Dear IEEE Members, Honorees, Colleagues, and Friends:

Welcome to the 2018 IEEE VIC Summit and Honors Ceremony!

Across the spectrum of technology and around the globe, there are amazing innovations and cutting-edge research and development happening. These technologies—and more—will be discussed at this second IEEE Vision, Innovation, and Challenges (VIC) Summit. The IEEE VIC Summit presents a unique opportunity to connect with and learn from some of the technology “Giants” in the world, including top innovators, disruptors, and entrepreneurs in an intimate setting, as well as take advantage of networking opportunities with peers to exchange experiences and build partnerships. We hope that everyone who attends will be empowered and revive your passion in your field of interest, or learn from a synergistic field.

Much of this work being done today was made possible by the pioneering achievements of those we are recognizing at the IEEE Honors Ceremony. Tonight’s award ceremony is a celebration of the contributions of some of the greatest minds of our time who have made a lasting impact on society.

It is important that we take opportunities like the Honors Ceremony to come together and recognize the accomplishments and contributions of our honorees. Not only to thank those who are receiving these awards and recognize their successes, but also to inspire the rest of us when we hear of their visionary efforts to triumph over challenges.

The best technologists working today are those who believe that learning is a journey that they will always be on. No matter how much they learn, no matter what advancements they make, they always try to strive for more, to envision that next advance that will be even more beneficial to the world.

On behalf of IEEE’s Board of Directors, we would like to extend our sincere gratitude to our generous awards sponsors and to all of the nominators, endorsers, volunteers, and professional staff for their dedication to making our Awards Program such a success. We would like to acknowledge all of this year’s well-qualified nominees, the diverse array of educators, engineers, scientists, innovators, visionaries, leaders, and practitioners who exemplify the mission of the IEEE of advancing technology for the benefit of humanity.

Jim Jefferies,  
IEEE President and CEO

Mark J. Karol,  
IEEE Awards Board Chair
9:30 AM Welcome Remarks (Gold Ballroom)
Welcome from James A. Jefferies, IEEE President
Introductions by “Master of Ceremonies”
Brent Lunceford, President of Memstronics

9:45 AM Keynote: New Immersive Mediums—the Search for Egg Yolk:
Todd Richmond, Director, Mixed Reality Lab/Studio, USC

10:30 AM Break

10:45 AM Geometry Processing and Animated Film:
Mark Meyer, Senior Scientist, Pixar Research Group

11:20 AM The New Gene Therapy: CRISPR-Cas9 and the Future of Medicine:
Moderated by Glenn Zorpette, Executive Editor, IEEE Spectrum, with John Tisdale, NIH, and Bruce Conklin, UCSF

12:00 PM Luncheon & Networking Mixer (Ralston Room)

1:30 PM Robots on the Rise: The Future of Robotics and AI:
Moderated by Oussama Khatib, Professor, Stanford University, with
Cynthia Breazeal, Associate Prof. at MIT & Founder and Chief Scientist of Jibo, Inc.;
Grant Imahara, Consulting Mechanical Designer, Disney Research, and Host, Discovery Channel’s MythBusters; Eric Krotkov, COO at Toyota Research Institute; and Marc Raibert, Founder and CEO of Boston Dynamics

3:30 PM Break

4:00 PM Social Impact, and the Role of Engineers in Today’s Society:
Moderated by Matthew Fiedler, Cofounder and CTO, re:3D, with Ryan Cousins, CEO, krtkl, inc.; Kevin Noetker, Cofounder and CEO, Ampaire; and Veronica Osinski, Founder and Managing Partner, Trifecta Capital

4:30 PM Closing Remarks by Brent Lunceford

5:00 PM Networking & Red-Carpet Reception (Regency Foyer)

6:00 PM Honors Ceremony Gala and Dinner (Grand Ballroom)

Brent Lunceford is a serial innovator who for two decades has driven product innovation and new market entry at both Fortune 500 companies and high-growth ventures. He is President of Memstronics specializing in distributed intelligence systems, data analytics, and artificial intelligence. Brent led product and business development at 3M’s Global Innovation Center, and he formed and led engineering and production teams at Silicon Light Machines, acquired by Cypress Semiconductor. In his early career, he invented new technologies, raised funding and managed innovation programs at the Microelectronic Computer Technology Corporation (MCC) resulting in the development and commercialization of multiple disruptive technologies including the first commercialized metal MEMS, laser-based manufacturing systems, and new electronic and optical materials. He is an Entrepreneurial Advisor for the University of Texas-Cockrell School of Engineering Innovation Center. Brent lives in Austin, Texas where he is an outdoor enthusiast, youth mentor, and sports coach.

Todd Richmond currently heads the University of Southern California’s Mixed Reality Lab as its director. He works in a variety of areas related to emerging disruptive technologies tied to augmented reality, virtual reality, mixed reality, and artificial intelligence and their implications/applications for training, learning, and operations. Future environments for communication and collaboration, immersive technologies, interactive education, and visualization and analytics are some of the areas in which he and his team focus. He is also a member of the research faculty at USC’s School of Cinematic Arts, working to better understand virtual, augmented, and mixed reality (VAMR). He earned a B.A. in chemistry from the University of San Diego and a Ph.D. in chemistry from the California University of Technology followed by a postdoctoral fellowship in protein engineering at the University of California, San Francisco.

Mark Meyer is a senior scientist and lead of the research group at Pixar Animation Studios. He received his B.S. in computer science and computer engineering from Northwestern University and his Ph.D. from the California Institute of Technology (Caltech). Before joining Pixar in 2003, he worked on virtual reality and simulation at Argonne National Laboratory and instructed computer graphics courses in the Computer Science Department at Caltech. He is currently working in Pixar’s Research Group on projects including character articulation, rendering acceleration, physical simulation, and machine learning.
Glenn Zorpette is executive editor of IEEE Spectrum magazine. His interests include chipmaking, vehicles, nuclear and national-security technologies, audio electronics, DIY, war-zone reconstruction, technology applications in the developing world, and digital imaging. His reporting for IEEE Spectrum has taken him to Iraq, Afghanistan, Kuwait, the South Pole, Kwa-jalein Atoll, South Africa, and an underwater habitat in the Caribbean. He has won a National Magazine Award for reporting, has been a finalist in the same category, and has won a Grand Neal Award, among other honors. An IEEE Fellow, he holds a B.S. in electrical engineering from Brown University.

John Tisdale joined the Molecular and Clinical Hematology Branch of the National Heart, Lung and Blood Institute (NHLBI) in 1998 and is now chief of the Cellular and Molecular Therapeutics Section. His group focuses on developing curative strategies for sickle cell disease through transplantation of allogeneic or genetically modified autologous bone marrow stem cells. He graduated from the College of Charleston in South Carolina with a B.A. in chemistry in 1986. He then earned his M.D. from the Medical University of South Carolina in 1990. He completed an internal medicine and chief residency at Vanderbilt University Medical Center in Nashville and then trained in hematology in the Hematology Branch of the NHLBI, where he served as a postdoctoral fellow.

Bruce R. Conklin is an investigator at the Gladstone Institutes and a professor of medicine, ophthalmology, and pharmacology at the University of California, San Francisco. He is also the deputy director of the Innovative Genomics Institute, focusing on biomedical applications of clustered regularly interspaced short palindromic repeats (CRISPR) technology. His research focuses on using genome engineering to identify therapeutic approaches to human disease. Using CRISPR gene editing, his lab is perfecting allele-specific editing of dominant negative genes causing incurable disease of the retina, motor neurons, and the heart. He is the founder of several public stem cell and genomics projects and the Gladstone Stem Cell Core and the Gladstone Genomics Core laboratories. He pioneered the field of using designer G protein coupled receptors (RASSLs) for tissue engineering. He is a member of the American Society for Clinical Investigation and is a Fellow of the California Academy of Sciences.

Cynthia Breazeal is an associate professor of media arts and sciences at the Massachusetts Institute of Technology, where she founded and directs the Personal Robots Group at the Media Lab. She is also founder and chief scientist of Jibo, Inc. She is an award-winning innovator, designer, and entrepreneur. Her research focuses on developing principles, techniques, and technologies for personal robots that are socially intelligent, can interact and communicate with people in human-centric terms, and can work with humans as peers. She has developed some of the world’s most famous robot creatures ranging from small hexapod robots, to embedding robotic technologies into familiar everyday artifacts, to creating highly expressive humanoid robots and robot characters. She has recently been working on investigating the impact of social robots on helping people of all ages to achieve personal goals that contribute to quality of life in domains such as education, health, wellbeing, and emotive connection and engagement despite distance.

Oussama Khatib is a professor with the Department of Computer Science at Stanford University. His seminal work on robot planning and control has radically changed the basis of manipulation, interaction, locomotion, and other aspects of system design critical to the development of human-friendly robots. He developed the artificial potential field concept for reactive control of robots, which became a fundamental framework for real-time obstacle avoidance. His pioneering contribution of control in operational space rather than joint space has been integral to advances in whole-body motion and force control, and in humanoid robotics. His recent work on a robotics-based approach to human motor control and human motion understanding is providing substantial benefits to restoring movement and improving human performance. His work on learning human skills and mapping to robot-compliant strategies is becoming fundamental to increasing the autonomous capabilities of robots in performing complex tasks and cooperating with people.

Grant Imahara is recognized as the electronics and robots expert from Discovery Channel’s MythBusters. Using a blend of science and fun, he and his colleagues put urban legends to the test, sometimes with explosive results. He brings his unique skills to the White Rabbit Project on Netflix. He has hosted Punkin Chunkin and Killer Robots for Science Channel, and he has appeared on Junkyard Wars and Comedy Central’s BattleBots. Before his career in front of the camera, Grant spent nine years working behind the scenes in special effects as an animatronics engineer and modelmaker for George Lucas’ Industrial Light and Magic, working on numerous blockbusters. An IEEE Senior Member, he has a B.S. in electrical engineering from the University of Southern California. He has numerous official commendations from various organizations, including the City of Los Angeles, the City of San Francisco, and the White House. Currently he consults for Walt Disney Imagineering on next-generation robots for Disney’s theme parks.
Eric Krotkov serves as the chief operating officer at Toyota Research Institute, where he directs R&D and manages operations for the company. Before joining Toyota, he founded Griffin Technologies, a consulting and software firm specializing in robotics and machine perception. Griffin consulted on robotics for the U.S. Defense Advanced Research Projects Agency (DARPA) and other government agencies. From 1997 to 1999, he served as a program manager at DARPA, where he created the Tactical Mobile Robotics (TMR) program, which developed man-packable robots used for defusing roadside bombs in areas of armed conflict including Iraq and Afghanistan. He also led programs developing automation systems for surface ships and navigation systems for submarines. From 1988 to 1997, at Carnegie Mellon University he taught and researched computer vision, machine perception, and mobile robotics, with a focus on planetary rovers. He earned his Ph.D. in computer and information science from the University of Pennsylvania and his B.A. from Haverford College.

