Scenes from ISSCC 2019

The 2019 IEEE International Solid-State Circuits Conference (ISSCC) was held 17–21 February 2019 at the San Francisco Marriott Marquis. The conference teemed with a wide array of forums, technical and tutorial presentations, short courses, an exciting plenary session, and opportunities to network with leading experts in the field. The 2019 conference chair was Jan Van der Spiegel, University of Pennsylvania, Philadelphia. Eugenio Cantatore, Eindhoven University of Technology, The Netherlands, was the 2019 International Technical Program chair.

Plenary Session

The plenary session, held 18 February 2019, began with welcoming remarks from Van der Spiegel, who briefly overviewed the 2019 conference registration. He spoke about how much the conference has grown since its start in 1954 (when there were 601 conference attendees, and the registration fee was just US$4). This year, there were an estimated 3,050 paid conference registrants. ISSCC 2019 had 197 technical presentations focusing on advanced circuit techniques and benchmark results (fastest, lowest power, and highest integration levels).

Van der Spiegel also talked about ISSCC 2019's exciting program, including a variety of educational events, interdisciplinary circuits forums, exciting evening sessions, and the Student Research Preview (SRP) and poster session. Making its debut at ISSCC 2019 was a student career panel, which aimed to enhance the student experience at ISSCC.

Next, Cantatore provided a brief summary of ISSCC 2019's technical program. For 2019, a total of 609 papers was submitted, and 107 were accepted (a 32% acceptance rate). The 197 papers were organized into 30 sessions.

Digital Object Identifier 10.1109/MSSC.2019.2909421
Date of publication: 24 June 2019

The ISSCC 2019 plenary session was filled to capacity.

Conference Chair Jan Van der Spiegel gives welcoming remarks and an overview of ISSCC 2019.

Yann LeCun presents "Deep Learning Hardware: Past, Present, and Future."

International Technical Program Chair Eugenio Cantatore talks about the ISSCC 2019 technical program.

Hoi-Jun Yoo gives the talk "Intelligence on Silicon: From Deep Neural Network Accelerators to Brain-Mimicking AI-SoCs."

The 2019 plenary session featured four distinguished speakers:

- Yann LeCun, Facebook Artificial Intelligence Research, Menlo Park, California and New York University
- Hoi-Jun Yoo, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, South Korea
- Meint K. Smit, Eindhoven University of Technology
- Vida Ilderem, Intel, Hillsboro, Oregon.

LeCun presented the talk "Deep Learning Hardware: Past, Present, and Future," discussing the revolution deep learning has caused in computer understanding of images, audio, and text and also

considering supervised learning. LeCun ended his talk with a look at the future of deep learning and said that making progress in self-supervised learning is the main challenge of artificial intelligence (AI) in the next decade.

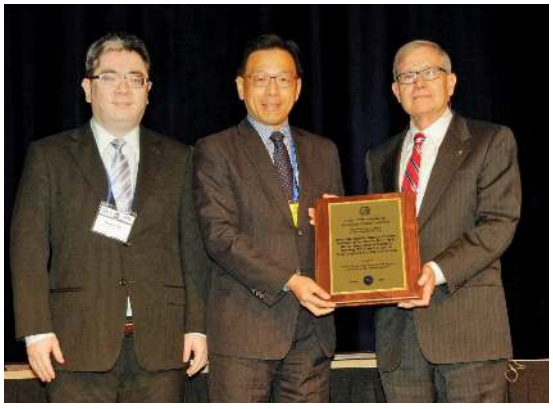
In "Intelligence on Silicon: From Deep Neural Network Accelerators to Brain-Mimicking AI-SoCs," Yoo discussed deep learning and mobile AI. He also spoke about brain mimicking and mobile learning, noting that brain mimicking and mobile learning will be the driving forces behind AI, opening up new requirements for next-generation deep-learning systems on chip. Yoo's talk was followed by the awards presentation.

Awards

- The 2018 Lewis Winner Award for Outstanding Paper was given to Shahriar Shahramian, Mike Holyoak, Amit Singh, Bahar Jalali Farahani, and Yves Baeyens for "A Fully Integrated Scalable W-band Phased-Array Module With Integrated Antennas, Self-Alignment and Self-Test."

The winners of the 2018 Anantha P. Chandrakasan Award for Outstanding Distinguished Technical Paper with Anantha Chandrakasan (second from right) and Conference Chair Jan Van der Spiegel (far right).

The winners of the 2018 Jan Van Vessem Award for Outstanding European Paper with Conference Chair Jan Van der Spiegel (right).



The recipients of the 2018 Takuo Sugano Award for Outstanding Far-East Paper with Conference Chair Jan Van der Spiegel (right).

