2021 IEEE Fellows Elevation and Recognition

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Anding Zhu and Robert H. Caverly

Elevation to Fellow of the IEEE is an honor reserved for a select group of engineers each year. The number of Fellows elevated in any year cannot exceed one-tenth of 1% of the total voting membership. This highest grade of membership in the IEEE is conferred by the IEEE Board of Directors in recognition of an individual's outstanding record of accomplishments in any IEEE field of interest.

This year, four honorees were awarded the status of Fellow of the IEEE with the IEEE Microwave Theory and Techniques Society (MTT-S) as the evaluating Society. Another three new Fellows are members of the MTT-S but were awarded the level of Fellow by other Societies or Councils. In alphabetical order, those awarded the level of Fellow by the MTT-S are

- Peter Burke, for contributions to active and passive microwave devices
- Rudy Emrick, for contributions to the development of millimeter-wave communication systems
- Nicholas Kolias, for contributions to the development of gallium nitride monolithic microwave integrated circuit technology
- Luciano Tarricone, for contributions to microwave interactions with living systems and biomedical applications.

In honor of their contributions, short biographies of our Society's new IEEE Fellows are presented in the following pages. These new Fellows have worked very hard and made many sacrifices for this work. Please join us in congratulating each of them.

Anding Zhu (anding.zhu@ieee.org) is with University College Dublin, Belfield, Dublin 4, Ireland, and Robert H. Caverly (r.caverly@ieee.org) is with Villanova University, Villanova, Pennsylvania, 19085, USA.

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Peter Burke
Department of Electrical Engineering and Computer Science, Department of Biomedical Engineering, and Department of Chemical Engineering and Materials Science and Engineering
University of California, Irvine
Irvine, California, United States

For contributions to active and passive microwave devices

Peter Burke received his B.A. degree in physics from the University of Chicago in 1992 and his Ph.D. degree in physics from Yale University, New Haven, Connecticut, in 1998. From 1998 to 2001, he was a Sherman Fairchild Postdoctoral Scholar in physics with the California Institute of Technology, Pasadena. Since 2001, he has been a faculty member with the Department of Electrical Engineering and Computer Science, University of California at Irvine. His current research interests include nanoelectronics, probes of cellular and subcellular electrophysiology, radio and antenna propagation and systems (including nanoelectromagnetics), and drones. Dr. Burke has been the recipient of the Office of Naval Research Young Investigator Award and the Army Research Office Young Investigator Program Award.

Dr. Burke's body of work coherently synthesizes concepts from quantum mechanics, RF propagation, and antennas into an elegant, unified theoretical framework for 1D systems. Based on this body of work, Dr. Burke is a visionary and in 2010 created the concept of a single-cell radio, which is now being explored by industry and academic groups worldwide. In the area of passive nanoelectronic 1D structures, Dr. Burke's contributions led to a complete rethinking of how signals propagate in the RF, microwave, and terahertz (THz) range along 1D guiding structures (e.g., carbon nanotubes and other 1D structures). His theoretical/modeling work and, more importantly, insight tied together Landauer-Buttiker transport theory, transmission line analysis, and electrically small antenna radiation patterns to create a comprehensive understanding of the RF to THz properties of 1D systems. Dr. Burke's modeling of nanoantennas is widely viewed as the most insightful theory of the ultimate miniaturization limit of RF to THz antennas set by the quantum properties of 1D systems. Dr. Burke's work combines quantum mechanics of electron transport, guided wave propagation, and antenna theory in new and novel ways that had not been previously connected. His experimental work demonstrated many of the key aspects described previously, including his lab's first measurements of the gigahertz (GHz) properties of 1D metallic nanotube devices and world-record length to diameter antenna fabrication in the Sheulkonopf limit. Dr. Burke's lab was the first to measure the active properties of 1D transistors at GHz frequencies.

Dr. Burke has also contributed in pioneering ways to the study of electronic phenomena in living systems at the nanoscale. His lab developed and demonstrated the first nanoelectronic sensors of the electronic activities of single ion channels in an artificial lipid bilayer, a major milestone for connected electrical devices to electrophysiology. He also developed a technology to assay the respiration of a single mitochondrial using a combination of microfluidics and microelectromechanical systems techniques. In addition, he pioneered cloud-based control of Internet-connected drones and the use of drones for characterizing antennas and propagation.

Dr. Burke is currently an associate editor of *IEEE Journal on Miniaturization for Air and Space Systems* and was previously associate editor of *IEEE Transactions on Nanotechnology*.