Matthew Fiedler is the Co-founder and CTO of re:3D® Inc., a Texas- and Puerto Rico-based, full-service company committed to affordable, large-scale industrial 3D printing providing custom hardware, engineering, and printing services. With 400+ customers in 50+ countries, re:3D manufactures Gigabot—the world’s largest industrial 3D printer under $9K. Gigabot rivals the printing quality of other industrial printers at 1/10th the cost and boasts a build volume starting at 30X larger than desktop models. re:3D’s customers represent domain experts in aerospace, defense, and academia, including US Army Aviation & Missile Research, Development and Engineering; Naval Air Weapons Center; US Air Force; Air National Guard; NASA Langley; NASA Johnson Space Center; Wyle Integrated Science & Engineering; Rolls-Royce Singapore; Autodesk; Honda Performance; the US Department of State; Harvard; and MIT. It also maintains multiple partnerships with 3D printing materials science experts, including an active collaboration with the University of Texas Austin.

Kevin Noertker, cofounder and chief executive officer of Ampaire, spent seven years in aerospace research and development and program management at Northrop Grumman, running multimillion dollar programs and developing and fielding advanced aircraft and satellite technologies. He has a proven track record for initiating and delivering innovative technical solutions, building and motivating teams, and optimizing systems. He now runs Ampaire, an aerospace startup based in Los Angeles that’s developing electric airplanes. Ampaire is nearly two years old and enables Kevin to combine his technical and management skills with his entrepreneurial vision, love for the outdoors, and passion for things that fly. He graduated with honors from the California Institute of Technology in 2009 with a B.S. in engineering.

Marc Raibert is founder and chief executive officer of Boston Dynamics, a company that creates some of the world’s most advanced dynamic robots, such as BigDog, Atlas, Spot, and Handle. These robots are inspired by the remarkable ability of animals to move with agility, dexterity, perception, and intelligence. A key ingredient of these robots is their dynamic behavior, which contributes to their life-like qualities and their effectiveness in the real-world. Before starting Boston Dynamics, he was professor of electrical engineering and computer science at the Massachusetts Institute of Technology (MIT) from 1986 to 1995. Prior to that he was associate professor of computer science and robotics at Carnegie Mellon University (CMU) from 1980 to 1986. While at CMU and MIT, he founded the Leg Laboratory, a lab that helped establish the scientific basis for highly dynamic robots. He is a Fellow of the Association for the Advancement of Artificial Intelligence and member of the U.S. National Academy of Engineering.

Ryan Cousins is cofounder and chief executive officer of krtkl inc. Based in Silicon Valley, krtkl (“critical”) makes life easier for companies developing heavily connected and automated products. Through prebuilt hardware modules, hardware accelerators, “soft” intellectual property, and engineering services, krtkl serves industries from robotics and unmanned aircraft to video processing and networking. The company is known for producing highly reliable systems and for squeezing every drop of performance out of the most compact, power-efficient, and affordable designs possible. His primary expertise is in program management, product development, supply chain/logistics, intellectual property, strategic partnerships, and revenue. He serves as a volunteer board member for Boost! West Oakland—a no-cost tutoring and mentoring program for K-5 students—and is a young entrepreneur mentor with Operation HOPE. Ryan earned a B.S. in mechanical engineering, with an emphasis in thermodynamics and fluid mechanics, from the University of California, Los Angeles.

Veronica Osinski is founding managing partner at Trifecta Capital. She previously apprenticed in venture capital at S-Cubed Capital under Mark Stevens, former managing partner at Sequoia Capital. While at S-Cubed, she sourced deals in Secret, Second Spectrum, and Embark. She attended board meetings for Elemental Technologies, Zapproved, Deal Décor, and Second Spectrum. Previous to venture capital, she launched a dairy farm while living in rural South Africa. She graduated summa cum laude with a degree in finance from the University of Southern California at the age of 20. While in college, she conducted research on the financial crash, executive compensation, and conflict of interest, and published her honors thesis on the impact of microfinance on inequality. During college she started businesses including a second-hand marketplace for women’s clothing and a photo editing/filtering business.
PRESENTATION OF AWARDS AT IEEE HONORS CEREMONY

Friday, 11 May 2018
The Palace Hotel
San Francisco, California, USA

OPENING REMARKS—IEEE President and CEO, James A. Jefferies & IEEE President-Elect, José M.F. Moura

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The awards presented by the 2018 IEEE Honors Ceremony Gala are supported by the generosity of the following organizations and societies

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2018 IEEE AWARDS BOOKLET | 5
Imagine wireless base stations floating in the stratosphere, providing broadband-speed Internet connections to the people below, no matter how remote their location. That’s the idea behind Project Loon, a venture at X, a sibling company of Google. Project Loon uses high-altitude balloons and solar power to quickly establish wireless networks with data rates as great as those of 4G LTE.

From a trial involving 30 balloons over the south island of New Zealand in 2013, the project has gone on to successful trials in Peru, Brazil, and most recently, Puerto Rico, where Loon balloons provided wireless service in the aftermath of Hurricane Maria to 200,000 residents of the island. In order to provide wireless service to a specific region, Project Loon engineers had to solve immense challenges, including inventing techniques to keep a cluster of stratospheric balloons over an area and for an extended period. They developed extremely sophisticated machine-learning algorithms that enable the balloons to navigate to an area and then maintain position and altitude in the powerful wind currents in the stratosphere. The system accomplishes this in part by relying on dynamic maps of the stratospheric winds that are updated constantly. Other software manages the unique challenges of maintaining connectivity in a cellular wireless network in which not only the customers are moving around, but also the base stations.

X is now negotiating partnerships with local communications providers to use Loon to establish Internet service to some of the world’s most underserved regions. They’re also looking forward to working closely with industry and governments to help them better prepare for disasters.

Gordon Moore, who won the IEEE Medal of Honor in 2008, famously declared in 1965 that the number of transistors on an integrated circuit was doubling at regular intervals, and that it would continue to do so for the foreseeable future. The prophecy has held up beyond anyone’s expectations (including Moore’s). So now, 53 years later, the “Law,” as it is known, still defines the pace of progress in the $409-billion-a-year semiconductor industry. But to keep the pace, remarkable breakthroughs must be achieved regularly. Some of the greatest of these occur in the area of photolithography, in which radiation is used to project patterns onto photosensitive materials in successive steps to create the transistors of an integrated circuit (IC). Starting out with visible light in the 1960s, lithographers had to invent new processes based on shorter and shorter wavelengths to produce smaller and smaller features. To continue the relentless pace, they had no choice but to move into the realm of X-rays, or Extreme Ultra Violet (EUV).

The challenges were great. There was no powerful and reliable source of the EUV radiation. The exposure process would have to be carried out in a total vacuum, because air absorbs EUV radiation. Also, lenses are useless at these wavelengths, so researchers had to build special multilayer mirrors. Over a period of decades, ASML managed to solve these and countless other challenges and develop a complete, working EUV lithography system. This pioneering system is set to begin producing commercial ICs later this year at several of the world’s most advanced chip-fab facilities.
An Academy Award®–winning film studio with world-renowned technical, creative, and production capabilities in the art of computer animation, Pixar Animation Studios has produced deep and lasting innovations in virtually every aspect of computer graphics. Starting in the early 1970s, Pixar technologists led by Edwin Catmull have been at the forefront of the field. Pixar has created some of the most successful and beloved animated films of all time, and their techniques have been responsible for the adoption of computer graphics in an extraordinary number of industries beyond entertainment. Pixar began as the Graphics Group, which was part of the Computer Division of Lucasfilm. At Lucasfilm, the team achieved key computer-generated imagery milestones. In 1986 Pixar was acquired by Apple co-founder Steve Jobs, and the studio’s short film, Luxo Jr., was a milestone in the use of 3D computer animation to tell a story. In 1995, Pixar forever impacted the future of filmmaking and animation with the release of its first feature film, Toy Story. Toy Story completely upended how animated films were produced, moving from 2D cell animation to full 3D computer animation. Among their many innovations, Pixar invented digital image compositing, including the now-standard Porter-Duff compositing algebra. Pixar’s depth buffer algorithm for hidden surface removal, texture mapping, programmable shading, and stochastic sampling became the basis of all modern renderers. Their RenderMan render engine has been used in hundreds of motion pictures. Pixar’s introduction of volume rendering became an indispensable tool not only in filmmaking but also in scientific visualization and medical imaging. Pixar also pioneered particle systems for creating a wide variety of physical phenomena. Marionette was Pixar’s first proprietary 3D animation program, enabling the creation of Toy Story and used for animated films through 2011. In 2012, Pixar launched the Presto animation system with a powerful layering and referencing model to allow large teams of artists to work collaboratively on extremely rich and complicated imagery and motion.

Located in Emeryville, CA, USA, Pixar is currently under the direction of Edwin Catmull, cofounder of Pixar Animation Studios and president of Pixar and Walt Disney Animation Studios.

Scope: For an outstanding innovation by an organization in an IEEE field of interest.

A recognized expert in electromagnetic compatibility standardization, Donald Heirman has dedicated his career to the development of standards and education in the field and extending technology to address business, consumer, and social needs. EMC is the ability of electronic devices to operate near each other without experiencing the effects of electromagnetic interference, and Heirman’s in-depth understanding of EMC coupled with his dedication to progressing the field of EMC product compliance measurements has resulted in many invaluable contributions. He spent over 30 years with Bell Laboratories, where he focused on reducing low-frequency and radio-frequency noise in telephone circuits, providing regulatory compliance testing strategies and designing, building, and operating compliance test facilities. There he founded the Global Product Compliance Laboratory and was responsible for the company’s major EMC and associated regulatory activities. He was instrumental in Bell’s participation in the IEEE EMC Society, ANSI Accredited Standard Committee C63 (EMC), and international EMC standardization committees. He has chaired or been a principal technical contributor to U.S. and international EMC standards organizations including ANSI ASC C63 and the International Electrotechnical Commission’s (IEC) International Special Committee on Radio Interference (CISPR). He presently chairs the IEC’s Advisory Committee on EMC (ACEC) and is a life member of the U.S. National Committee of the IEC’s Technical Management Committee. Heirman’s outstanding service to the IEEE, particularly to the IEEE EMC Society and to the IEEE Standards Association, includes serving on the IEEE Board of Directors, president of the IEEE EMC Society and IEEE Standards Association, multiple terms as vice president of the IEEE EMC Society; and as chair of multiple technical committees in the society. Heirman is also a voting member of the Smart Electric Power Alliance (SEPA) Testing and Certification Committee and chairman of its Electromagnetic Interoperability Issues Working Group, which provides EMC recommendations for smart grid equipment and systems.

An IEEE Life Fellow and recipient of the 2008 IEC Lord Kelvin Award, Heirman is president of Don HEIRMAN Consultants, Lincroft, NJ, USA, which he founded in 1997.

Scope: For distinguished service advancing the technical objectives of the IEEE.

Oddiet Heirman

For leadership and service to industry and IEEE, and for the development of global consensus and education in IEEE technical fields and standards.

IEE Corporate Innovation Award

Sponsored by IEEE

Pixar Animation Studios

For a long history of pioneering innovations in computer animation and computer graphics.

