003).

## Curriculum Revision

Columbia’s comprehensive revision of its undergraduate curriculum was a massive endeavor that Tsividis chaired. It has succeeded in satisfying the students’ desire for more flexibility and topicality, while not forsaking a curriculum grounded in strong fundamentals. Heinz recalls “the revision involved everything from philosophical questions of what is most essential in undergraduate education (general or specialized, fundamental or oriented towards current technology, etc.) to available teaching resources and the coordination of courses with those in other departments and a plan for smooth implementation.” The effort completely reorganized the subject matter of several traditional courses, and incorporated separate lab classes into lecture courses. “Tsividis even induced the math department to restructure their offerings to better support engineering curricula.” Heinz concluded, “The results of this effort have been met with great satisfaction by both the students and faculty.”

As part of the curriculum revision, Tsividis created a lab-based Introduction to Electrical Engineering. This course serves as a sampler for prospective electrical engineering majors, as well as giving committed majors a better perspective of the discipline as a whole before they encounter the more mathematically oriented core courses. Heinz reported that “the new course was so successful at Columbia that the School of Engineering and Applied Science has urged all of its departments to develop an equivalent introductory course to assist students in making an informed choice about their major.”

## The Award

The IEEE Undergraduate Teaching Award is a Technical Field Award



of the Institute established by the Board of Directors in 1990 to honor teachers of electrical and electronics engineering and the related disciplines “for inspirational teaching of undergraduate students in the fields of interest of the IEEE.” Selection criteria include contributions such as curriculum development, authorship of course materials, involvement with students and faculty in advisory

**Y**annis P. Tividis is a Charles Batchelor Professor of Electrical Engineering. He has been working on merging precision analog and digital circuits on a single chip ever since he joined Columbia in 1976. He and his students are responsible for several contributions toward that goal, ranging from precision device modeling and novel circuit building blocks to new techniques for analog signal processing, self-correcting chips, switched-capacitor network theory, and the creation of computer simulation programs. This work has resulted in several patents in several countries.

capacities, as well as “attracting students to engineering and scientific professions, and preparing them for effective careers in engineering and the sciences.” It is pre-

He is the recipient of the 1984 IEEE W. R.G. Baker Best Paper Award, the 1986 European Solid-State Circuits Conference Best Paper Award, the 1998 Guillemin-Cauer Best Paper Award, and is the co-recipient of the 1987 IEEE Circuits and Systems Society Darlington Best Paper Award. He is a Fellow of the IEEE and received a Golden Jubilee Medal from the IEEE Circuits and Systems Society in 2000. He has received the Great Teacher Award from the Alumni Association and the Distinguished Faculty Teaching Award from the Columbia Engineering School Alumni Association. ●

sented to an individual only. The award consists of a bronze medal, a certificate, and a cash honorarium that will be presented at the ISSCC 7 February 2005. ●

## 2004 International Conference on Microelectronics (MIEL)

**T**he 24th International Conference on Microelectronics (MIEL 2004) was held 16–19 May 2004 at the Faculty of Electronic Engineering, University of Nis, Serbia and Montenegro. The conference was organized by the Yugoslavia IEEE Section and ED/SSC Chapter, in cooperation with Faculty of Electronic Engineering and Ei-Holding Company-Nis, and under the auspices of the Serbian Ministry of Science and Environment Protection, the Yugoslav Academy of Engineering, the Society for ETRAN, and the City Assembly of Nis.

Two workshops, “Power Devices and ICs” and “Microsystem Technologies,” along with an opening address titled “The objectives of the 6th framework of the European Commission: Research training networks, nanotechnologies, and eligibility of participants from western Balkan countries,” given by Dr. Gordana Popovic, a representative of the Research Directorate General, European Commission (Brussels, Belgium), attracted

a lot of attention. They were an excellent introduction to the main technical program that consisted of eight sessions: Power Devices and ICs, Microsystem Technologies, Modeling and Simulation, Opto and Microwave Devices, Processes and Technologies, Circuit Design, Reliability Physics, and System Design.