The recipients of the 2018 Demonstration Session Certificate of Recognition with Conference Chair Jan Van der Spiegel (far right).

The 2018 Evening Session Award recipients with Conference Chair Jan Van der Spiegel (far right).

Sorin P. Voinigescu (left), winner of the 2018 ISSCC Award for Outstanding Forum Presenter, with Conference Chair Jan Van der Spiegel.

Oichi Kumagai (left), recipient of the 2018 Demonstration Session Certificate of Recognition, with Conference Chair Jan Van der Spiegel.

Jinmook Lee (left), recipient of the 2018 Demonstration Session Certificate of Recognition, with Conference Chair Jan Van der Spiegel.

Sungpill Choi (left), recipient of the 2018 Demonstration Session Certificate of Recognition, with Conference Chair Jan Van der Spiegel.

IEEE SSCS President Bram Nauta talks about SSCS membership benefits.

Prof. Patrick Yue (left) accepts the 2018 SSCS Outstanding Chapter Award on behalf of the SSCS Hong Kong Student Chapter.

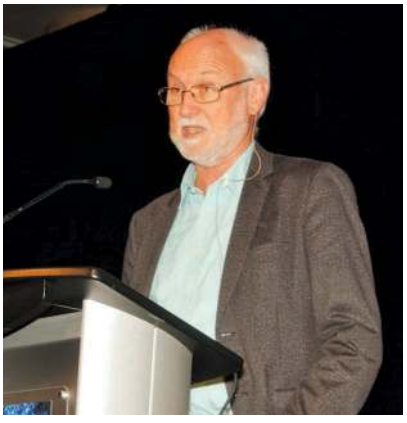
This award is named after Lewis Winner, who served as editor, publisher, and conference coordinator from 1958 to 1988. The award is based on ratings by conference attendees in the previous year.

- The 2018 Anantha P. Chandrakasan Award for Outstanding Distinguished Technical Paper went to "A 16 Gb 18 Gb/s/pin GDDR6 DRAM With Per-Bit Trainable Single-Ended DFE and PLL-Less Clocking" by Young-Ju Kim, Hye-Jung Kwon, Su-Yeon Doo, Min-Su Ahn, Yong-Hun Kim, Yong-Jae Lee, Dong-Seok Kang, Sung-Geun Do, Chang-Yong Lee, Gun-Hee Cho, Jae-Koo Park, Jae-Sung Kim, Kyung-Bae Park, Seung-Hoon Oh, Sang-Yong Lee, Ji-Hak Yu, Ki-Hun Yu, Chul-Hee Jeon, Sang-Sun Kim, Hyun-Soo Park, Jeong-Woo Lee, Seung-Hyun Cho, Keon-Woo Park, YongJun Kim, Young-Hun Seo, Chang-Ho Shin, Chan-Yong Lee, Sam-Young Bang, YounSik Park, Seouk-Kyu Choi, Byeong-Cheol Kim, Gong-Heum Han, Seung-Jun Bae, Hyuk-Jun Kwon, Jung-Hwan Choi, Young-Soo Sohn, Kwang-Il Park, and Seong-Jin Jang. This award, given for the first time at ISSCC 2019, was named in honor of past ISSCC Conference Chair Anantha Chandrakasan, Massachusetts Institute of Technology (MIT), Cambridge, for his many decades of contributions.
- The 2018 Jan Van Vessem Award for Outstanding European Paper was presented to "A 128-Pixel 0.56 THz Sensing Array for Real-Time Near-Field Imaging in 0.13 μm SiGe BiCMOS" by Philipp Hillger, Ritesh Jain, Janusz Grzyb, Laven Mavarani, Bernd Heinemann, Gaëtan Mac Grogan, Patrick Mounaix, Thomas Zimmer, and Ulrich R. Pfeiffer. This award is named after Jan Van Vessem, who served as the first ISSCC European Program Committee chair and is based on ratings by conference attendees in the previous year.
- The 2018 Takuo Sugano Award for Outstanding Far-East Paper was given to "A PUF Scheme Using Competing Oxide Rupture with Bit Error Rate Approaching Zero" by Meng-Yi Wu, Tsao-Hsin Yang, Lun-Chun Chen, Chi-Chang Lin, Hao-Chun Hu, Fang-Ying Su, Chih-Min Wang, James Po-Hao Huang, Hsin-Ming Chen, Chris Chun-Hung Lu, Evans Ching-Sung Yang, and Rick Shih-Jye Shen. This award is named after Takuo Sugano, who, from 1967 to 1989, served as an early member of what became the Far-East Program Committee. The award is based on rating by conference attendees in the previous year.
- The 2018 Evening Session Award went to "Lessons Learned—Great Circuits That Didn't Work—(Oops, If Only I Had Known!)." The organizers

The winners of the 2017 IEEE Journal of Solid-State Circuits Best Paper Award with IEEE SSCS President Bram Nauta (far right).