IEE Richard M. Emberson Award

Sponsored by the IEEE Technical Activities Board

Donald Heirman

For outstanding innovation by an organization in an IEEE field of interest.
**IEEE Haraden Pratt Award**

*Sponsored by the IEEE Foundation*

### Loretta Arellano

**For furthering IEEE's objectives, promoting cooperation among IEEE organizational units, and exemplary innovation in developing IEEE volunteer leaders**

A dedicated leader whose volunteer efforts have spanned many IEEE major organizational units at all leadership levels, Loretta Arellano has shown remarkable initiative in identifying and developing opportunities to carry out the Institute’s mission of advancing technology for the benefit of humanity. Balancing her professional career—where she was an expert in reliability, maintainability, and logistics at Raytheon Company—with her IEEE service, Arellano has inspired teams and promoted cooperation among IEEE organizational units. In 2013, she was instrumental in meeting the IEEE Member and Geographic Activities (MGA) Board’s goal of modernizing the volunteer experience. Recognizing a need to train promising volunteers, she proposed and created what is now known as the Volunteer Leadership Training Program (VoLT) to identify and develop leaders from the ranks of IEEE’s local organizational units. The program introduces aspiring leaders to leadership skills and all aspects of IEEE operations and involving each of IEEE’s major organizational units. Each VoLT trainee is assigned a mentor who shepherds the volunteer through a practical project designed to provide practical leadership experience. The volunteer participates in interactive webinars along with completion of a leadership project. The end result is a volunteer who is prepared to assume higher levels of responsibility in leading IEEE activities. For better efficiencies of staff and volunteer resources, Arellano also implemented a plan to integrate the MGA’s training activities into a single committee, providing a one-stop approach to volunteer training and leadership development. She merged VoLT, the IEEE Center for Leadership Excellence (CLE), and the MGA Training Committee into one committee whose mission is to focus on all aspects of volunteer training. Among her many positions, she has served as Region 6 Director, Division 6 Director, and was president of the IEEE Reliability Society.

An IEEE Senior Member and an Institute for the Advancement of Engineering Fellow, Arellano is senior manager (retired) with Raytheon. She lives in Sun Valley, CA, USA.

**Scope:** For outstanding volunteer service to the IEEE.

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**IEEE Honorary Membership**

*Sponsored by IEEE*

### Anton Zeilinger

**For pioneering conceptual and experimental contributions to the development of quantum communications and encryption**

A visionary quantum physicist and a pioneer of quantum information science, Anton Zeilinger has helped shape the future of quantum technologies, including quantum communications. Quantum communications will play an important role in protecting information channels against eavesdropping by using quantum cryptography. He has performed many groundbreaking experiments in quantum mechanics, from important fundamental tests all the way to innovative applications. Most of his research concerns the fundamental aspects and applications of quantum entanglement. He discovered (with Greenberger and Horne), and later realized in experiments, the first multiparticle entangled states. These have since become essential in fundamental tests of quantum mechanics and in quantum information science, most notably in quantum computation. Among the innovative applications he and his group developed are the first entanglement-based quantum cryptography, quantum teleportation of independent photons, key concepts in optical quantum computation, the one-way quantum computer, and novel entanglement-based imaging methods. Quantum teleportation involves sending quantum information where the exact state of an atom or photon can be transmitted exactly from one location to another, with the help of classical communication and previously shared quantum entanglement between the sending and receiving locations. With his team, he also realized a few of the first long-distance entanglement-based quantum communication experiments, first across the Danube River in Vienna and later in many experiments between the Canary Islands. He has developed various schemes of quantum cryptography, demonstrating photonic key distribution in optical fibers as well as through free space. He also performed numerous tests of Bell’s inequality, closing more loopholes and thus making quantum cryptography unconditionally secure. Recent work, in cooperation with the Chinese Academy of Sciences, includes the establishment of the world’s first intercontinental quantum cryptography link via the quantum satellite Micius.

Recipient of the inaugural Isaac Newton Medal from the United Kingdom’s Institute of Physics (2008), Zeilinger is a professor of physics at the University of Vienna and president of the Austrian Academy of Sciences, Vienna, Austria.

**Scope:** For those who have rendered meritorious service to humanity in the IEEE’s designated fields of interest and who are not members of the IEEE.
From smartphones to quantum computing, Mike Lazaridis has been a catalyst at the heart of the most important technological developments of our time. His creativity, entrepreneurial spirit, and belief in the power of basic science as a transformative tool have put him at the forefront of innovation. Lazaridis founded Research in Motion in 1984, which became BlackBerry, where he developed one of the world’s first smartphones and in the process revolutionized personal mobile communications. Since its invention and evolution, the BlackBerry device has pushed the advancement of wireless communication, mobile computing, and computer security. Lazaridis turned his passion for theoretical physics into the Institute for Theoretical Physics, which he established in 2000. The Institute has been widely recognized as a leading international center for physics research, training, and outreach. He also founded the Institute for Quantum Computing (IQC) at the University of Waterloo, which is dedicated to the experimental foundations of the quantum computer. He has donated more than US$170 million to Perimeter, and more than US$120 million to the IQC. In March 2013, Lazaridis launched Quantum Valley Investments (QVI) with US$100 million to provide financial and intellectual capital for the development and commercialization of quantum physics and quantum computing breakthroughs. QVI aims to help transform ideas and early stage breakthroughs into commercially viable products, technologies, and services. QVI has been instrumental in realizing Lazaridis’ goal of creating in Waterloo a “Quantum Valley” to rival Silicon Valley by bringing the world’s best minds in physics, engineering, mathematics, computer science, and materials science together to collaborate on cutting-edge quantum research. Lazaridis has helped put Waterloo on the map as a recognized high technology center for physics and innovation that is fueling the next revolution in quantum physics.

Mike Lazaridis

For revolutionary contributions to wireless communication and visionary leadership in fostering the advancement of fundamental physics toward future innovation

Scope: For those who have rendered meritorious service to humanity in the IEEE’s designated fields of interest and who are not members of the IEEE.

The driver of the semiconductor industry’s revolutionary shift from NMOS (N-channel metal oxide semiconductor) to CMOS (complementary metal oxide semiconductor), Tsugio Makimoto’s technical expertise and vision have led to the commercialization of high-speed memories and microprocessors that enable the digital consumer electronics we take for granted today. Makimoto helped develop and commercialize the world’s first high-speed 4K/16K CMOS static random-access memory (SRAM) based on twin-well structure technology. He then developed a high-speed CMOS microprocessor unit (MPU) that was as fast as its NMOS counterpart, but which operated at much less power. This was instrumental in the industry's transition from NMOS to CMOS, with production of integrated circuits for logic, dynamic RAM, and flash memory switching to CMOS processes under his leadership. Most of today’s electronic devices are based on CMOS technology. Makimoto is also noted for developing field-programmable MPUs with embedded flash memory, which substantially shortened the time to market for new products. His leadership in promoting high-performance, low-power reduced instruction set computer (RISC)-based MPUs was instrumental in creating the digital consumer market segment to provide the digital cameras, hand-help PCs, and other powerful portable devices that proliferate our society today and enable our mobile lifestyle. Makimoto has also provided the semiconductor industry with a valuable tool for predicting trends and developing strategies. He recognized that there is a cyclical nature to the semiconductor industry where, over time, there would likely be an oscillation between customized and standardized products. He theorized that over a 10-year period, key forces such as differentiation, value-add, operational efficiency, cost effectiveness, and time to market would drive this oscillation. This became known as “Makimoto’s Wave,” and it contributed to the rise of the field-programmable gate arrays. Makimoto also helped establish the World Semiconductor Council to promote international cooperation among semiconductor associations from around the globe.

Tsugio Makimoto

For technical and managerial leadership in CMOS memory and microprocessors

Scope: For exceptional contributions to the microelectronics industry.

An IEEE Life Fellow and recipient of 2004 Bellwether Award and 2013 Global IT Award, Makimoto is the president of Tech-novision, Tokyo, Japan.
The technologies developed by Eli Yablonovitch affect anyone who uses a mobile phone or searches the Internet. Yablonovitch proposed that semiconductor lasers should be strained, in order to benefit from reduced valence band (hole) effective mass. Today, with almost every human interaction with the Internet, optical telecommunication occurs by strained semiconductor lasers. Most likely, billions of people are unknowingly using his idea every time they connect to the Internet, make a phone call, or check e-mail. In his photovoltaic research, Yablonovitch’s 4n² light-trapping factor is in worldwide use for almost all commercial solar panels. Known as the Yablonovitch Limit, this factor increased the theoretical limits and practical efficiency of solar cells. To the extent that solar electricity is blended with other power sources, there are billions of people unknowingly taking advantage of the Yablonovitch Limit. In his photonics work, Yablonovitch unified Maxwell’s Equations and Schrodinger’s Equation through the concept of the photonic crystal. The geometrical structure of the first experimentally realized photonic bandgap is often called Yablonovite. His invention of photonic crystals unifies optics, solid-state physics, electromagnetics, and quantum optics. Among other applications, photonic crystals are used in telecommunications, particularly in polarization-splitting two-dimensional grating couplers—which are a critical part of silicon photonic integrated circuits. His original paper on photonic crystals has been cited over 10,000 times and is the second-most-cited paper in the history of Physical Review Letters. Yablonovitch has cofounded four science-based companies, including Ethertronics, which became a major independent cellphone antenna manufacturer, having shipped over 2 billion antennas.

An IEEE Fellow and member of both the U.S. National Academy of Engineering and National Academy of Sciences, Yablonovitch holds the James and Katherine Lau Chair in Engineering and is a professor with the Electrical Engineering and Computer Sciences Department at the University of California, Berkeley, Berkeley, CA, USA.

Scope: For a career of meritorious achievement in electrical science, electrical engineering, or the electrical arts.

Nambi Seshadri’s pioneering research and commercial intuitiveness have impacted multiple generations of mobile and wireless communications and have helped make technology more affordable for consumers. While at AT&T Shannon Labs, one of Seshadri’s key research initiatives was his work on transmission and coding techniques using multiple transmit antennas. This helped create a new field of wireless communications called space-time coding that improved the reliability of data transmission. An earlier version of this work that he did at AT&T Bell Labs, called delay diversity, was an important component of the 2G cellular time-division multiple access systems and has also impacted WiFi and LTE systems. His contributions to reliable transmission of compressed speech over mobile radio channels also influenced the development of 2G cellular systems. He also drove the adoption of adaptive modulation and hybrid automatic repeat request techniques (important for high performance in time varying channels) in to the Enhanced Data Rates for Global Evolution (EDGE) standards. These techniques have become core to robust transmission in 3G and 4G systems around the world. His work on list Viterbi decoding and applications for combined speech and channel decoding as well as data transmission systems have been applied to improve speech quality in 2G and 3G systems. Following his career at AT&T Bell Labs and AT&T Shannon Libs, Seshadri helped build Broadcom into a significant player in the wireless market. Here, he initiated or nurtured projects such as short-range wireless, WiFi modems in phones, cellular modems, GPS, near-field communications, and the multimedia chip set strategy that resulted in pioneering products such as the high-definition video camcorder and advanced megapixel camera phones. Through his leadership, the company was able to reduce prices while improving the performance of wireless chipsets. This system–on-chip integration of applications processing, graphics, haptics, WiFi, Bluetooth, camera, and 2G/3G/4G modems has impacted the industry by making smart phones much more affordable.

An IEEE Fellow and member of the U.S. National Academy of Engineering, Seshadri is a professor of electrical and computer engineering at the University of California, San Diego, San Diego, CA, and consulting CTO at Quantenna Communications, San Jose, CA, USA, in addition to serving as an advisor for several startups.