Rudy Emrick
Northrop Grumman Space Systems
Chandler, Arizona, United States

For contributions to the development of millimeter-wave communication systems

Rudy Emrick received his B.S. degree in electrical engineering from Michigan Technological University and his M.S. and Ph.D. degrees, both in electrical engineering, from The Ohio State University. He started his career working on the development of government electronics with Motorola, including early work as part of the development team for the PRC-112 survival radio, which integrated GPS before GPS technology was mainstream and required the development of custom multichip modules. Later, he moved toward higher-frequency development and was responsible for the design of a low-cost waveguide feed used in an early "low-cost" phased array intended for more widespread commercial use. It allowed for high-volume production of a feed that fit into the end of a circular waveguide using a lead frame with injection-molded plastic. This transitioned the feed from being one of the most expensive parts of the array to one of the lowest cost and was captured with his first patent. Dr. Emrick was an early advocate for the future use of the millimeter-wave (mm-wave) spectrum in communications, radar, and imaging, well before it was clear that the performance or costs required for commercial use could be achieved. He led the development of a technology roadmap for a series of technologies and demonstration systems to show the potential use of mm-wave bands for communications through the demonstrations of gigabyte-per-second communications in the 60-GHz band, by 2003. His team continued to develop technologies for wireless communications, radar, and imaging using mm-wave frequencies. His contributions have been captured partially through his 14 issued utility patents, receipt of the Motorola Distinguished Innovator Award, and his more than 30 technical publications spanning journals, conferences, and book chapters.

Dr. Emrick later joined Northrop Grumman Space Systems, where he has been involved in a wide range of programs and engaged in solving challenging technical issues along with technology development. His contributions have included leading teams and individual contributions in solving some of the most challenging problems related to mission systems, satellite technology, missile interceptors, and launch vehicles, and he was recognized with an innovation award for his internal proposal that made the case for entering a new business area.

In addition to his work in the technical community as a whole, he has also served as a mentor to many graduate students through his university research initiatives and his participation in the National Science Foundation Research Centers. He has provided a balance of technical leadership, driving the technology being developed to have direct alignment with industry needs, while also developing students' skills and backgrounds so that they can contribute substantially to the community as well.

Nicholas J. Kolias
Raytheon Technologies
Andover, Massachusetts, United States

For contributions to the development of gallium nitride monolithic microwave integrated circuit technology

Nicholas J. Kolias is a Principal Engineering Fellow and Lead Technologist for RF components and microelectronics at Raytheon Technologies. He received his B.S., M.S., and Ph.D. degrees in electrical engineering from Cornell University, Ithaca, New York, in 1990, 1993, and 1996, respectively. His Ph.D. research focused on the design, fabrication, and characterization of high-power microwave and mm-wave quasi-optical solid-state amplifier arrays.

Upon completion of his Ph.D. degree, Dr. Kolias joined Raytheon's research organization in Andover, Massachusetts, where he led the company's early gallium nitride (GaN) monolithic microwave integrated circuit (MMIC) development efforts. He was among the first to recognize and prove the capabilities of GaN for dramatically improving MMIC performance over the gallium arsenide MMICs historically used in defense systems. Dr. Kolias designed and characterized Raytheon's first GaN MMIC amplifiers, demonstrating record MMIC output power and proving the benefits of the technology. He also demonstrated the benefits of harmonic tuning to improve the efficiency of GaN microwave amplifiers, providing the basis for the high-efficiency Raytheon GaN amplifier designs in use today. He then led the Raytheon team to refine the performance, improve the reliability, and mature the technology, enabling today's GaN-based microwave phased array radar systems, which provide increased radar range and improved overall performance.

Dr. Kolias also oversaw the development of Raytheon's mm-wave GaN MMIC process and the demonstration of the highest-performing W-band (93-GHz) GaN amplifiers in 2011 and E-band GaN amplifiers in 2012. The E-band MMICs have been used to demonstrate a high-speed wireless communication link with record bidirectional data rates, showing the benefits of mm-wave GaN for both defense and commercial high-speed communications. The W-band MMICs have been power-combined to produce kilowatt-level solid-state power amplifiers, more than two orders of magnitude higher than prior art. This is an enabler for compact active denial systems as well as W-band solid-state radars.

Dr. Kolias presently serves as technical director of Raytheon's corporate microelectronics research and development efforts, where he leads a team developing and maturing the next generation of enabling microwave and mm-wave microelectronics technology. Dr. Kolias is a long-time member and volunteer of the MTT-S, serving as Society president in 2012.

Luciano Tarricone
University of Salento
Lecce, Italy

For contributions to microwave interactions with living systems and biomedical applications

Luciano Tarricone received his master degree from the University of Rome "La Sapienza" in 1989 and his Ph.D. degree from the same university in 1993. In 1990, he was a visiting researcher at the National Institute of Health in Rome, dealing with electromagnetic (EM) compatibility of implanted pacemakers. Between 1991 and 1994, he was a researcher and system engineer at the IBM European Center for Scientific and Engineering Computing in Rome, dealing with high-performance computing for large scientific applications. In 1994, he was appointed as a researcher of EM fields at the University of Perugia, Italy. In 2002, he became an associate professor at the University of Salento in Lecce, Italy, where he has been a full professor since 2011 and coordinates his research group and the EM Lab Lecce.