Anantha Chandrakasan (left), recipient of the IEEE Solid-State Circuits Society Distinguished Service Award with SSCS President Bram Nauta.

Laurence Nagel (left), the winner of the 2019 Donald O. Pederson Award in Solid-State Circuits, with IEEE SSCS President Bram Nauta.



Meint K. Smit presents "Integration of Photonics and Electronics."

Vida Ilderem gives the talk "5G Wireless Communication: An Inflection Point."

were Phillip Restle, Kostas Doris, Vivek De, and Paul Ferguson. Tom Lee was the moderator, and the panelists were IEEE Solid-State Circuits Society (SSCS) President Bram Nauta, Nicky Lu, Shanthi Pavan, David J. Allstot, Chris Mangelsdorf, and Jon Strange. The award is based on conference-attendee ratings from the previous year.

- The recipients of the 2018 ISSCC Award for Outstanding Forum Presenter were Klaas Bult for "Energy Efficient Nyquist-Rate ADCs" and Sorin P. Voinigescu for "RF, mm-wave and Fiber-Optics Design in FDSOI CMOS Technologies." The award is based on forum-attendee ratings from the previous year.
- The 2018 Demonstration Session Certificate of Recognition was given to Oichi Kumagai for "A ¼-inch 3.9 Mpixel Low-Power Event-Driven Back-Illuminated Stacked CMOS Image Sensor" and Brian P. Ginsberg, Adrian Ozer, Karthik Ramasubramanian, Vijay Rentala, and Venkatesh Srinivasan for "A Multimode 76-to-81 GHz Automotive Radar Transceiver with Autonomous Monitoring."
- In addition, the 2018 Demonstration Session Certificate of Recognition was presented to Jinmook Lee for "UNPU: A 50.6TOPS/W Unified Deep Neural Network Accelerator With 1b-to-16b Fully-Variable Weight Bit-Precision" and Sungpill Choi for "A 9.02 mW CNN-Stereo-Based Real-Time 3D Hand-Gesture Recognition Processor for Smart Mobile Devices."

Next, SSCS President Bram Nauta took the stage and talked about the benefits of SSCS membership, such as access to world-class SSCS publications, the opportunity to attend members-only SSCS webinars, free access to SSCS educational content, and the opportunity to attend SSCS-sponsored conferences at a discounted rate. Nauta then presented the SSCS awards.

- The recipient of the 2018 SSCS Outstanding Chapter of the Year Award was the SSCS Hong Kong Student Chapter. Chapter Advisor Patrick Yue accepted the award on behalf of the Chapter.
- The 2017 Journal of Solid-State Circuits Best Paper was awarded for "A 28-GHz 32-Element TRX Phased-Array IC With Concurrent Dual-Polarized Operation and Orthogonal Phase and Gain Control for 5G Communications," published in the December 2017 issue of *IEEE Journal of Solid-State Circuits*, vol. 52, no. 12, pp. 3373–3391. The authors of the paper are Bodhisatwa Sadhu, Yahya Tousi, Joakim Hallin, Stefan Sahl, Scott K. Reynolds,

Örjan Renström, Kristoffer Sjögren, Olov Haapalahti, Nadav Mazor, Bo Bokinge, Gustaf Weibull, Håkan Bengtsson, Anders Carlinger, Eric Westesson, Jan-Erik Thillberg, Leonard Rexberg, Mark Yeck, Xiaoxiong Gu, Mark Ferriss, Duixian Liu, Daniel Friedman, and Alberto Valdes-Garcia.

- For the first time ever, Nauta presented the SSCS Distinguished Service Award. This award, established in 2018, recognizes exceptional and distinguished service to the SSCS. Anantha Chandrakasan was presented the 2019 award for his service and dedication as the conference chair for ISSCC from 2010 to 2018.
- Nauta then presented Laurence Nagel with the 2018 IEEE Donald O. Pederson Award in Solid-State Circuits "for the development and demonstration of SPICE as a tool to design and optimize electronic circuits."

To conclude the awards portion of the plenary, Nauta recognized the 2019 newly elevated IEEE Fellows. For a full list of IEEE Fellows who are SSCS members, please see the article "Congratulations to the 16 SSCS Members Elevated to IEEE Fellow" in the "Society News" column in this issue. After the awards presentation, there was a short break, and the two remaining plenary speakers made their presentations.

Plenary Session Continues

Following the SSCS awards, Meint K. Smit presented "Integration of Photonics and Electronics," focusing on the rapidly growing application market for photonic ICs. He described the current status and future developments of InP-based generic integration platforms. Vida Ilderem then gave the last talk of the session, "5G Wireless Communication: An Inflection Point." She discussed the 5G era and the countless new opportunities for technology innovation across the computing and connectivity landscape. She spoke about the disruptive architectures and technology innovations required to make 5G and beyond a reality. After the last talk, plenary speakers were given plaques.