Scope: For exceptional contributions to communications and networking sciences and engineering.
Narayana Murthy’s leadership in guiding Infosys from a start-up into a software engineering giant has served as the foundation of India’s role as a global superpower in information technology, and he has used the company’s success to give back to his native country. Murthy founded Infosys with six other colleagues in 1981 and developed it into what is today a US$35 billion software services company that has helped reshape the economic and social fabric of India. Key to the company’s success was Murthy’s Global Delivery Model (GDM), which is based on collaborative software development resulting in the on-time delivery of superior quality products to global customers within budget. GDM is the backbone of the Indian software industry and integral to the information technology outsourcing revolution. Under Murthy, Infosys became a role model for strong execution, product quality, corporate governance, and ethical practices with a culture of honesty, fairness, transparency, and meritocracy. Infosys’ pioneering stock options plan ensured that employees fully shared in the company’s success. Murthy also instituted an in-house training facility to provide quality skill development opportunities to keep up with rapid advances in technology. A generous philanthropist both institutionally and personally, Murthy established the Infosys Foundation to utilize a percentage of corporate profits to promote education, health, social welfare, destitute care, and culture programs in India. Through the Infosys Foundation, Murthy and his family have contributed heavily to assist the very poorest through access to better food, water, hygienic living conditions, education, and jobs. The Foundation has created libraries for poor children in 15,000 villages, has built hospitals and donated many sophisticated medical instruments, and has supported the largest free-lunch program in the world. Now retired, Murthy remains a strong voice for corporate ethics and social responsibility worldwide, while promoting stronger institutional governance in India. An IEEE Honorary Member and fellow of the Indian National Academy of Engineering, Murthy is the founder of Infosys, Bengaluru, India.

Erdal Arikan’s groundbreaking work on channel polarization coding methods for achieving maximal channel capacity in digital communications has revolutionized information and communications theory by meeting the challenges of Shannon’s limit for determining the maximum rate that data can be sent with zero error. A culmination of over 20 years of research, in 2009 Arikan described the concept of channel polarization and a completely new, remarkably clear method of data coding for transmission over symmetric channels with binary input. Considered one of the most powerful developments in coding theory of the past decade, his discovery of using polar codes for error correction was a major step in determining the limit at which reliable and efficient transmission of data over noisy channels is possible. Enhancing the original application to binary-input channels, Arikan extended his codes to channels with arbitrary input size to enable broader applications. His framework has proven to be flexible and adaptable to the parameters of communication channels, allowing researchers to construct polar coding schemes for a large range of block lengths and information transmission rates. His polar codes also feature simple iterative schemes of data encoding and decoding to allow efficient hardware implementation. His work has also been extended to polar codes for channels that are not necessarily symmetric, dual polar codes for data compression, and polar codes for data hiding with information-theoretic security guarantees. Initially met with skepticism by practitioners due to major obstacles preventing their practical use, Arikan’s polar codes have evolved in a short time to become an integral component of emerging wireless standards for enhanced mobile broadband (eMBB) control channels in 5G New Radio (NR) interfaces, with a major wireless company recently demonstrating 27 Gbps in 5G field-trial tests. An IEEE Fellow and recipient of the 2013 IEEE W.R.G. Baker Award, Arikan is a professor with the Department of Electrical Engineering at Bilkent University, Ankara, Turkey.

IEEE Founders Medal
Sponsored by the IEEE Foundation

Narayana Murthy
For visionary leadership at Infosys contributing to human progress through technology and for advancing corporate ethics and social responsibility

IEEE Richard W. Hamming Medal
Sponsored by Qualcomm, Inc.

Erdal Arikan
For contributions to information and communications theory, especially the discovery of polar codes and polarization techniques

**Scope:** For outstanding contributions in the leadership, planning, and administration of affairs of great value to the electrical and electronics engineering profession.

**Scope:** For exceptional contributions to information sciences, systems, and technology.
IEEE Medal for Environmental and Safety Technologies

Sponsored by Toyota Motor Corporation

Jerome Faist and Frank K. Tittel

For pioneering contributions to the quantum cascade laser and optical chemical sensors for environmental sensing

The numerous direct and indirect collaborations between Jerome Faist and Frank K. Tittel have made quantum cascade laser (QCL) spectroscopy an established, more powerful, and versatile chemical detection tool for trace chemical sensing in environmental, medical, and security applications. Faist developed the QCL in 1994, providing a fundamentally new semiconductor laser that could operate in the mid-infrared and terahertz wavelength range. He then created the first single-mode laser suitable for spectroscopy in 1997. Faist has continuously advanced QCLs with innovations expanding the wavelength range, improving efficiency, developing theoretical models underpinning their properties, and expanding their applicability by improving room-temperature operation. Tittel had already been a leading researcher in several fields related to vibrational spectroscopy, especially in the development of new light sources and spectroscopy systems. With Faist’s invention of the QCL, Tittel was eager to adapt the technology to environmental monitoring and medical diagnostics. In 2004, Faist supplied Tittel with one of the first QCLs cooled only by a thermoelectric cooler operating in the 9-µm region, which Tittel used to observe the absorptions of several species. Then Faist developed a broadly tunable QCL with an antireflection coating enabling external cavity tuning, which Tittel incorporated into a broad scanning source for his spectroscopic applications. One of the most important techniques developed in Tittel’s lab was quartz-enhanced photoacoustic spectroscopy (QEPAS). In this method, absorption of a modulated laser beam by a tiny sample of gas excites the resonance of a quartz tuning fork. By combining QEPAS with a QCL, Tittel produced a very compact and portable trace gas monitor with high sensitivity and stability that was readily deployable to the field. QCL-based sensors developed by Tittel have been shown to detect trace amounts of methane and nitrous oxide at landfills. Overall, Faist and Tittel have provided the global climate research community with tools to solve critical problems of unprecedented complexity.

An IEEE Member, Optical Society of America Fellow, and recipient of the 1994 American Association for the Advancement of Science’s Newcomb Cleveland Prize, Faist is a professor with the Department of Physics at ETH Zurich, Zurich, Switzerland. An IEEE Fellow and Optical Society of America Fellow, Tittel is the J.S. Abercrombie Professor in Electrical and Computer Engineering at Rice University, Houston, TX, USA.

Scope: For outstanding accomplishments in the application of technology in the fields of interest of IEEE that improve the environment and/or public safety.
Bede Liu’s pioneering work on signal processing focused primarily on lowering implementation complexity and reducing power consumption, which have been central to the creation of cost-effective, high performance, low-power signal processing, important in the development of mobile and multimedia systems. To battle the cost of implementing digital signal processing algorithms, Liu developed novel methods that require much less computation by replacing computation with memory. His revolutionary approach of incorporating simple shift-and-adds for multiplier-free filters provides a 3-to-1 savings in computation over the traditional methods, thus enabling highly efficient implementation of digital filters and the fast Fourier transform algorithm. Multiplier-less processing has been widely used and commercialized in chips for control and imaging applications, dynamic signal analyzers, and a discrete cosine transform chip that was the fastest at the time. Liu’s proposal to use 1-bit coefficients on over-sampled data achieved significant savings in chip area and power. This approach is now widely used to allow for tradeoffs among clock rate, area, and power consumption in implementations for applications including mobile information devices. In video coding, Liu’s novel way to determine motion vectors that reduces computation by a factor of 4 was incorporated in software packages and also led to a number of other proposed efficient approaches. In video analysis, his proposal to use reduced resolution processing to extract video content cuts computation by two orders of magnitude. He also developed novel ways of transcoding the conversion of an encoded video bit stream to another with a smaller bit rate in order to adapt to network conditions.

An IEEE Life Fellow and member of the U.S. National Academy of Engineering, an academician of Academia Sinica (Taipei), and a foreign member of the Chinese Academy of Sciences (Beijing), Liu is a Professor Emeritus with the Department of Electrical Engineering at Princeton University, Princeton, NJ, USA.

**Scope:** For sustained contributions to the analysis and the development of low-complexity realizations of digital signal processing algorithms.

Thomas F. Budinger’s groundbreaking work has defined how radiation can be safely applied to medical imaging, enabling the development of positron emission tomography (PET) and single photon emission computed tomography (SPECT) radiotracers critical to investigating conditions including cancer, heart disease, Alzheimer’s disease, and brain injury. His research group at the Lawrence Berkeley National Laboratory has made world-class contributions in the fields of radiotracer development, radiotracer imaging, and tomographic image reconstruction. Budinger pioneered the use of the 82Rb generator for heart imaging, which was commercialized under the brand name CardioGen-82, for clinical use. He performed the first SPECT dynamic imaging study of the human heart, which required a novel combination of list-mode data acquisition, cardiac gating, attenuation measurements of the spatially inhomogeneous human chest, and tomographic reconstruction. Budinger’s team created the Primer on Reconstruction Algorithms, which was distributed worldwide during the late 1970s and 1980s, allowing scientists and students to gain hands-on experience in computed tomography using radionuclides or X-rays. This work also led to the quantitative understanding of how time-of-flight could be used in PET and how the statistical noise in reconstructed PET images could be reduced as the timing resolution was improved. These concepts are found in PET scanners being used today. Under his leadership, the construction of the PET 280 and the PET 600 scanners demonstrated how the limits of PET resolution could be approached. The PET 600 was constructed using 600 individually paired detectors and photomultiplier tubes to obtain a landmark 2.3-mm resolution. Budinger was a key player in the development of the Committee on Medical Internal Radiation Dose (MIRD) guidelines for safe use of radiopharmaceuticals. The MIRD Primer was published in 1988, providing outlined models and methods for determining organ dosimetry. He described, from biophysical principles and experiments, the safety of magnetic resonance imaging that is leading to human studies at 10 Tesla and beyond.

An IEEE Life Member and member of both the U.S. National Academy of Medicine and National Academy of Engineering, Budinger is a professor of bioengineering at the University of California, Berkeley, Berkeley, CA, USA.

**Scope:** For pioneering contributions to tomographic radiotracer imaging.
The groundbreaking contributions of Thomas Haug and Philippe Dupuis in developing the Global System for Mobile Communications (GSM) set the international policy framework responsible for the success and continued advancement of international mobile communications. Haug’s experience in developing the Nordic Mobile Telephone project, a 1G analog system that was the first example of international roaming among mobile phone users in Sweden, Norway, Denmark, and Finland, helped pave the way to developing GSM. Serving as chair of the Special Mobile Group of the European Conference of Postal and Telecommunications Administrations (CEPT), Haug was tasked with finding a consensus on 2G digital technology for mobile communications. GSM would be the solution. Dupuis led the Franco-German cooperation program that demonstrated digital technologies were mature enough to build the GSM system. Dupuis strongly supported using slow frequency hopping, which later allowed operators to manage the huge growth of traffic with reduced impairments to the quality of service. This enabled GSM to achieve performance equal or superior to competing digital systems. Under Haug’s leadership, GSM allowed the first digital telephone call in 1992 between the Finnish prime minister and the mayor of Tampere. His initiatives also led to the inclusion of the SIM card and SMS text messaging. Dupuis is credited with moving GSM from concept to reality, and he followed Haug as chair of the Special Mobile Group. Dupuis also promoted a smooth transition concept that ensured the continuation of GSM as a foundation for 3G, 4G, and even today’s emerging 5G standards. Haug’s and Dupuis’ development of GSM as a singular cellular standard to replace a plethora of competing national standards has stood the test of time in providing seamless service improvements for successful worldwide wireless communications.