A total of 47 domestic and 109 foreign participants took part in the conference, representing 34 countries. Dr. Aleksandar Popovic, Serbian Minister of Science and Environment Protection, gave the opening address at MIEL 2004. A total of 22 invited keynote speakers and 135 regular papers (71 oral and 64 posters) were presented. The conference proceedings (two volumes, 802 pages) were published through the IEEE Book Broker Program.

Based on evaluation of the quality of the papers and presentations, three Best Paper Awards were presented to J. Millan (CNM-CSIC, Barcelona, Spain) for the oral paper “Direct mea-

surements of self-heating effects at the drift region of 600V PT-IGBTs,” to H. Hein (Fraunhofer Institute for Integrated Circuits, Erlangen, Germany) for the poster paper “A fully integrated 0.35-mm CMOS MMIC amplifier for short-range 433-MHz ISM band transceiver application,” and to F. De Paola (University of Naples Federico II, Italy) for the student paper “A scalable physical model for coplanar waveguide transition in flip-chip applications.” The international scientific journal *Microelectronics Reliability* also gave an award to A. Paskaleva et al. (Institute of Solid State Physics, Bulgarian Academy of Sciences, Sofia, Bulgaria) for the paper “Electrical properties and conduction mechanisms in Hf<sub>x</sub>Ti<sub>y</sub>SizO films obtained from novel MOCVD precursors.” ●

**Dr. Ninoslav Stojadinovic**  
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*Faculty of Electronic Engineering*  
*University of Nis*  
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# International Conference on Computer-Aided Design (ICCAD) Meets 7–11 November in San Jose

On behalf of the ICCAD 2004 Executive and Technical Program Committees, we invite you to attend the International Conference on Computer-Aided Design. We hope you visit the conference to learn about the latest advances in electronic design technology and automation.

The core of the conference is the technical program. This year, ICCAD received 520 submissions, the highest number in our history. Based on the results of a rigorous and thorough review, followed by a full day of face-to-face discussions, 127 papers were selected and compiled into an exciting final program that is enriched by multiple special sessions and events. Besides technical sessions, there are social hours every evening beginning Sunday and running through Wednesday. These are opportunities to meet colleagues for further discussion in a relaxed atmosphere and to develop networks for information exchange.

As in the previous two years, the conference activities begin on Sunday, 7 November. First, a workshop titled “IC design in 65 nm and beyond: Evolution or revolution?” is a forum where leading experts from industry and academia present their visionary views on the challenges and solutions for 65-nm design and beyond. There are two parallel tracks of three presentations each, focusing on system- and physical-design topics. Following the workshop, participants are invited to a concluding panel and the ICCAD opening reception. All conference registrants are welcome to attend the workshop, panel, and reception. On Sunday,

ACM/SIGDA is sponsoring a CADathlon, a programming contest that challenges students’ CAD knowledge and their skills in problem solving, programming, and teamwork.

The main part of the ICCAD conference begins on Monday morning with the keynote speaker, Peter Rickett, Director of Platform Technology Development at Texas Instruments, giving a talk titled “Problems or opportunities? Beyond the 90-nm frontier.” The technical program follows with 38 regular paper sessions and five embedded tutorials on “Statistical STA,” “Variability impact on design,” “Formal verification,” “Design-manufacturing interface,” and “Transaction-level modeling.” The Monday night panel, “Divine for dollars,” focuses on the next EDA innovations that can change the way chips are developed.

Multiple side events complement the technical program and enhance the overall ICCAD schedule. The Technology Fair on Tuesday provides a forum where conference attendees can meet industry R&D colleagues to discuss technical challenges and solutions, or simply make new contacts. The Technology Fair reception follows in the evening and is a perfect opportunity to network with the vendors and colleagues.

The conference concludes on Thursday, 11 November, with the 2004 tutorial program. This year we are introducing a new format for the tutorials. Six half-day tutorials will be offered and attendees will receive the full set of notes so that they can freely choose any morning and afternoon sessions. Special care has been taken in the selection of topics

and speakers so that there is a good balance of theoretical aspects and real industrial practices. The tutorials cover the topics “Power reduction techniques,” “Industrial power reduction experiences,” “Physical design at 90 nm,” “Signal integrity and reliability,” “Clock distribution,” and “New algorithm for CAD.”