—Abira Altvater

Evening Sessions

SRP

- Cochairs: Denis Daly, Omni Design Technologies, Billerica, Massachusetts, and Makoto Ikeda, University of Tokyo
- Poster session chairs: Yoonmyung Lee, SungKyunKwan University, Seoul, South Korea, and Mondira Pant, Intel, Massachusetts
- Secretary: Jerald Yoo, National University of Singapore, Singapore
- Advisor: Jan Van der Spiegel, University of Pennsylvania, and Anantha Chandrakasan, MIT
- Media/publications: Laura Fujino, University of Toronto
- A/V: Trudy Stetzler, Houston, Texas
- Committee members: Jason Anderson, University of Toronto; Masoud Babaie, Delft University of Technology, The Netherlands; Andrea Baschirotto, University of Milan-Bicocca, Italy; Ben Calhoun, University of Virginia; Hayun Chung, Korea University, Seoul; Shidhartha Das, Arm, United Kingdom; Andreas Demosthenous, University College London; Seulki Lee, imec, The Netherlands; Salvatore Levantino, Politecnico di Milano, Italy;

The 2019 SRP Committee members. First row (from left): Yoonmyung Lee, Tinoosh Mohsenin, Rabia Tugce Yazicigil, Jason Anderson, Farhana Sheikh, Cormac O'Connell, Marian Verhelst, Mondira Pant, Samira Zaliasl, and Seulki Lee. Second row (from left): Salvatore Levantino, Chia-Hsiang Yang, Shahriar Mirabbasi, Atsushi Shirane, Denis Daly, Jeffrey Weldon, Makoto Ikeda, Anantha Chandrakasan, Jerald Yoo, Laura Fujino, and Shih-Chii Liu.

Denis Daly gives welcoming remarks at the SRP.

Prof. Marian Verhelst talks about machine learning at the SRP.

The 2019 Silkroad Award recipient Ikki Nagaoka (left) with Far East Regional Committee Chair Tai-Cheng Lee.

SRP session 1 student participants and chairs. First row (from left): Muya Chang, Aminah Hina, Van Loi Le, Chia-Hsiang Yang, Tinoosh Mohsenin, Deepak Kadetotad, Hyunjoon Kim, Zhe Yuan, and Jiaming Xu. Second row (from left): Denis Daly, Makoto Ikeda, Anantha Chandrakasan, Jerald Yoo, and Laura Fujino.

SRP session 2 student participants and chairs. First row (from left): Mingqiang Guo, Kwanseo Park, Hamidreza Maghami, Shanthi Pavan, Samira Zaliasl, Baibhab Chatterjee, and Chaerin Hong. Second row (from left): Denis Daly, Makoto Ikeda, Anantha Chandrakasan, Jerald Yoo, Alessio Santiccioli, and Laura Fujino.

SRP session 3 student participants and chairs. First row (from left): Yun Wang, Beomsoo Park, Rabia Tugce Yazicigil, Hesam Sadeghi Gougheri, Tsung-Ching Tsai, Bangan Liu, and Chao Fan. Second row (from left): Denis Daly, Makoto Ikeda, Anantha Chandrakasan, Jerald Yoo, and Laura Fujino.

Qiang Li, University of Electronic Science and Technology of China, Chengdu; Shih-Chii Liu, University of Zurich and ETH Zurich; Shahriar Mirabbasil, University of British Columbia, Canada; Tinoosh Mohsenin, University of Maryland; Cormac O'Connell, TSMC, Canada; Shanthi Pavan, Indian Institute of Technology (IIT) Chennai; Jae-sun Seo, Arizona State University; Mingoo Seok, Columbia University, New York; Farhana Sheikh, Intel, Oregon; Bing Sheu, Chang Gung University, Taiwan; Atsushi Shirane, Tokyo Institute of Technology; GuoXing Wang, Shanghai Jiao Tong University, China; Jeffrey Weldon, University of Hawaii; Chia-Hsiang Yang, National Taiwan University, Taipei; Rabia Tugce Yazicigil, Boston University; Samira Zaliasl, Ferric, New York; and Milin Zhang, Tsinghua University, China.