Haug is the recipient of the 2013 Charles Stark Draper Prize from the U.S. National Academy of Engineering and is a former chairman of the Special Mobile Group of the CEPT (now the European Telecommunications Standards Institute), Sollentuna, Sweden. Dupuis was awarded Knight distinction in France’s National Order of the Legion of Honor (1989) and is a former chairman of the Special Mobile Group of the CEPT (now the European Telecommunications Standards Institute), Gif-sur-Yvette, France.
A leading innovator in the field of photonics, Joe C. Campbell’s development and advancement of avalanche photodiodes (APDs) have raised the sensitivity of optical receivers to a new level to increase the amount of information that can be transmitted in high-bandwidth fiber-optic networks. Optoelectronic devices play an integral role in communication systems with lasers and photodetectors acting as information sources and receivers, and the APD has become the standard for long-haul, high-bitrate systems. APDs are also widely used in laser range finders, in biomedical imaging applications such as positron emission tomography, and in particle physics experiments. Beginning with his work at Bell Labs in the 1980s and continuing through his academic career at the University of Texas at Austin and the University of Virginia, Campbell has carried out groundbreaking work that has enabled the realization and advancement of high-performance APD-based fiber-optic receivers crucial to long-distance telecommunications links. Campbell was responsible for the initial design, fabrication, and experimental characterization of the APD, and he demonstrated the order-of-magnitude improvement in system performance that APDs enabled. He also demonstrated the critical importance of separate avalanche and detection (SAM), as well as the importance of charge (SACM) and grading (SAGM) layers in this design. He showed the importance of nonlocal effects and how APD receivers can be made superior to existing theories as a result of this effect in superlattice APDs. Campbell was the first to show that the multiplication noise of these high-speed APDs did not degrade for very thin multiplication regions. Campbell also modeled the noise and frequency response of the SAM-APD. His analytic treatment of the frequency response includes all the physical mechanisms that affect the speed. This model is widely accepted as the most accurate method to simulate the frequency response of the technologically important APD.

An IEEE Life Fellow and member of the U.S. National Academy of Engineering, Campbell is the Lucian Carr Professor of Electrical and Computer Engineering at the University of Virginia, Charlottesville, VA, USA.

**Scope:** For outstanding contributions to material and device science and technology, including practical application.

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A pioneer in the field of computer education for engineers, Delores M. Etter’s groundbreaking vision has produced some of the most influential educational works that have transformed and improved undergraduate engineering education in the fields of computers and programming. Etter has written more than a dozen textbooks that have helped educate hundreds of thousands of students worldwide. A unique characteristic of her textbooks is the focus on a consistent problem-solving methodology beyond just writing code. She refined her initial approach with feedback from hundreds of students over several years into a problem-solving technique based on five steps. Step 1 is to carefully describe the problem to be solved, because sometimes we start to solve a problem before we fully understand it. Step 2 is to define the input and the output to the problem. Step 3 is to work a simple problem by hand, since, if you can’t do a simple problem by hand or with a calculator, you aren’t ready to start writing a computer program. Step 4 is to develop an algorithm for the solution and convert it into a computer program (always start with a flowchart or pseudocode, even for simple problems). Step 5 is to test the program carefully (start with the solution you hand-worked in Step 3 and then move on to testing it with a variety of inputs, including invalid inputs). This five-step process is defined at the beginning of each of Etter’s textbooks, and it is consistently used for every complete example throughout her texts. She has demonstrated that the technique works for computer languages ranging from MATLAB to Fortran to C++. New editions of her textbooks have been translated into different languages including Chinese, Japanese, Korean, Spanish, and Italian, benefitting students around the world.

An IEEE Life Fellow and member of the U.S. National Academy of Engineering, Etter is a Professor Emeritus with the Department of Electrical Engineering at Southern Methodist University, Dallas, TX, USA.

**Scope:** For a career of outstanding contributions to education in the fields of interest of IEEE.
Mark E. Davis
For technical contributions to advanced aerospace multifunction microwave and foliage penetration radars, and for leadership within the radar community

Hirofumi Akagi
For pioneering contributions to theory and practice of power conversion systems and their applications

Both a technical innovator and manager of some of the most advanced radar systems ever conceived, developed, and deployed, Mark E. Davis has established a sustained history of outstanding and pioneering contributions to radar systems, radar phenomenology, and radar signal processing. Davis led the team that developed a new generation of airborne microwave radars known as modular survivable radar (MSR), utilizing emerging technologies of monolithic microwave integrated circuits (MMIC) and very-large-scale integrated circuits (VLSI). A breakthrough in radar surveillance technology, MSR provided novel, multimode features that were vastly superior to competitive systems, such as achieving an order of magnitude improvement in mission reliability; performing multimode, simultaneous detection; and tracking of ground targets by employing ten independent sum and difference beams. It also enabled real-time synthetic aperture radar (SAR) and ground moving target indication (GMTI) radar mode operation. Responsible for the U.S. Air Force Science and Technology Plan for Space Based Radar (SBR) development, Davis transformed the SBR community from a collection of scientists into a team of specialists who develop state-of-the-art technology for the United States and its allies. He was also instrumental to the U.S. Defense Advanced Research Projects Agency (DARPA) Mountain Top Radar Program, which involved the collection of measured data for validating radar space-time adaptive processing (STAP) techniques. His contributions to industry include the development of critical electronic components and signal processing technologies that were ahead of their time, leading to highly sophisticated, advanced, multifunction radar technology for improved GMTI and real-time SAR capabilities. Davis’ more recent activities include pioneering work on advancing foliage penetration (FOPEN) radar systems for improved detection and characterization of objects hidden by dense foliage. Davis authored the textbook *Foliage Penetration Radar: Detection and Characterization of Objects Under Trees* (2011) and has been the IEEE Aerospace Systems Society’s distinguished lecturer on foliage penetration and ultra-wideband radar since 2012.

An IEEE Life Fellow and recipient of the 2011 Warren D. White Award for Excellence in Radar Engineering, Davis is an international consultant through medavis consulting, Prospect, NY, USA.

**Scope:** For outstanding accomplishments in advancing the fields of radar technologies and their applications.

One of the most prolific contributors to increasing the use of power electronics to benefit power systems, Hirofumi Akagi’s pioneering work on power conversion techniques has led to energy-saving applications in industrial and residential systems and has been integral to advances in renewable energy systems, electric/hybrid vehicles, and energy storage. Akagi presented the first paper on the theory of instantaneous active and reactive power in three-phase circuits. Known as “p-q theory,” Akagi applied it to a three-phase reactive power compensator consisting of switching devices without any bulky energy storage component. He also experimentally verified innovative operating characteristics that had until then been impossible to obtain through the application of conventional reactive-power theory in single-phase circuits. Considered a fundamental theory for three-phase circuits, Akagi’s p-q theory has allowed students and power engineers to gain insight into the instantaneous concept of voltage, current, active power, and reactive power. It has provided breakthroughs in the control of static synchronous compensators and unified power flow controllers in high-voltage transmission systems, as well as pure and hybrid active filters. Akagi’s work on developing the three-level neutral-point-clamped (NPC) inverter has impacted high-power converters for medium-voltage motor drives and grid-tied applications. Marking the beginning of multilevel converter technology, the NPC concept has been used around the world in photovoltaic inverters, general-purpose inverters, steel mill drives, and bullet trains. Akagi has tackled the detrimental effects of electromagnetic interference (EMI) encountered in power conversion systems with innovative research leading to active and passive filters for reducing conductive EMI and bearing current in motor-drive systems. Akagi is also well known for his innovations regarding pure and hybrid active filters for power conditioning.

An IEEE Fellow and recipient of the 2008 IEEE Richard H. Kaufmann Award, Akagi is a Distinguished Research Professor with the Department of Electrical and Electronic Engineering at the Tokyo Institute of Technology, Tokyo, Japan.

**Scope:** For outstanding contributions to the technology associated with the generation, transmission, distribution, application and utilization of electric power for the betterment of society.
Heinz Stoewer’s systems engineering approach to solving complex challenges has led to the successful implementation of important international space projects and has benefited diverse industries. Stoewer was the European Space Agency’s (ESA) first program manager for the Spacelab project, where he created a strong systems group. Spacelab was essentially a small reusable space station designed to fit within the cargo bay of the U.S. National Aeronautics and Space Administration’s (NASA) Space Shuttle that consisted of pressurized modules, unpressurized pallets, and other hardware that could be reconfigured for specific missions. Stoewer’s systems engineering approach was critical to the success of the project, where the Spacelab and Shuttle depended on each other for power, life support, thermal management, crew functions, and communication. In these efforts, he led the requirements, system definition, and interface negotiations between ESA and NASA. This work ultimately set the stage for U.S. and European cooperation on the International Space Station. Stoewer also founded the ESA’s Systems Engineering and Programmatic Department, where he implemented an end-to-end systems engineering philosophy across ESA projects. He served as managing director of the German Space Agency’s national space science and applications projects, which included important work on shuttle imaging radar and the gravity recovery and climate experiment. Stoewer was also founding director of Delft University of Technology’s international master’s degree program in space systems engineering, where he introduced the use of small satellite-based projects as an effective teaching and training tool for engineering students. Serving on the International Council on Systems Engineering (INCOSE), he helped to broaden the organization’s global perspective beyond aerospace and added a commercial component to complement its original aerospace focus. For the past eight years, Stoewer has been a Distinguished Visiting Scientist at NASA’s Jet Propulsion Laboratory, where he has helped transform their system capabilities into a modern model-based systems engineering set of assets.

A member of the International Academy of Astronautics and recipient of the NASA Administrator Public Service Award (1984 and 1995) and of the Medal of the German Bundesrat (Senate), Stoewer is president of Space Associates GmbH, Munich, Germany.

Scope: For pioneering accomplishments in and technical leadership of space systems engineering, and for profound influence on teaching and practice of systems engineering.

With the introduction and development of abstract interpretation, Patrick Cousot has provided the computer programming industry with one of the most sweepingly influential and impactful tools in all of computing. Working with his wife Radhia (who passed away in 2014), Cousot’s groundbreaking demonstration in 1977 of abstract interpretation was a fundamental paradigm shift that placed static program analysis on a mathematical footing so that researchers could reason about correctness. It is now the dominating approach to static program analysis and is pervasive in today’s programming tools, including compilers and the interactive development environment. Abstract interpretation provides a foundation for performing automatic program analysis, where the goal is to obtain information about the possible states that a program passes through during execution, but without actually running the program on specific inputs. In compilers, it is used to gather information used to decide which optimizations to employ, thereby allowing programs to run faster. In software-engineering tools, it is used to provide feedback to programmers about a program’s runtime properties, which helps them do a better job of developing, modifying, debugging, and testing programs. In verification tools, it is one of the key techniques used to show that a program never reaches a bad state, thereby establishing that the program is correct with respect to some property of interest. Verification has grown increasingly important as computers and microchip-based controllers have become pervasive, and it is especially crucial regarding critical systems, such as controllers in nuclear reactors, automobile-braking and airbag-deployment systems, and aircraft collision-avoidance systems. Cousot and his team developed the ASTEREE software system to analyze C programs for the occurrence of runtime errors. ASTEREE has been applied to many safety-critical applications, such as the flight-control software for the Airbus A340 and A380 aircraft.