On behalf of the organizers of ICCAD, we thank everyone involved in the 2004 event. In particular, we thank the members of the Executive and Technical Program Committees, everyone at MP Associates, and the many volunteers from our sponsoring societies. Also, we give our sincere thanks to all the authors who submitted papers with valuable results, since their contributions form the basis of our technical excellence.

As we move into the era of nanoscale integrated circuits, many issues will confront us, such as complexity, manufacturability, and power dissipation. These issues can be overcome by tighter collaboration among EDA researchers, designers, manufacturers, and application engineers. ICCAD 2004 offers an ideal place for these people to meet and exchange ideas about the challenges and solutions for the future. We are looking forward to an exciting ICCAD 2004, and we hope that you will join us in November. ●

**Hidetoshi Onodera**  
*General Chair*

**Majid Sarrafzadeh**  
*Technical Program Chair*

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## 2005 Student Member Renewals, New Applications Only Via Web

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Starting in September 2005, IEEE will only accept membership applications and/or renewals from students via the Web. To accommodate this change, paper application forms and renewal forms for students will no longer be produced. However, the IEEE will continue to offer a brochure highlighting the benefits of student membership. These brochures will be distributed to sections and student branches during August.

This past February, the online student application was enhanced to improve access and to allow students from any school in the world to join IEEE online. Features of the enhanced version include:

- Students can join IEEE online with a credit card
- Instant access to online services with an IEEE Web account
- Improved data integrity since the student enters his/her information directly. No re-keying of data is required.
- Students can self-certify that they qualify for IEEE student membership.

The application process no longer needs the approval of the

Student Branch Counselor or faculty member. Undergraduate or graduate students taking at least 50% of a normal full-time program/course of study in IEEE designated fields are eligible for student membership in IEEE.

IEEE is aware that there are many students who do not have a credit card. Students who wish to pay by check or other means can still make use of the online application form. Once the online application or renewal form has been completed, the user will be presented with the options "Continue to Checkout" or "Print and Mail with Payment." By choosing the "Print and Mail" option, the information that has been entered is temporarily stored and is matched with the form when it arrives at the IEEE Operations Center with payment.

This new policy is the result of an action taken by the IEEE Board of Directors in November 2003. The board acknowledged that there may be extenuating circumstances where paper applications would still be acceptable, such as at a conference where there is no Internet connection available. For these situ-

ations, an electronic version (pdf) of the student application can be provided for printing and mailing.

For additional information on this change, please contact IEEE Student Services at [student-services@ieee.org](mailto:student-services@ieee.org).

### Value Added—Discount for Graduating Student Members

IEEE student members who graduate and become full IEEE members at renewal will automatically receive a one-year discount of 50% off the full higher grade IEEE and Society membership dues rates. The offer is available once to IEEE student members upon their graduation and elevation to full IEEE membership. The discount is available to all IEEE student members graduating with an undergraduate or graduate degree.

IEEE student members who previously graduated with a bachelor's degree and received a discount upon their elevation to full IEEE member grade are not eligible to receive the 50% discount again if they return to school and complete an advanced degree

## OFAC Problems Resolved: Scholarly Publishing Process Exempt from OFAC Restrictions

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On 2 April 2004, IEEE received a ruling from OFAC (United States Department of the Treasury's Office of Foreign Assets Control) that resolved U.S. embargo-related publishing issues for the IEEE. The decision confirmed IEEE's argument that its entire scholarly publishing process is exempt from OFAC restrictions. IEEE immediately resumed its normal publication process, including copy and style editing, for authors worldwide. IEEE is now focusing its resources on an assessment of unresolved membership issues to determine

those that may require further clarification from OFAC.