Dr. Tarricone has made seminal and groundbreaking contributions in the area of bioelectromagnetics, developing a variety of theoretical, modeling, and numerical approaches for the study of the interaction between EM fields and living systems. He devotes special attention to nonthermal effects of megawatt fields to numerical dosimetry and exploits this knowledge in biomedical applications. He developed a theoretical methodology to link new modeling strategies with numerical analysis at the whole-body level, joining Markov models with transmission-line approaches. This strategy has changed the way one approaches boundary element method interactions at microscopic levels. He has also attacked significant numerical problems, such as the calculation of the specific absorption rate in complex exposure conditions, namely, the near-field exposure to large radio base station antennas. Currently, he is focusing on investigating similar problems related to 5G systems.

Other important contributions are related to the applications of wireless power transmission (WPT) and RF identification (RFID) to biomedical engineering. In WPT, he has deeply studied the main theoretical and design issues related to resonant inductive links and has shown how WPT technologies can be a viable solution to the problem of battery-free, implanted biomedical devices and embedded sensors. In the RFID area, he has developed a family of devices and solutions joining the advantages of RFID technologies and energy-harvesting solutions to create smart wireless sensors for biomedical applications.

Dr. Tarricone has authored four books and more than 300 papers in international journals. He is associate editor for various international journals and has chaired several international conferences. In 1984, he was awarded the "Alfiere del Lavoro" by the Italian Presidente della Repubblica Sandro Pertini. In 2017, he was awarded the international scientific award Duchessa Lucrezia Borgia by the cities of Bisceglie and Ferrara, Italy.

MTT-S Members Elevated to Fellow of the IEEE Evaluated by Other Societies

We also recognize our members who have been elevated to IEEE Fellow by other Societies or Councils. Currently, there are 39 Societies and seven Technical Councils in the IEEE. Members elevated to the level of Fellow by other Societies who are also members of the MTT-S are listed here in alphabetical order according to the evaluating Society or Council:

- *Yi Huang*, by the IEEE Antennas and Propagation Society, for contributions to rectenna technology
- *Bhyrav Mutnury*, by the IEEE Electromagnetic Compatibility Society, for contributions to signal integrity in complex data center systems
- *Jianqing Wang*, by the IEEE Electromagnetic Compatibility Society, for contributions to electromagnetic compatibility of biological and wearable/implant devices.

The Four IEEE Fellow Nomination Categories

- **Application engineer/practitioner (AE/P)**
  - This category accounts for 7% of all nominations. The composition of AE/P nominees in terms of employment affiliation types is approximately as follows: 74% are in industry, 16% in academia, 7% in government, and 3% other. AE/P may make significant technical contributions in the design and/or evolution into manufacturing of products or systems; the use, operation, or application of such products or systems; and the advancement of industry practices and standards. Key aspects to consider are innovativeness, originality, creativity, meeting market needs, regional as well as global impact on the profession or society at large, and advances in quality, reliability, cost effectiveness, and manufacturability.
- **Educator (EDU)**
  - This category accounts for nearly 4% of nominations. The composition of EDU nominees in terms of employment affiliation types is approximately as follows: 97% are in academia and around 3% in industry. A nominee in this category must have had an impact on engineering education. As an educator, the nominee's personal contributions can encompass the development of a new curriculum or courses that are innovative or unique. An accepted and widely used pioneering text is a significant useful contribution, as are published papers on engineering education matters. The contributions, again, will be judged based on uniqueness, innovation, wide acceptance, etc. Another important aspect to consider is the degree of acceptance (local, national, international) of such innovations.
- **Research engineer/scientist (RE/S)**
  - This category accounts for nearly 80% of all nominations. The composition of RE/S nominees in terms of employment affiliation types is approximately as follows: 80% are in academia, 13% in industry, 5% in government, and 1% other. For RE/S nominees, sustained scholarly work is typically documented by significant (quality and quantity) scholarly contributions such as peer-reviewed publications, books, papers in technical reports, patents, or other publications. The focus of the evaluation is on inventions, discoveries, or advances in the state of the art made by the nominee, all of which must confirm innovation, creativity, impact, and a distinct personal role.
- **Technical leader (TL)**
  - This category accounts for around 10% of all nominations. The composition of TL nominees in terms of employment affiliation types is approximately as follows: 51% are in industry, 28% in academia, 17% in government, and 4% other. The individual contributions of TL nominees can be exemplified through technical leadership of a team or company-wide effort that led to an important benefit to society, technical innovation, advancement of a device, and also idea or system leading to development, application and/or production. The technical innovation, risk involved, performance improvement, economic results, or other advantages must be above the norm. For TL nominees, their leadership and technical role must be crucial for the successes of the cited accomplishments, and specific technical contributions by the nominee that made the achievement possible must be present and supported by verifiable evidence.