An IEEE Member and recipient of the 2008 Humboldt Research Award and the 2014 IEEE Harlan D. Mills Joint Award, Cousot is the Silver Professor of Computer Science at the Courant Institute of Mathematical Sciences, New York University, New York, NY, USA.

Scope: For outstanding achievements in computer-related science and technology.
A visionary leader in academia, industry, and the U.S. military, Bradford W. Parkinson’s role in developing and advancing the Global Positioning System (GPS) has provided the world with technology we now take for granted and that impacts virtually all aspects of modern living. GPS has become an engine of economic development and the basis for countless applications that rely on accurate positioning and timing information. Parkinson was the chief architect of this satellite-based navigation system that works in any weather condition, anywhere in the world, 24 hours a day, to let us know precisely where we are—whether on land, at sea, or in the air. As a Colonel in the U.S. Air Force in 1973, Parkinson led the efforts to gain government approval of GPS and served as the first director of the GPS Joint Program Office. While GPS was originally funded solely by the military, Parkinson insured that certain GPS signals would be freely available for civil applications. Under his leadership, the GPS satellites were produced and launched in 44 months. Simultaneously, a ground control system was developed and deployed to upload the satellites. Also developed were eight different kinds of user equipment to demonstrate the capabilities of the new system, and Parkinson led extensive tests to confirm that GPS could meet its goals.

As a professor at Stanford University, Parkinson participated in the development of many innovative applications for GPS while leading a research group within the Center for Positioning, Navigation, and Time. His group successfully modified a commercial Boeing 737 for robotic aircraft landings. In 1992, this plane made 110 fully “blind” landings using GPS alone. They also developed the first precision robotic farm tractor controlled to an accuracy of approximately 2 inches on a rough field. This initiated the era of “autofarming” that is now a US$900 million-a-year worldwide market. The group also created the Wide Area Augmentation System (WAAS) intended to enable aircraft to rely on GPS for all phases of flight, including precision approaches to any airport within its coverage area. WAAS can also improve accuracy of personal GPS devices. Parkinson also served as coprincipal investigator and program manager of the NASA/Stanford Relativity Gyroscope Experiment, which validated Einstein’s general theory of relativity using orbiting gyroscopes. With GPS providing precision orbit control and measurement, the experiment verified two effects of general relativity never before tested with a mechanical apparatus.

Parkinson’s technical, program management, and political expertise made the initial configuration of GPS a reality. He then worked tirelessly to ensure that GPS remains an effective and reliable military capability as well as a precise and reliable international utility supporting an ever-increasing array of civil applications. Today’s mobile Long-Term Evolution (LTE) communications technology is essentially dependent on high-precision GPS timing for its operation. GPS is also integral to providing emergency services; marine, air, and automotive navigation; weather forecasting and tracking; and surveying and mapping applications.

An IEEE Life Fellow and coreipient of the 2003 Charles Stark Draper Prize, Parkinson is the Edward C. Wells Professor of Aeronautics and Astronautics Emeritus at Stanford University, Stanford, CA, USA.

**IEEE Medal of Honor**

*Sponsored by the IEEE Foundation*

Bradford W. Parkinson

For fundamental contributions to and leadership in developing the design and driving the early applications of the Global Positioning System

**Scope:** For an exceptional contribution or an extraordinary career in the IEEE fields of interest.
### IEEE TECHNICAL FIELD AWARDS

The following Technical Field Awards are presented at 2018 IEEE technical conferences

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IEEE Biomedical Engineering Award
Sponsored by the IEEE Circuits and Systems Society and IEEE Engineering in Medicine and Biology Society

Mark S. Humayun
For contributions to the bioelectric retinal implant

A pioneer in vision restoration, Mark S. Humayun’s development of the Argus II bioelectric artificial retina is improving patient quality of life by restoring sight to the blind. The first and to date only artificial retina to be both approved by the U.S. FDA and receive the European CE mark, the device receives image data from an external camera that is wirelessly transmitted to an electronic array implanted on the retina, enabling patients who are blind to recover enough vision to see letters and large objects and navigate obstacles. Key to the realization of the implant was Humayun’s ability to lead diverse teams of engineers and combine the unique elements of electrical/biomechanical engineering, optics, materials science, and miniaturization. Humayun’s current focus with the implant is on providing color vision and the ability to read smaller text.

An IEEE Fellow, Humayun is a professor at the University of Southern California, Los Angeles, CA, USA.

IEEE Control Systems Award
Sponsored by the IEEE Control Systems Society

John N. Tsitsiklis
For contributions to the theory and application of optimization in large dynamic and distributed systems

A leader in the effort to optimize and control large-scale dynamic and distributed systems, John N. Tsitsiklis’ algorithmic innovations have made possible advances in diverse applications ranging from dynamic resource allocation to sensor networks and distributed computation. Dynamic programming, the central methodology behind sequential decision making and control, often suffers from the curse of dimensionality. Tsitsiklis’ work is behind some of the most powerful methods for overcoming this challenge in settings such as reinforcement learning, path planning, and the pricing of complex financial derivatives. Furthermore, his early work on consensus algorithms and distributed and asynchronous computation is impacting modern large-scale optimization methods, network management, and distributed control.

An IEEE Fellow and a member of the U.S. National Academy of Engineering, Tsitsiklis is a Clarence J. Lebel Professor of Electrical Engineering at the Massachusetts Institute of Technology, Cambridge, MA, USA.

IEEE Cleo Brunetti Award
Sponsored by the Brunetti Bequest

Siegfried Selberherr
For pioneering contributions to Technology Computer Aided Design

One of the founders of modern Technology Computer Aided Design (TCAD), Siegfried Selberherr has provided modeling and software development tools invaluable to the continued miniaturization of semiconductor devices. TCAD involves the use of computer simulation to develop and optimize semiconductor processing technologies. Selberherr developed MINIMOS for two-dimensional predictive simulation of the electrical characteristics of miniaturized devices to understand and control the short-channel effects and doping profiles encountered as device sizes shrink. MINIMOS was later enhanced for three-dimensional simulation to address energy transport and interface physics. He also created the ZOMBIE and PROMIS simulators, which incorporate mesh generation and programming interfaces. Selberherr then developed the Vienna Integrated System for TCAD Applications (VISTA) to combine both process and device simulation tools in a common framework.

An IEEE Fellow, Selberherr is a professor with the Institute for Microelectronics at the Technische Universität Wien, Vienna, Austria.

IEEE Electromagnetics Award

Tatsuo Itoh
For contributions to electromagnetic modeling, artificial materials, microwave electronics, and antennas

With over 50 years of theoretical and technological innovations, Tatsuo Itoh is among the most respected experts in electromagnetics and microwave techniques. He extended electromagnetic simulation to high-frequency applications, developing models that allow inclusion of relevant interactions between microwave circuit elements, their packaging, and the electromagnetic environment. His comprehensive field-based approach to global modeling helped establish the system-in-package concept important to smart phones. Itoh’s spectral domain method for microwave circuit analysis is one of the most popular techniques for computer-aided design of microwave components. Recent achievements include realizing metamaterials enabling leaky-wave antennas that can continuously scan from the backward wave region to the forward wave region as a function of frequency.

An IEEE Life Fellow, Itoh is the Northrop Grumman Chair in Electrical Engineering at University of California, Los Angeles, Los Angeles, CA, USA.
Mari Ostendorf has advanced the field of speech and language processing by combining pioneering advances in statistical modelling and machine learning with an understanding of the deeper structures in speech. In acoustic modeling, she developed stochastic segment models to overcome the limitations of hidden Markov models, allowing the use of richer feature sets. Ostendorf helped standardize the method for annotating prosodic events (the properties of syllables and larger units of speech such as intonation, tone, and rhythm), as a major contributor to the now standard “ToBI” method for labeling speech prosody, and demonstrated its utility for improving spoken language technology. She also created novel frameworks of language modeling that are effective in separating different contextual factors, significantly impacting language modeling for speech recognition.

An IEEE Life Fellow, Ostendorf is a professor of electrical engineering at the University of Washington, Seattle, WA, USA.

Gurtej Singh Sandhu’s pioneering achievements concerning patterning and materials integration have enabled the continuation of Moore’s Law for aggressive scaling of memory chips integral to consumer electronics products such as cell phones, digital cameras, and solid-state drives for personal and cloud server computers. Sandhu initiated the development of atomic layer deposition high-k films for DRAM devices and helped drive cost-effective implementation starting with 90-nm node DRAM. Extreme device scaling was also made possible through his pitch-doubling process, which led to the first 3X-nm NAND flash memory. Sandhu’s method for constructing large-area straight-wall capacitors enabled the formation of double-sided capacitors that extended the scaling of important one-transistor, one-capacitor (1T1C) device technologies. His process for CVD Ti/TiN is still in use for making DRAM and NAND chips.

An IEEE Fellow, Sandhu is a Senior Fellow and director of Micron Technology, Inc., Boise, ID, USA.

Peter Stoica’s extensive contributions have impacted virtually every important subject of modern statistical signal processing. He has made seminal contributions to a broad area of theoretical topics. In particular he has been hailed for his pioneering contributions to array processing and direction-of-arrival estimation techniques and to multi-input multi-output radar. His influential scholarly texts, *System Identification* and *Spectral Analysis of Signals*, have been used worldwide to educate many generations of students, and his more recent books on wireless communications and sequence design have been invaluable references for researchers in the field. Throughout his life-long career he has also been a leader in bringing innovative signal processing techniques to a wide spectrum of important applications including radar, nuclear magnetic resonance, breast cancer diagnosis, wireless communications, sensor networks, and exo-planet search in astronomy.

An IEEE Fellow, Stoica is a professor with Uppsala University, Uppsala, Sweden.
The advanced modeling tools and innovative equipment developed by Jinliang He are making drastic improvements in protecting high-voltage power transmission lines from the effects of lightning strikes. Using electromagnetic field theory, He developed lightning shielding failure analysis methods for extra- and ultra-high-voltage transmission lines that are more accurate than conventional electrogeometric analysis. Tackling the difficult subject of upward lightning leaders originating from the transmission lines, He’s models more accurately simulate the real process of a lightning strike, enabling optimal design of overhead power lines to reduce lightning shielding failure events. He also pioneered polymeric surge arresters that are smaller, lighter, and safer to better suppress overvoltage due to lightning strikes and to effectively reduce the cost of constructing ultra-high-voltage systems.

An IEEE Fellow, He is the Chang Jiang Scholars Distinguished Professor of China’s Ministry of Education with the Department of Electrical Engineering at Tsinghua University, Beijing, China.

Linus Torvalds is a Finnish-American software engineer and architect of the Linux operating system. Torvalds started writing Linux, an open UNIX-like kernel, while working on his master’s degree while at the University of Helsinki. His freely shared work ignited a technical revolution that enabled anyone to have a web presence at very low cost and has made Linux the leading operating system for servers, supercomputers, netbooks, Internet networking equipment, embedded systems, and numerous personal devices. His collaborative development process in the Linux kernel is the key success of open source software. Linux is in billions of smartphones, powers most tablets, and underlies computer-enabled eyewear, thermostats, and kitchen appliances. Torvalds is also the original author of the “git” source control management system. To this day, he remains the technical lead developer of the Linux kernel project.

Torvalds is a Fellow at Linux Foundation, Portland, OR, USA.