One of these unresolved issues is restrictions on scholarly collaboration. IEEE President Arthur Winston reported at the June 2004 Board of Directors' meeting that "this concerns IEEE because it is a membership issue that transcends publication authorship and could be seen to inhibit a broad range of activities that are normally associated with participating as a member of a professional society." The information below provides the background leading up to the April 2004 OFAC ruling and the current status of

issues affecting membership.

In 2001 IEEE, during a transfer of funds for a conference to be held in Iran, was informed by a financial institution that the transfer could not occur due to OFAC restrictions. IEEE researched OFAC embargoes and found that they could impact our normal business operations including member services and publishing activities for individuals in certain countries. Needless to say, IEEE was not at all pleased with this realization; staff and volunteers have been actively working with the U.S. government and the publishing industry to determine what needs to happen

to allow us to continue our business as usual.

With knowledge of the embargoes, IEEE informed members residing in Cuba, Iran, Libya, and Sudan—countries sanctioned by OFAC—that, because of OFAC regulations, those members would not be able to take advantage of member benefits and services; only print subscriptions to IEEE publications could be provided with membership.

Certain aspects of editing papers and manuscripts submitted to IEEE publications also were affected by these regulations. So, in December 2002, IEEE sent a request for OFAC to exempt its entire publishing process. After many months of discussions and after providing additional information to OFAC, on 30 September 2003, OFAC confirmed that IEEE could publish articles from authors in Iran and that the IEEE peer review process was

entirely exempt from the Iranian embargo rules. But OFAC also said IEEE needed a license for editing. On 6 October 2003, IEEE provided supplemental information to OFAC, reiterating our position that the entire publishing process for authors in all embargoed countries should be exempt. At the same time, IEEE also requested that OFAC issue a license to enable us to carry on our normal publication process if an exemption was not possible. After the ruling, IEEE continued to receive papers, send them to editors and reviewers for peer review and publish those that met its publication standards without style and copy editing.

While awaiting the decision about the October request, IEEE took a leading role to help other scholarly publishers understand its experience with OFAC regulations by organizing a special summit of

scientific, technical, and medical publishing organizations, which was held on 9 February 2004 in Washington, D.C. At that meeting, David Mills, OFAC chief of licensing, encouraged the groups represented to work together to help OFAC better understand the academic peer review process.

After the meeting, IEEE continued discussions with OFAC. On 2 April 2004 IEEE received the ruling mentioned above that exempted our entire scholarly publishing process from OFAC restrictions. During recent months, IEEE has been the subject of a number of news stories worldwide about this issue. Since many of these stories contain inaccurate information, IEEE has been communicating the facts on the IEEE OFAC Web page at [www.ieee.org/ofac](http://www.ieee.org/ofac). Please continue to monitor this Web page for updates. ●

## University of Nis ED/SSC Joint Chapter and Student Branch Chapter Report

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A promotional campaign specifically aimed at attracting younger students to join IEEE was conducted in the first half of September 2003. At the end of the campaign a luncheon was organized for the five best students from each year of studies, followed by a presentation of chapter activities by Tatjana Pesic. At the chapter meeting, held in conjunction with the ED/SSC Chapter, Dr. Ninoslav Stojadinovic gave the lecture titled “IEEE: Why students should join.”

In December 2003 our chapter meeting was held at the Faculty of Electronic Engineering, University of Nis. Professor H. Schwanbeck (Technical University of Ilmenau, Germany) presented the lecture “Installation, administration, and parallel programming of/in Linux clusters,” while Professor V. Zerbe (Technical University of Ilmenau, Germany) gave the presentation “Parallel algorithms—parallel matrix multiplication.” This was an all-day

meeting with a lunch break. Besides chapter members, post-graduate students from the field of microelectronics attended the meeting.

Also in December our student chapter organized a visit to the EI Holding Corporation, the largest manufacturer of electronic products in Serbia and Montenegro. Our delegation of 44 people was received by Dr. Vojislav Mitic, Head of Corporation, and Dr. Zoran Prijic, Vice-Head of Corporation. The students toured corporate factories, a computer center, and a factory restaurant. The visit enabled students to get a feel for the atmosphere in a corporation and to talk to electrical engineers working in industry.