The SRP at ISSCC 2019 was held on 17 February 2019, bringing eager students to San Francisco. The program highlighted selected student research projects by graduate students from around the world. Selection is based on the work's technical quality and innovation. The session began with a welcome and introduction by SRP Cochair Denis Daly. Afterward, award recipients for the 2019 SSCS predoctoral fellowships and the 2019 ISSCC/SSCS student travel grant were acknowledged. In addition, the 2019 Silkroad Award and ISSCC 2018 SRP Award were given. The award ceremony was followed by a talk by Prof. Marian Verhelst, Katholieke Universiteit Leuven, Belgium, who presented "Machine Learning: The Next Big Opportunity for Chip Designers." She spoke about what is happening in the area of embedded processors for AI and machine learning and also discussed the opportunities this new field can provide for circuit and chip designers and how they can be prepared.

Following Verhelst's talk, each student was given 1 min to present his or her research to the audience. The talks focused on three sessions:

1) Digital and Machine Learning Circuits and Systems (Chairs: Chia-Hsiang Yang and Tinoosh Mohsenin)
2) Data Converters and Clocking (Chairs: Samira Zaliasl and Shanthi Pavan)
3) Analog and Wireless Circuits (Chairs: Rabia Tugce Yazicigil and Milin Zhang).

After the student presentations, the poster session allowed attendees to take an in-depth look at the students' research.

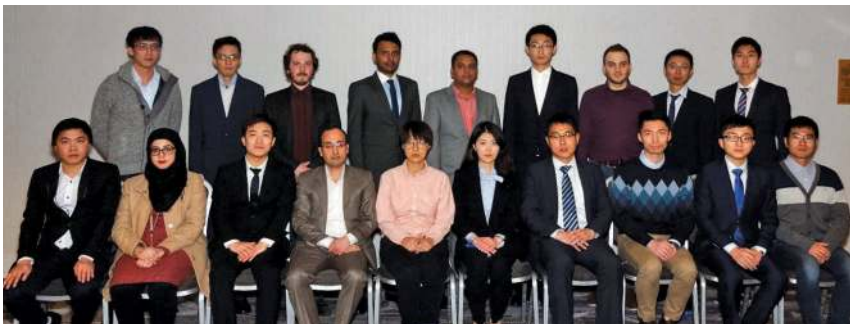
—Abira Altvater

Workshop on How to Save Lives With Circuits

- Chair: Kathy Wilcox, AMD, Boxborough, Massachusetts
- Committee: Edith Beigne, Facebook, Menlo Park, California; Dina El-Damak, University of Southern California (USC), Los Angeles; Azita Emami, California Institute of Technology, Pasadena; Ulkuhan Guler, Worcester Polytechnic Institute, Massachusetts; Rikky Muller, University of California, Berkeley; Mondira Pant, Intel, Hudson, Massachusetts; Negar Reiskarimian, Columbia University; Farhana Sheikh, Intel, Hillsboro, Oregon; Trudy Stetzler, Halliburton, Houston, Texas; Vivienne Sze, MIT; Ingrid Verbauwhede, KU Leuven; Alice Wang, PsiKick, Santa Clara, California; and Rabia Yazicigil Kirby, Boston University.

More than 300 engineers attended the workshop "How to Save Lives With Circuits" on Sunday, 17 February at the San Francisco Marriott Marquis. The workshop, cosponsored by the ISSCC and the SSCS Women in Circuits (WiC) Committee, was open to the public, and both ISSCC conference attendees and local engineers and students participated. The purpose of the workshop was to have leading women at all stages of life talk about topics relevant to their careers in health care, AI, and security—all hot topics in our field. Two senior women were invited to give distinguished talks, two junior women gave invited talks, and a panel session, "What Can Circuit Designers Do to Bolster Security in AI-Driven Healthcare?," capped off the evening with a third distinguished talk by a Turing Award winner.

Sue Siegel, chief innovation officer of General Electric, talked about exciting research showing that electronics is helping to industrialize



The recipients of the 2019 ISSCC/SSCS student travel grant. First row (from left): Van Loi Le, Aminah Hina, Beomsoo Park, Hesam Sadeghi Gougheri, Boyi Zheng, Chaerin Hong, Mingqiang Guo, Xiyuan Tang, Yuncheng Zhang, and Huan Wang. Second row (from left): Muya Chang, Hyunjoon Kim, Maxence Bouvier, Abhishek Bhat, Sachin Taneja, Wenning Jiang, Spyros Kalogiros, Wei Wang, and Kwanseo Park.

The recipients of the 2019 SSCS Pre-Doctoral Fellowship. First row (from left): SSCS Award Chair John Corcoran, Hossein Jalili, Parisa Mahmoudidaryan, Sheikh Nijam Ali, Nandish Mehta, Heein Yoon, Aravind Nagulu, Fahim ur Rahman, Angad Rekhi, and Kamala Raghavan Sadagopan. Second row (from left): Yaoyao Jia, Hani Esmaeelzadeh, Mahmood Baraani Dastjerdi, Jingzhi Zhang, Woojun Choi, Kodai Ueyoshi, Susnata Mondal, Min-Yu Huang, Yi-Chung Wu, Haowei Jiang, Linxiao Shen, Chee Cheow Lim, and Jian Pang.