Ramesh Govindan’s pioneering work on defining Internet topology, discovering how the many hosts, routers, and autonomous systems are connected, has been integral to the continued growth of the Internet. His Mercator mapping tool was one of the first network mappers and provided extensive views of the Internet’s backbone. He was among the first to study the Border Gateway Protocol, identifying oscillation issues affecting network stability. Govindan is also one of the founders of the sensornet movement, important to developing the Internet of Things in which everyday objects are imbedded with sensors that enable constant monitoring and interaction. Notable here is his work on directed diffusion and development of the Tenet program for wireless sensing, which set the direction for continued research.

An IEEE Fellow, Govindan is the Northrop Grumman Chair in Engineering and a professor at the University of Southern California, Los Angeles, CA, USA.

Greg Stone’s role in creating the first widely used commercial online partial discharge (PD) instrument has benefited electric utility companies by providing advanced diagnostics for assessing the condition and the need for maintenance of aging power equipment. The challenge in detecting PD is being able to separate it from electrical noise prevalent in power systems. Stone’s work made it possible to separate PD signals from noise to facilitate online measurements and enable assessment of the condition of a machine’s insulation system. To achieve this, he characterized how PD and noise pulses propagate in machine windings and measured pulse shape characteristics. He then helped develop algorithms to enable the online monitoring. Stone’s recent work has addressed the challenges of detecting PD in variable-speed drives to avoid premature failure.

An IEEE Fellow, Stone is a dielectrics engineer with (and co-founder of) Iris Power, L.P., Mississauga, Ontario, Canada.
IEEE Joseph F. Keithley Award in Instrumentation and Measurement
Sponsored by Keithley Instruments, a Tektronix company, and the IEEE Instrumentation and Measurement Society

David W. Allan

For leadership in time determination and precise timing instruments

Keeping time, or more precisely, keeping accurate time, has been the focus of David W. Allan’s career. He developed a device to automatically remove systematic timing errors from quartz-crystal oscillators used for generating the United States’ official time. He also created a dual-mixer time-difference measurement system with sub-picosecond precision for comparing atomic clocks. His GPS common-view timing receiver has been used to transfer time from timing centers around the world to the International Bureau of Weights and Measures for generating coordinated universal time (UTC) as the world’s official time. His “smart-clock” method for enhancing GPS civil signals has been instrumental in synchronizing cell phone towers. The Allan Variance, Modified Allan Variance, and the Time Variance, which he developed, have become international standards for designing and constructing time and frequency equipment.

An IEEE Life Senior Member, Allan is president of Allan’s TIME, Fountain Green, UT, USA.

IEEE Gustav Robert Kirchhoff Award
Sponsored by the IEEE Circuits and Systems Society

Alan Willson

For fundamental contributions to the theory and design of nonlinear circuits and signal processing systems

Alan Willson’s seminal achievements over 50 years (many in collaboration with his Ph.D. students) have substantially enhanced theory and design in the fields of nonlinear circuits and digital signal processing (DSP). His nonlinear circuits research has produced fundamental theorems for transistor circuits that have lasting impact. He has also developed highly effective design techniques for finite impulse response digital filters. Willson’s work on direct digital synthesizer technology, resulting in many patents through his company Pentomics, Inc., has had significant industrial application. In the early 1970s Willson also created the University of California, Los Angeles’ first DSP courses and research projects.

An IEEE Life Fellow and U.S. National Academy of Engineering member, Willson is the Charles P. Reames Professor Emeritus at the University of California, Los Angeles, Los Angeles, CA, USA.

IEEE Leon K. Kirchmayer Graduate Teaching Award
Sponsored by the Leon K. Kirchmayer Memorial Fund

Mark S. Lundstrom

For creating a global online community for graduate education in nanotechnology as well as teaching, inspiring, and mentoring graduate students

Mark S. Lundstrom’s innovative courses and pioneering online programs are transforming the way electronics is taught. Lundstrom created nanoHUB to provide online access to simulations of nano-materials and devices. He then developed nanoHUB-U to provide short courses that bring new insights and understanding from research to graduate education. More than 60,000 students from over 1,000 universities have registered for these courses. He complemented nanoHUB-U with the student-friendly Lessons from Nanoscience Lecture Notes series, which aims to rethink traditional topics, so that working from the nanoscale to the macroscale becomes natural and intuitive. In his work with students, Lundstrom instills the need for clear and concise communication and demonstrates the importance of intellectual honesty and modesty in everything a student or professional does.

An IEEE Life Fellow, Lundstrom is the Don and Carol Scifres Distinguished Professor of Electrical and Computer Engineering at Purdue University, West Lafayette, IN, USA.

IEEE Koji Kobayashi Computers and Communications Award
Sponsored by NEC Corporation

Victor Bahl

For contributions to broadband wireless systems

With seminal research achievements that have enabled the modern wireless Internet to become a reality, Victor Bahl has shaped the broadband access technologies we take for granted today, making Internet access more affordable, reliable, and globally available. Among his many important contributions, Bahl developed opportunistic networking and the world’s first white space network. He was instrumental in the U.S. Federal Communications Commission’s decision to open 180 MHz of spectrum for unlicensed use. His community wireless mesh networks implementing multi radio routers also brought affordable Internet access to rural communities. Other accomplishments include the first Wi-Fi hotspot; Wi-Fi based indoor localization systems, which showed how RF signals can be used for functionality beyond communications; and Virtual Wi-Fi available in today’s computers and smartphones.

An IEEE Fellow, Bahl is a Distinguished Scientist with Microsoft Research, Redmond, WA, USA.
IEEE William E. Newell Power Electronics Award
Sponsored by the IEEE Power Electronics Society

Rainer Marquardt

For development of the modular multilevel converter application in medium drives and high-voltage DC transmission systems

A milestone achievement in power electronics, Rainer Marquardt pioneered the modular multilevel converter (MMC) concept, which has revolutionized the capabilities of power conversion technology. It has changed high-voltage DC (HVDC) conversion, which is important for future applications including electronically controlled transmission networks for long distances. MMC has become the most common type of voltage-source-controlled HVDC due to its scalability from the megawatt up to the gigawatt range, transformer-less operation, high efficiency, high reliability, and fault tolerance. Developed by Marquardt in 2002, the MMC has become important for medium-voltage drives, wind power and other applications, and regenerative energy sources. His MMC technology was successfully applied in the Trans Bay HVDC underwater cable connecting San Francisco, CA, to Pittsburg, CA. As a worldwide standard, MMC topology has extended the application field and the capabilities of power electronics significantly.

Marquardt is a professor with the University of Bundeswehr, Munich, Germany.

IEEE Daniel E. Noble Award for Emerging Technologies
Sponsored by the Motorola Solutions Foundation

Rajiv V. Joshi

For contributions to predictive failure analytics, VLSI memory design, and technology

Rajiv V. Joshi’s innovations have revolutionized industrial techniques and products across many domains, including interconnect process technology, circuits, SRAM design, technology modeling, and CAD. He has overcome previously insurmountable barriers to scaling. Joshi’s development and commercialization of statistical methodologies for variability analysis of novel memories and application of new technologies to SRAMs paved the way for widespread industrial adoption of statistical techniques. His innovations to interconnect processes and structures for multiple metallization technologies—aluminum, tungsten, and copper—have been widely used in IBM memory and logic processes. His developments have been broadly licensed and commercialized to the tune of hundreds of millions of dollars. They are engrained in every facet of our modern lives: in servers; low-power, hand-held devices; and the wearable computing market.

An IEEE Fellow, Joshi is a research staff member at IBM T. J. Watson Research Center, Yorktown Heights, NY, USA.

IEEE Donald O. Pederson Award in Solid-State Circuits
Sponsored by the IEEE Solid-State Circuits Society

William S. Carter and Stephen Trimberger

For contributions to field-programmable gate array technology

William S. Carter and Stephen Trimberger were pioneers at Xilinx, creating and refining an important new semiconductor product category—field-programmable gate-array (FPGA) technology, now a multibillion-dollar industry. Carter saw that Moore’s Law would make FPGAs increasingly capable and useful and developed efficient circuits for implementing programmable logic. He designed the Xilinx XC2000 and XC3000 FPGAs and led the engineering effort on later versions. Trimberger’s experiments on the architecture of the fabric and its influence on the performance of a user design as well as its impact on the design of the silicon was crucial in developing efficient FPGA architectures. Many features of this approach are now standard for all programmable logic manufacturers. Carter and Trimberger helped form a new industry with profound and beneficial societal impact. FPGAs are used in aerospace and defense; IC prototyping; audio/video and image processing; automotive, professional, and consumer electronics; data-center and high-performance computing; industrial control; security and surveillance; medical systems; and wired and wireless communications. Carter and Trimberger’s technical leadership, innovation, and vision have been critical to making FPGAs as popular and important as they are today.

William S. Carter is retired in Los Gatos, CA, USA. An IEEE Fellow, Trimberger recently retired from Xilinx and lives in Incline Village, NV, USA.
IEEE Frederik Philips Award
Sponsored by Philips Electronics N.V.

Ian A. Young

For leadership in research and development on circuits and processes for the evolution of microprocessors

Ian A. Young revolutionized the design of microprocessor clocking circuitry by designing Phase Locked Loop (or PLL) clocking circuits that drove the performance of Intel Pentium and Intel Core processors from 50 MHz to over 3 GHz. This innovation contributed to the rapid increase in the speed performance of microprocessors through the 1990s while following Moore’s Law scaling. PLL clocking circuits are among the most used analog components within microprocessor integrated circuit products. As a manager of SRAM design and analog circuit design teams, Young developed a “Process Development & Circuit Design Co-optimization Methodology” to optimize the microprocessor performance, process density, and yield. This co-optimization methodology has become a standard across the semiconductor industry to date.

An IEEE Life Fellow, Young is a Senior Fellow and director of exploratory integrated circuits at Intel Corporation, Hillsboro, OR, USA.

IEEE Robotics and Automation Award
Sponsored by the IEEE Robotics and Automation Society

Matthew T. Mason

For scientific and educational contributions to the mechanics of manipulation enabling real-world robot autonomy, and for leadership in robotics

Matthew T. Mason’s contributions to advancing the mechanics of grasping and manipulation are essential to enabling robots to physically interact with the world. A proponent of minimalism in robotic manipulation, his innovative thinking provides simple solutions that allow robots to perform sophisticated tasks, such as parts feeders used for automatic assembly and packaging. He established the geometrical and mechanical foundations for robotic manipulation, and he pioneered pushing and planar sliding as important processes in manipulation. As founder of Carnegie Mellon University’s Manipulation Lab, Mason supervised development of the origami-folding robot, desktop mobile manipulators, scale-invariant grasping, throwing, striking, regrasp, and the use of simple single-actuator. He was also a key architect of the Robotics Roadmap that led to the National Robotics Initiative.

An IEEE Fellow, Mason is a professor of computer science and robotics at Carnegie Mellon University, Pittsburgh, PA, USA.

IEEE Frank Rosenblatt Award
Sponsored by the IEEE Computational Intelligence Society

Enrique H. Ruspini

For fundamental contributions to the understanding of fuzzy logic concepts and their applications

In a seminal 1969 paper, Enrique H. Ruspini provided the conceptual bases and tools for fuzzy clustering: the summarization and understanding of large data sets and complex objects as collections of fuzzy sets. In subsequent work, Ruspini defined methods that generalize fuzzy clustering by allowing the discovery of multiple, overlapping clusters of different nature and for recognizing important relations between those clusters. His work has led to numerous approaches for data representation and their application to fields ranging from image understanding to neurophysiology to genomics. His developments in the field of approximate reasoning led to a better understanding of methodologies for the analysis of systems described by uncertain data and to approaches to the intelligent control of autonomous robots and to pattern matching in databases (finding “needles” in data “haystacks”).