At the annual chapter meeting in January Dr. Stojadinovic presented the report for 2003 and plan for 2004, which were supported and adopted. For the student branch chapter meeting, Tatjana Pesic did the same. We organized a promo-

tion ceremony for new members, followed by a cocktail party. We have found that social events, such as cocktail parties and evening parties in the local student pub, are interesting for students and are a good way to attract new members. Our membership promotion campaign also uses former or current student members who are working as professors and teaching assistants to discuss the value of membership during the classes they teach.

In February we organized a visit to the museum of the great inventor Nikola Tesla in Belgrade. The chapter subsidizes some students' costs.

As a final step in the student promotion campaign, Dr. Stojadinovic gave a presentation on the IEEE's mission, goals, and benefits in a lecture hall at the Faculty of Electronic Engineering, University of Nis. Also, the April chapter meeting was held at the Faculty of Electronic Engi-

neering, University of Nis, at which we played the videotape "Getting ready: Careers for electrical engineering and computer scientists," borrowed from the EDS Video Tape Lending Library. The videotape presentation was aimed at increasing the interest of young scholars in pursuing careers in engineering disciplines, particularly, in electrical engineering.

During May 2004, the University of Nis ED/SSC Student Branch Chapter helped organized portions of the MIEL 2004 conference (16–19 May 2004, Nis), allowing students to get a feel for the atmosphere of an international scientific meeting. They also were invited to join the sightseeing tour organized for conference participants and will be remembered for their charm and

enthusiasm. See more about the MIEL conference in the accompanying article.

During the 48th Conference on Electronics, Telecommunications, Computer Sciences, Automatics, and Nuclear Science (ETRAN 2004) held in Cacak, 6–10 June, chapter members contributed some of the 36 papers in the session on Microelectronics and Optoelectronics. ●

## Books of Interest to SSCS

This selection of technical books covers topics that may be of interest to our readers. The descriptions are provided by the publishers.

### **CMOS: Circuit Design, Layout, and Simulation (Second Edition)**

by R. Jacob Baker, published by Wiley-IEEE Press, October 2004, \$99.95, ISBN 0-471-70055-X.

*CMOS: Circuit Design, Layout, and Simulation, Second Edition* covers the practical design of both analog and digital integrated circuits, offering a vital contemporary view of a wide range of analog/digital circuit blocks, the BSIM model, data converter architectures, and much more. This edition takes a two-path approach to the topics. Design techniques are developed for both long- and short-channel CMOS technologies and then compared. The results are multidimensional explanations that give readers deep insight into the design process. Complete with layout software for the PC, this comprehensive presentation of CMOS integrated circuit design navigates readers through the process of implementing a chip from the physical definition to the design and simulation of the finished product.

### **CMOS Electronics: How It Works, How It Fails**

by Jaume Segura and Charles F. Hawkins, published by Wiley-IEEE Press, March 2004, \$89.95, ISBN 0-471-47669-2.

An essential text for practitioners in the CMOS industry or for students headed there, the first part of the book covers the electronics at a tutorial level. The second half offers thorough descriptions of failure mechanisms, some previously found only in research papers, addressing such common questions as:

- Is the problem an outcome of random defects, or does it show a common failure signature?
- Why do custom test programs miss detecting certain defects?
- Are test escapes a reliability problem?
- Is the defect, a bridging problem, an open circuit problem, or a subtle speed-related problem?

### **The Design of CMOS Radio-Frequency Integrated Circuits (Second Edition)**

by Thomas H. Lee, published by Cambridge University Press, March 2004, £45.00, ISBN 0-52-183539-9.

*The Design of CMOS Radio-Frequency Integrated Circuits* is an expanded and thoroughly revised new edition of Tom Lee's acclaimed guide to the design of gigahertz RF integrated circuits. A new chapter on the principles of wireless systems provides a bridge between system and circuit issues. The chapters on low-noise amplifiers, oscillators, and phase noise have been significantly expanded. The chapter on architectures now contains several examples of complete chip designs, including a GPS receiver and a wireless LAN transceiver, that

bring together the theoretical and practical elements involved in producing a prototype chip. Every section has been revised and updated with the latest findings in the field and the book is packed with physical insights and design tips, and includes a historical overview that sets the whole field in context. With hundreds of circuit diagrams and homework problems this is an ideal textbook for students taking courses on RF design and is a valuable reference for practicing engineers.