The SRP poster session.

SRP chairs with ISSCC 2018 SRP Poster Award recipients (from left): Makoto Ikeda, Younghyun Lim, Sujin Park, and Denis Daly.

The speakers, organizers, and chairs of the "How to Save Lives With Circuits" event (from left): Dina Reda El-Damak, Andreia Cathalin, Marian Verhelst, Sugako Otani, Shafi Goldwasser, Wenyuan Xu, Ingrid Verbauwhede, Vivienne Sze, Alison Burdett, Kathy Wilcox, Trudy Stetzler, Jennifer Lloyd, Rabia Yazicigil Tugce, Rikky Muller, Damla Dimlioglu, and Alice Wang.

innovation and new business models. She also said that partnerships across disciplines are enabling more circuit content in medical devices and applications. After her presentation, Siegel had a fireside chat with Mondira Pant, talking about the challenges women face. Siegel shared her wisdom and described how she encourages diversity in her team and organization.

The second distinguished speaker, Dr. Jennifer Lloyd, vice president of Healthcare and Consumer Systems at Analog Devices, San Jose, California, showed how circuits are revolutionizing the CT scanner, making it both lower power and lower cost, so that it can be portable and kept at home. She encouraged the audience to embrace teamwork and learning, which are needed to keep up with the innovation required for advanced products.

Dr. Carolina Mora Lopez from imec presented exciting analog and mixed-signal circuits in neural interfaces that her team is working on. Prof. Hyunjoo (Jenny) Lee, KAIST, demonstrated circuits interacting with brains through a neuroprobe, showed the audience pictures of noninvasive probing of mice, and suggested how circuits are enabling us to understand and engineer brains. At the end of her talk, she went into some of the challenges of being the only female professor at one of the top universities in South Korea. Turing Award winner and professor at the University of California, Berkeley, Shafi Goldwasser, spoke about the foundations of cryptography and the impact circuits can make on security.

A panel session made up of five experts in the biomedical, AI, and security fields ended the night. The speakers gave audience members their widely varying views on the subject of circuits helping to keep healthcare data safe. The panel was led by moderator Ingrid Verbauwhede. The panelists were Alison Burdett, Sensium Healthcare; Shafi Goldwasser, University of California at Berkeley; Rikky Muller, University of California at Berkeley; Sugako Otani, Renesas Electronics Corporation, Tokyo, Japan; Vivienne Sze, MIT; and Wenyuan Xu, Zhejiang University, China.

Looking forward, at ISSCC 2020, the SSCS WiC Committee is looking for new programs to support more diversity within the SSCS community. If you are interested in volunteering with WiC, please contact one of the organizers through the SSCS website: https://sscs.ieee.org/women-in-circuits.

—Alice Wang

Making a Career Choice

Organizers: Emre Ayranci, pSemi, San Diego, California; Anantha Chandrakasan, MIT; Denis Daly, Omni Design Technologies; and Jan Van der Spiegel, University of Pennsylvania.

Moderator: Negar Reiskarimian, Columbia University.

Panelists: Edith Beigné, Facebook, California; Robert Brodersen, University of California at Berkeley; Barrie Gilbert, Analog Devices, Oregon; Nicky Lu, Etron Technology, Taiwan; and Marian Verhelst, KU Leuven, Belgium.

This year, for the first time in ISSCC history, a "Making a Career Choice" panel was organized for student attendees. Held on Monday, 18 February, the panel featured renowned experts from academia, industry, and research labs across the United States, Europe, and Asia. The conversation started with brief introductory remarks from each panelist covering the importance of building a professional network, expanding one's knowledge in a broad range of topics, the upcoming generation's role in the economic growth of the IC industry, and work–life balance.

Afterward, the floor was opened for a Q&A session. The attendees were enthusiastic to hear more about the process of innovations in circuit design, opportunities in research, and the IC industry's growing market through start-ups. The unique background and experiences of the panelists created an opportunity for discussions the audience appreciated. One important topic discussed was whether we are getting to the end of Moore's law and whether this is affecting the number of jobs in the IC industry. The consensus among

panelists was that the IC industry has a unique position in tech right now. Exciting new applications from AI, machine learning, and the Internet of Things have opened new opportunities in terms of design and innovation for the newest generation of IC designers and engineers. The evening concluded with postpanel discussions and networking among the panelists and other attendees.

—Negar Reiskarimian

Industry Showcase

Chair: Eugenio Cantatore, Eindhoven University of Technology, The Netherlands.

Session organizers: Alison Burdett, Sensium Healthcare, Abingdon, United Kingdom; Kush Gulati, Omni Design Technologies, Milpitas, California; and Un-Ku Moon, Oregon State University, Corvallis.