An IEEE Life Fellow, Ruspini is currently an independent consultant residing in Palo Alto, CA, USA.

IEEE Photonics Award
Sponsored by the IEEE Photonics Society

Ursula Keller

For seminal contributions to ultrafast laser technology enabling important industrial applications and novel scientific breakthroughs

A pioneer in the field of ultrafast lasers, Ursula Keller has revolutionized photonics and enabled important scientific and industrial applications in physics, chemistry, and biology. Keller developed the semiconductor saturable absorber mirror (SESAM) for generating ultrashort pulses, which transformed femtosecond lasers from complex devices only used by specialists to reliable instruments suitable for use in any general-purpose scientific laboratory and industrial applications. Most ultrashort lasers today utilize her SESAM mode-locking technology for optical communication, precision measurements, microscopy, ophthalmology, and micromachining applications. Her work has also enabled the optical frequency comb revolution and the invention of the attoclock to resolve electron tunneling. Keller’s development of carrier phase stabilization and frequency comb technology during the 1990s was integral to Hänsch and Hall’s development of laser-based spectroscopy that garnered the 2005 Nobel Prize in Physics.

An IEEE Fellow, Keller is a professor in the physics department at ETH Zürich, Zürich, Switzerland.
IEEE Marie Sklodowska-Curie Award
Sponsored by the IEEE Nuclear and Plasma Sciences Society

David Nygren

For pioneering radiation detector developments, enabling major discoveries in diverse areas of science

David Nygren’s powerful particle-detection instruments are enabling breakthrough discoveries in physics and have improved practical applications such as medical imaging. Nygren developed the time projection chamber (TPC) to identify and track charged particles in complex high-energy collisions. Incorporating an intrinsically three-dimensional capability, the TPC has been implemented in particle colliders at major national research laboratories, has provided evidence of the gluon plasma state, and is playing a key role in searching for weakly interacting massive particles, in learning more about the elusive neutrino, and for many other applications. His proposal for fully depleted charge-coupled device imagers for optical astronomy are enabling a deeper view into space. Nygren’s quantum-counting mammography system enables improved image quality while greatly reducing radiation exposure.

An IEEE Member, Nygren is a Presidential Distinguished Professor of Physics at the University of Texas at Arlington, Arlington, TX, USA.

IEEE Charles Proteus Steinmetz Award
Sponsored by the IEEE Standards Association

Craig M. Wellman

For leadership in developing and promoting standards that enable arc hazard assessment and injury-risk mitigation

A champion of improving electrical safety in the workplace, Craig M. Wellman’s founding and chairing of the working group that developed the IEEE 1584-2002 standard for performing arc flash hazard calculations has reduced injuries and saved lives. This groundbreaking standard provides a method to predict the severity of arc flashes so that workers can wear appropriate arc-rated clothing or revise protective devices to reduce the hazards. Wellman volunteered to lead the 47-person working group through the process of reviewing available data, defining a test program, soliciting funds, conducting testing, analyzing data, developing a model, writing the standard, and working through the ballot process. Remarkably completed within two years, the standard has impacted the design of power system equipment, safe work practices, personal protective equipment, and worker training.

An IEEE Life Fellow, Wellman was employed by DuPont for thirty years and then worked as an independent consultant. He resides in Newark, DE, USA.

IEEE Eric E. Sumner Award
Sponsored by Nokia Bell Labs

Peter W. Shor

For contributions to quantum communication and information theory

Peter W. Shor’s dramatic breakthroughs have fueled the modern quantum information revolution and ignited a global race to build the world’s first practical quantum computer. Shor’s 1994 integer factoring algorithm demonstrated that quantum computers could solve concrete and highly sensitive problems much faster than silicon computers. His algorithm also showed that encryption codes could be broken, which has had great implications for the security of classical communication systems. Shor proved skeptics of quantum communication wrong by pioneering the development of quantum error-correction codes to protect quantum states against decoherence and noise. His quantum accuracy threshold theorem provides confidence in the potential for constructing large-scale quantum computers since it guarantees that quantum computation is possible despite imperfections, provided the noise level is sufficiently low.

Shor is currently the Morss Professor of Applied Mathematics at the Massachusetts Institute of Technology, Cambridge, MA, USA.

IEEE Nikola Tesla Award
Sponsored by Wolong Electric Group, the IEEE Industry Applications Society, and the IEEE Power & Energy Society

Longya Xu

For contributions to design and control of efficient electric machines for wind power generation and electrified vehicles

Longya Xu’s high-efficiency and high-reliability electric machine design and control techniques are driving advances in electric vehicles and in harnessing wind power. His development and enhancement of the first doubly fed brushless machine led to a sensorless and brushless wind-power generation system with high reliability compared to conventional motor and generator systems. He designed a brushless wind turbine generator that allows flexible AC or DC connection to power grids. Xu also developed the dual-mechanical-port (DMP) machine concept, which allows multiple mechanical subsystems to effectively interact with electrical subsystems for optimal performance and flexible power flow control within a single electric machine frame. A major contribution to meeting the needs of high-efficiency electric vehicles, his DMP system was successfully installed on a 2.8-ton SUV capable of driving 125 km/hour at grades up to 30%.

An IEEE Fellow, Xu is a professor at The Ohio State University, Columbus, OH, USA.
At the forefront of modern communications research, J. Nicholas Laneman’s contributions are driving the development of next-generation wireless networks that are reliable, spectrally efficient, and secure. An early proponent of cooperative communications and relaying techniques, Laneman’s highly cited work has served as the foundation for one of the most active research areas in wireless communications. The concept involves mobile users in a wireless network cooperating with one another to convey their information to a common destination, relaying each other’s information to provide more robust paths from sender to receiver. His research has been integral to both achieving higher data rates and extracting higher diversity from communications channels for more efficient and reliable communication.

An IEEE Fellow, Laneman is a professor of electrical engineering and founding director of the Wireless Institute in the College of Engineering at the University of Notre Dame, Notre Dame, IN, USA.

For contributions to wireless network communication theory, algorithms, and architectures

J. Nicholas Laneman

One of the earliest international authorities on electric vehicles, C.C. Chan has been at the forefront of developing technologies enabling clean and efficient transportation methods benefiting the environment. Chan has made extraordinary contributions to the theoretical analysis and optimization of electric machines, power electronic devices, converters, special mechanical structures, and cooling systems that meet the special needs of electric vehicles including adaptive decoupling control, electromagnetic and thermal field analysis, hybrid architectures, and energy management. Considered the first comprehensive book on the topic, Chan’s Modern Electric Vehicle Technology provided the fundamentals for modern electric vehicle technology, addressed key issues, and assessed their environmental impact. His recent research in smart charging and vehicle-to-grid systems has gained attention from not only automakers but also power utilities.

An IEEE Fellow, Chan is a professor with the University of Hong Kong’s Department of Electrical and Electronic Engineering, Hong Kong.

For contributions to the advancement of electric vehicle technologies

C.C. Chan

Considered by students and colleagues as an extraordinary educator and role model, Susan M. Lord is making engineering education more accessible and appealing to diverse students. At the University of San Diego (USD), Lord has coordinated redevelopment of the first-year engineering course multiple times to enhance student learning and improve retention. She also implemented laboratory programs for engineering design to foster continuous improvement. In her drive to make engineering education more welcoming to students of diverse backgrounds, she has conducted research to help faculty better understand who their students are, their pathways into engineering fields, and their classroom experiences. Lord was the first USD engineering faculty member to incorporate service learning where the students present hands-on science to middle- and high-school classes.

An IEEE Fellow, Lord is a professor and chair of engineering at the University of San Diego, San Diego, CA, USA.

For contributions to the development of more inclusive and innovative undergraduate teaching in electrical and computer engineering

Susan M. Lord

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David F. Ferraiolo, D. Richard Kuhn, and Ravi Sandhu

For advancing the foundations and practice of information security through creation, development, and technology transfer of role-based access control (RBAC)

The individual and combined efforts of David F. Ferraiolo, D. Richard Kuhn, and Ravi Sandhu in developing and strengthening role-based access control (RBAC) have provided the computer industry with the world’s most widely used cybersecurity tool for protecting valuable digital data. Implemented at virtually all levels of computing, including operating system, database management, network, and enterprise management applications, RBAC overcame the limitations of previous security models based on military requirements that proved cumbersome for commercial industry needs. RBAC provides efficient security administration for large enterprises, simplified auditing of permissions to evaluate risk and regulatory compliance, efficient implementation of separation of duty rules to reduce insider threat risks, and scalability to some of the largest systems in existence.

Ferraiolo is manager of the Secure Systems and Applications Group, Computer Security Division, at the National Institute of Standards and Technology, Gaithersburg, MD, USA.

An IEEE Fellow, Kuhn is a computer scientist, Computer Security Division, at the National Institute of Standards and Technology, Gaithersburg, MD, USA.

An IEEE Fellow, Sandhu is the Lutcher Brown Endowed Chair in Cyber Security and executive director of the Institute for Cyber Security at the University of Texas at San Antonio, San Antonio, TX, USA.

Mary Ward-Callan is the staff executive at IEEE responsible for the strategic and operational leadership of the IEEE Technical Communities within the IEEE and of the Conference Line of Operation. The 47 Technical Societies and Councils, and numerous emerging technical communities, collectively deliver more than 1,000 conferences, 192 periodicals, countless technical training seminars, and several certification programs. Ward-Callan has been responsible for the programming and visibility of new technology areas within the IEEE, such as Internet of Things, Software Defined Networks, Rebooting Computing, 5G, and Big Data. She led the Award-winning IEEE Humanitarian Technology Challenge, a project that used solid engineering techniques to provide solutions to pressing world problems such as lighting Haiti/Africa/Nicaragua, providing data communications to healthcare facilities in Peru, and providing RFID patient identification in India.

An IEEE Senior Member, Ward-Callan is a certified association executive, is on the Vaughn College Board of Trustees, and is a member of the American Society of Association Executives.

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For leadership of and service to IEEE volunteers, and for commitment and care in IEEE Technical Activities for the benefit of IEEE

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Jonathan Wiggins

For embodiment of the IEEE Professional Core and dedicated service to the IEEE

Jonathan Wiggins does a lot of things—from day-to-day management of IEEE’s large copyright and trademark portfolio to overseeing matters involving social media, technology licensing, privacy law, and litigation. If it has anything to do with intellectual property, technology, or privacy, Wiggins is usually involved. He began his career at IEEE in 2011 in the Intellectual Property Rights Office. In the ensuing six years, he has developed an understanding of and strong relationship with IEEE’s operations, staff, and members that has led to his ability to assist and support a wide variety of individuals from all IEEE organizational units on a number of different subjects. Jon believes in the value of respect for others, hard work, and equal collaboration with members of every team he is fortunate enough to be a part of.

Wiggins is currently the senior intellectual property attorney and chief privacy officer in the IEEE Legal and Compliance Department, New York, NY, USA.
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for contributions to monolithic RF CMOS power amplifiers and transceiver frontends

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