### **Designing Digital Computer Systems with Verilog**

by David Lilja and Sachin Sapatnekar, published by Cambridge University Press, December 2004, £35.00, ISBN 0-52-182866-X.

This unique book serves both as an introduction to computer architecture and as a guide to using a hardware description language (HDL) to design, model, and simulate real digital systems. The book starts with an introduction to Verilog—the HDL chosen for the book since it is widely used in industry and straightforward to learn. Next, the instruction set architecture (ISA) for the simple VeSPA (Very Small Processor Architecture) processor is defined—this is a real working device that has been built and tested at the University of Minnesota by the authors. The VeSPA ISA is used throughout the remainder of the book to demonstrate how behavioral and structural models can be developed and intermingled in Ver-

ilog. Although Verilog is used throughout, the lessons learned will be equally applicable to other HDLs. Written for senior and graduate students, this book is also an ideal introduction to Verilog for practicing engineers.

### **Electronic Packaging and Interconnection Handbook (Fourth Edition)**

by Charles Harper, published by McGraw-Hill Professional, October 2004, \$150, ISBN 0-07-143048-2.

This is the standard reference in the field, nearly 75% rewritten to reflect the tremendous advances that have taken place in the past five years. From new materials and technologies to increasingly prevalent lead-free manufacturing practices, *Electronic Packaging and Interconnection Handbook* offers a unique source of key reference data, practical guidance, and circuit and package design basics. Through three best-selling editions, this classic reference has served those involved in the design, manufacture, testing, and use of all types of electronic packaging, becoming the most widely used reference in the industry. This thoroughly revised and expanded Fourth Edition adds new information on key MEMS; optoelectronic, single-chip, and high-speed technologies; and updates important chapters on ball-grid array and flip-chip technologies.

Of interest to mechanical and electrical engineers, chemists, physicists, and materials scientists in all areas of the electronic packaging industry, the book takes a unique interdisciplinary approach to the field, allowing specialists in one area to understand the needs and responsibilities of others.

### **Low-Voltage CMOS RF Frequency Synthesizers**

by Howard Luong, published by Cambridge University Press, August 2004, £60.00, ISBN 0-52-183777-4.

A frequency synthesizer is one of the most critical building blocks in any wireless transceiver system. Its design is getting more and more challenging as the demand for low-voltage low-power high-frequency wireless systems grows. As the supply voltage is decreased, many existing design techniques are no longer applicable. This book provides the reader with architectures and design techniques to enable CMOS frequency synthesizers to operate at low supply voltage at high frequency with good phase noise and low power consumption. In addition to updating the reader on many of these techniques in depth, this book also introduces useful guidelines and step-by-step procedures on behavior simulations of frequency synthesizers. Finally, three successfully demonstrated CMOS synthesizer prototypes (with detailed design considerations and descriptions) illustrate potential applications of the architectures and design techniques described for engineers, managers, and researchers working in radio-frequency integrated-circuit design for wireless applications.

### **Machine Vision**

by Wesley E. Snyder and Hairong Qi, published by Cambridge University Press, January 2004, £40.00, ISBN 0-52-183046-X.

This book is an accessible and comprehensive introduction to machine vision. It provides all the necessary theoretical tools and shows how they are applied in actual image-processing and machine-vision systems. A key feature is the inclusion of many programming exercises that give insights into the development of practical image processing algorithms. The authors begin with a review of mathematical principles and go on to discuss key issues in image processing such as the description and characterization of images, edge detection, restoration and feature extraction, segmenta-

tion, texture, and shape. They also discuss image matching, statistical pattern recognition, clustering, and syntactic pattern recognition. Important applications are described, including optical character recognition and automatic target recognition. A CD-ROM containing software and data used in the book is included. The book is aimed at graduate students in electrical engineering, computer science, and mathematics and also is a useful reference for practitioners.