Committee members: Ahmed Ali, Analog Devices, Greensboro, North Carolina; Min Chen, Analog Devices, Milpitas, California; Muhammad Khellah, Intel, Hillsboro, Oregon; Yan Li, Western Digital, Milpitas, California; Yao-Hong Liu, imec, Eindhoven, The Netherlands; Mike Perrott, TDK-InvenSense, Boston; Bruce Rae, STMicroelectronics, Edinburgh, United Kingdom; Jiayoon Ru, Broadcom, Irvine, California; Takayuki Shibasaki, Fujitsu Laboratories, Kawasaki, Japan; and Youngmin Shin, Samsung, Hwansung, South Korea.

The ISSCC is the premier forum to present advances in solid-state circuits and systems on chip. These developments enable exciting innovations in products and applications, and they have a far-reaching impact on everyday lives. The Industry Showcase provides a forum at ISSCC where representatives can demonstrate their most advanced products in an entertaining and interactive way.

Bill Dally's keynote "Accelerated Platforms: The Future of Computing" introduced the Industry Showcase event at ISSCC 2019.

The Industry Showcase event was organized again this year after the success of the first edition in 2018. Its format was enriched with many new initiatives. The showcase began with "Accelerated Platforms: The Future of Computing," a keynote by Bill Dally, chief scientist and senior vice president of research, Nvidia, Santa Clara, California, and professor (research) of electrical engineering and computer science, Stanford University, California.

After Dally's talk, all demonstrations were briefly introduced by Kush Gulati, while Alison Burdett presented each showcase participant with a Technology Innovation Award. The 13 demonstrations this year were chosen via an open submission, followed by a selection based on voting by the event committee. The participants in this extremely well-attended and lively event were the following:

- Altia Systems, Cupertino, California, presenting a real-time 180° intelligent vision system, producing 2D panoramic 4-K and 3D 4-K video, which includes AI-based people- and object-detection capabilities
- AMS, Premstätten, Austria, showcasing a direct time-of-flight module, based on single-photon avalanche diode detectors, which are able to discriminate among multiple objects in the field of view with no hindrance from the glass covering the sensor
- Ayar Labs, Emeryville, California, demonstrating the TeraPHY, a high-density electronic-photonic chiplet platform for enabling tens of terabits per second out of compute packages
- Healthrian, Daejeon, South Korea, displaying a noninvasive blood pressure monitor that exploits impedance measurements to enable a wristband form factor
- IBM T.J. Watson Research Center, Yorktown Heights, New York, demonstrating a 28-GHz software-defined phased-array radio able to optimize a wireless directional communication link in the presence of reflectors and interferers
- MediaTek, Hsinchu, Taiwan, exhibiting a vision on the future of driving,

"Making a Career Choice" organizers, panelists, and moderators (from left): Robert Brodersen, Jan Van der Spiegel, Marian Verhelst, Barrie Gilbert, Edith Beigne, Emre Ayranci, Nicky Lu, Denis Daly, and Negar Reiskarimian.

The ballroom fills up with people before the keynote talk by Bill Dally at the ISSCC 2019 Industry Showcase event.

including an advanced parking assist and a driver monitoring system

- Nufront, Beijing, showing the Enhanced Ultra High Throughput wireless communication system, a reliable and low-latency system developed for high-speed rail, metro, and vehicle-to-everything applications
- Nvidia, Santa, Clara, California, showcasing deep learning inference in two demos, the first focusing on inference in the data center, based on the Nvidia TensorRT inference server, and the second showing real-time video insight for up to 35 high-definition streams on a single Jetson AGX Xavier for inference at the edge
- Ouster, San Francisco, demonstrating a 64-channel lidar system that includes a single monolithic laser array chip containing 64 lasers as well as an application-specified IC (ASIC) containing 64 photodetectors and digital signal processing
- PsiKick, Santa Clara, California, showing its ultralow-power state-of-the-art sensor network with completely battery-less edge sensor nodes for continuous industrial monitoring
- Samsung Electronics, Hwaseong, South Korea, displaying a dynamic vision sensor that removes motion artifacts while tracking fast-moving objects and is applied to simultaneous localization and mapping on a smart phone
- Samsung Electronics, presenting its Exynos Modem 5100, a new multimode 5G modem chipset supporting both sub-6-GHz and millimeter-wave 3rd Generation Partnership Project 5G New Radio standards together with global cellular radio access technologies
- SiFive, San Mateo, California, demonstrating the use of open hardware and frameworks by showcasing the Nvidia Deep Learning Accelerator running on a field-programmable gate array (FPGA) connected via ChipLink to SiFive's HiFive Unleashed board.