### **Microchip Fabrication (Fifth Edition)**

by Peter Van Zant, published by McGraw-Hill Professional, May 2004, \$69.95, ISBN 0-07-143241-8.

A perfect introduction to the industry that drives high tech, *Microchip Fabrication* offers a low-math, straight-talk approach to the entire process of semiconductor processing—from raw materials through shipping the finished, packaged device. Filled with detailed illustrations and analogies to everyday life, this is the industry's most novice-friendly text! Used for training, teaching, and vocational-technical programs, *Microchip Fabrication* covers every stage of semiconductor processing, from raw material preparation to packaging and testing to traditional and state-of-the-art processes. Each chapter contains quizzes and review summaries buttressed by an extensive glossary.

By the time you've finished *Microchip Fabrication*, you'll have a solid working knowledge of the important issues and processes and materials and methods involved in semiconductor technology, whether on the subatomic level or in the context of large-scale industrial practices.

### **Nano-CMOS Circuit and Physical Design**

by Ban Wong, Senior Engineering Manager for NVIDIA Corporation, Anurag Mittal, Senior Staff Engineer

for Virage Logic Inc., Yu Cao, Berkeley Wireless Research Center at University of California at Berkeley, and Greg Starr, Design Manager at Altera Corporation, published by John Wiley & Sons, December 2004, \$94.95, ISBN 0-471-46610-7.

Nano-CMOS Circuit and Physical Design bridges the gap between circuit and physical design and fabrication processing, manufacturability, and yield. This innovative book covers process technology, including sub-wavelength optical lithography; impact of process scaling on circuit and physical implementation; and the yield and impact of physical implementation.

### **The Nano-Micro Interface: Bridging the Micro and Nano Worlds**

by Hans-Jörg Fecht and Matthias Werner (editors), published by John Wiley & Sons, November 2004, \$135.00, ISBN 3-527-30978-0.

*The Nano-Micro Interface* explores two exciting areas in science and technology: the nano and micro dimensions. The former is a booming new field of research, the latter the established size range for electronics. For mutual technological benefit and future commercialization, suitable junctions need to be found. Functional nanostructures such as DNA computers, sensors, neural interfaces, nano-optics, or molecular electronics need to be wired to their 'bigger' surroundings. Coming from the opposite direction, microelectronics has experienced an unprecedented miniaturization drive in the last decade, pushing ever further down through the micro size scale towards submicron circuitry. Bringing these two worlds together is a new interdisciplinary challenge for scientists and engineers alike—recognized and substantially funded by the European Commission and other major project initiators worldwide. This book offers a wide range of information from technologies to materi-

als and devices, as well as from research to administrative know-how collected by the editors from renowned members of the nano-micro community.

### **Planar Microwave Engineering: A Practical Guide to Theory, Measurement, and Circuits**

by Thomas Lee, published by Cambridge University Press, October 2004, £45.00, ISBN 0-52-183526-7.

Modern wireless communications hardware is underpinned by RF and microwave design techniques. This insightful book contains a wealth of circuit layouts, design tips, and practical measurement techniques for building and testing practical gigahertz systems. The book covers everything needed to know to design, build, and test a high-frequency circuit. Microstrip components are discussed, including tricks for extracting good performance from cheap materials. Connectors and cables also are described, as are discrete passive components, antennas, low-noise amplifiers, oscillators, and frequency synthesizers. Practical measurement techniques are presented in detail, including the use of network analyzers, sampling oscilloscopes, spectrum analyzers, and noise figure meters. Throughout the focus is practical, and many worked examples and design projects are included. There also is a CD-ROM that contains a variety of design and analysis programs. The book is packed with indispensable information for practicing engineers and for students taking courses on RF or microwave circuits.

### **Silicon Micromachining**

by Miko Elwenspoek and Henri V. Jansen, published by Cambridge University Press, August 2004, £33.00, ISBN 0-52-160767-1.