—Eugenio Cantatore

Moving to The Dark Side!

Tuesday featured a *Star Wars*–themed evening panel, where six executives defended their case in front of a live audience.

Organizers: Jan Westra, Broadcom, Bunnik, The Netherlands, and Matt Straayer, Maxim, North Chelmsford, Massachusetts.

Moderator: Matt Straayer.

Panelists: Dave Dwelley, Maxim, San Jose, California; Kave Kianush, Catena, Delft, The Netherlands; Curtis Ling, MaxLinear, Carlsbad, California; Jennifer Lloyd, Analog Devices, San Jose, California; Tyson Tuttle, Silicon Labs, Austin, Texas; and Patrick Yue, Hong Kong University of Science and Technology, China.

This *Star Wars*–themed evening panel certainly lived up to the hype of an epic Hollywood battle between engineering and management. The panel was appropriately divided into a trilogy of three episodes. During "Episode I: The Manage Menace," the panelists, all having moved from engineering to management, defended their case. Did they still have Jedi engineering qualities, or had they really moved to the Dark Side? More than 200 members in the audience voted for the executives from Team Jedi and Team Dark Side with an online poll.

For "Episode II: The Battle," the panelists scored points by crossing lightsabers over existential and provocative questions about the peaceful coexistence of engineering and management. During the episode, Chewbacca entered the scene by strolling around the audience and eventually joining Team Jedi onstage.

The surprises culminated in "Episode III: The End Game," a crazy fast-paced quiz. Team Dark Side almost surrendered, until unexpected help from the audience in the persons

The cast and crew of "Moving to the Dark Side!" (from left): SSCS President Bram Nauta, Chris Mangelsdorf, Matt Straayer, Jennifer Lloyd, Kavé Kianush, Curtis Ling, Tyson Tuttle, Dave Dwelley, Patrick Yue, and Jan Westra.

of Chris Mangelsdorf and Laura Fujino came and the Furry Fraud was unveiled to be SSCS President Bram Nauta. With a tied score, the evening panel ended as everyone rejoiced in the great symbiosis of engineering and management.

—Jan Westra
—Matt Straayer

How Can Hardware Designers Reclaim the Spotlight?

Organizers: Mike Shuo-Wei Chen, University of Southern California; Sudhakar Pamarti, University of California, Los Angeles; and Nagendra Krishnapura, IIT Madras, Chennai, India.

Moderator: Mike Shuo-Wei Chen.

Panelists: Luca Benini, ETH Zurich, and Universita di Bologna, Italy; Bill Dally, NVIDIA. Santa Clara, California; Varada Gopalakrishnan, Amazon Lab126, Sunnyvale, California; Colin Lyden, Analog Devices, Limerick, Ireland; Liam Madden, Xilinx, San Jose, California; Andreas Olofsson, DARPA, Arlington, Virginia; and Shaojun Wei, Tsinghua University.

On Tuesday, 19 February 2019, the evolving roles of hardware engineers and strategies to be more effective and relevant in this era of exponentially increasing IC complexity made up the topic of an evening session attended by nearly 200 people. The panelists debated what hardware designers must do to be more effective, how design cycles can be shortened, what role automation should play, and how the future generation of hardware engineers should be trained.

The opening statements and Q&A session that followed addressed current concerns, such as increased complexity of IC design erecting barriers to all but a few companies, viability and verification costs of ever-more-complex ICs, and the role of AI. The consensus was that hardware designers have to move up the chain, include system architecture in their repertoire, and prepare themselves for reconfigurable hardware design and hardware/software codesign. Increased abstraction, which would sacrifice performance a bit but improve productivity substantially, was identified as the key to building more complex systems. The end of Moore's law was brought up as an opportunity for creative, domain-specific accelerator IC design and hardware/software codesign.

On the question of whether complex ASICs would survive technology scaling, there was disagreement, with some panelists rooting for FPGAs or software-defined chips rather than ASICs and other panelists feeling that IC innovations would continue in older processes and that the focus need not necessarily be on sub-10-nm nodes. One opinion was that ASICs would be developed by big companies, whereas smaller ones would have to change. An open source hardware repository combined with automated layout and verification would make silicon ICs part of every developer's toolkit.

Hackathons were brought up as a way to tear down barriers created by complexity for young students trying to appreciate the area. The months-long tape-out delay would make it unfeasible for IC design to be included, but hackathons based on FPGAs or open source hardware would certainly be viable.

The session closed by summarizing the idea that hardware engineers should embrace higher levels of abstraction and learn systems and algorithms so that they can add value to tremendously complex hardware of the future. The teamwork required for such designs was captured by one of the panelists, who compared hardware design to the work of an orchestra rather than a solo performer in the spotlight.

—Nagendra Krishnapura

SSC