This comprehensive book provides an overview of the key techniques used in the fabrication of micron-scale structures in silicon. Recent

advances in these techniques have made it possible to create a new generation of microsystem devices, such as microsensors, accelerometers, micropumps, and miniature robots. The authors underpin the discussion of each technique with a brief review of the fundamental physical and chemical principles involved. They pay particular attention to methods such as isotropic and anisotropic wet chemical etching, wafer bonding, reactive ion etching, and surface micromachining. There is a special section on bulk micromachining, and the authors also discuss release mechanisms for movable microstructures. The book is a blend of detailed experimental and theoretical material, and will be of great interest to graduate students and researchers in electrical engineering and materials science whose work involves the study of micro-electromechanical systems (MEMS).

### **WCDMA Design Handbook**

by Andrew Richardson, published by Cambridge University Press, November 2004, £65.00, ISBN 0-52-182815-5.

Developed out of a successful professional engineering course, this practical handbook provides a comprehensive explanation of the Wideband CDMA (Code Division Multiple Access) air interface of third generation UMTS cellular systems. The book addresses all aspects of the design of the WCDMA radio interface from the lower layers to the upper layers of the protocol architecture. The book considers each of the layers in turn, to build a complete understanding of the design and operation of the WCDMA radio interface, including the physical layer, RF and baseband processing, MAC, RLC, PDCP/BMP, non-access stratum and RRC. The *WCDMA Design Handbook* is an ideal course book and reference for professional engineers, undergraduate students, and graduate students. ●

# SSCS EVENTS CALENDAR

Also posted on [www.sscs.org/meetings](http://www.sscs.org/meetings)

## SSCS SPONSORED MEETINGS

### 2004 CICC Custom Integrated Circuits Conference

[www.ieee-cicc.org](http://www.ieee-cicc.org)

3–6 October 2004

Caribe Royale Resort Suites, Orlando, FL, USA

Paper deadline: passed

Contact: Ms. Melissa Widerkehr, [cicc@his.com](mailto:cicc@his.com)

### 2005 ISSCC International Solid-State Circuits Conference

[www.isscc.org](http://www.isscc.org)

6–10 February 2005

San Francisco Marriott Hotel, San Francisco, CA, USA

Paper deadline: passed

Contact: Courtesy Associates, [ISSCC@courtesyassoc.com](mailto:ISSCC@courtesyassoc.com)

### 2005 Symposium on VLSI Circuits

[www.vlssymposium.org](http://www.vlssymposium.org)

16–18 June 2005

Kyoto, Japan

Paper deadline: 7 January 2005

Contact: Phyllis Mahoney,

[vlsi@vlssymposium.org](mailto:vlsi@vlssymposium.org)

or Business Center for Academic Societies, Japan,

[vlsisymp@bcasj.or.jp](mailto:vlsisymp@bcasj.or.jp)

## SSCS PROVIDES TECHNICAL CO-SPONSORSHIP

### 2004 European Solid-State Circuits Conference

[www.esscirc.org](http://www.esscirc.org)

20–24 September 2004

Leuven, Belgium

Paper deadline: passed

### 2004 Compound Semiconductor IC Symposium

(Formerly IEEE GaAs IC Symposium)

[www.csics.org](http://www.csics.org)

24–27 October 2004

Monterey, CA, USA

Paper deadline: passed

### 2004 International Conference on Computer-Aided Design

[www.iccad.org](http://www.iccad.org)

7–11 November 2004

San Jose CA, USA

Paper deadline: passed

### 2005 International Conference on VLSI Design

[www.isical.ac.in/~vlsi2005](http://www.isical.ac.in/~vlsi2005)

3–7 June 2005

Taj Bengal, Kolkata, India

Paper deadline: passed

### 2005 Radio Frequency Integrated Circuits Symposium

[www.rfic2005.org](http://www.rfic2005.org)

12–14 June 2005

Long Beach, CA, USA

Paper deadline: 3 January 2005

### 2005 Design Automation Conference

[www.dac.com](http://www.dac.com)

13–17 June 2005

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14–16 June 2005

Kyoto, Japan

Paper deadline: 7 January 2005

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