# Education News

## The 2024 MTT-S Graduate Student Fellowship Awards

■ Giovanni Crupi, Valeria Vadalà, Marco Mercuri, Changzhi Li, and Xun Gong

The IEEE Microwave Theory and Technology Society (MTT-S) Graduate Student Fellowship Awards are sponsored by the MTT-S to encourage and support graduate students from around the world who are interested in pursuing the field of microwave engineering. The fellowship honorees receive an award of US$6,000, presented at the annual IEEE MTT-S International Microwave Symposium (IMS), to support their research activities. Supplemental funding is offered to support the recipients' travel to the IMS (up to a maximum of US$1,500). In addition, the highest-ranked honoree is awarded the IEEE MTT-S Tom Brazil Graduate Fellowship, with an additional travel grant of US$1,000.

Because there were so many high-quality applications, a special motion was approved by the MTT-S AdCom to temporarily increase the number of awardees this year. As a result, 15 graduate fellowships were awarded for 2024 in the general category and three in the medical applications domain. To be eligible for these graduate fellowships, applicants must be students in a recognized M.S. and/or Ph.D. degree program. Full details regarding eligibility and application requirements can be found at https://mtt.org/students/. The submission deadline for the 2025 awards cycle is 15 October 2024.

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For the 2024 awards, 67 applications from 18 countries were received in the general category, and 15 applications from seven nations were received in the medical area. All of the applications were excellent and represented some of the best research being conducted around the world. The overall success rate was 22% because of the large number of submissions. The difficult task of selecting the awardees was performed by a group of dedicated, impartial MTT-S volunteers from both industry and academia. Special thanks to the volunteers who spent many hours reviewing and grading the proposals.

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*Digital Object Identifier 10.1109/MMM.2024.3403311*
*Date of current version: 15 July 2024*

Xibi Chen (Massachusetts Institute of Technology, United States) was selected for the IEEE MTT-S Tom Brazil Graduate Fellowship.

## 2024 Graduate Student Fellowship Awardees

**Rosalind Agasti**

*School*: University of Oklahoma, Norman, USA.

*Advisor*: Prof. Hjalti H. Sigmarsson.

*Project topic*: A highly integrated system-on-aperture (SoA) front end using spatiotemporal modulation.

Rosalind Agasti received her B.Sc. degree in electrical engineering from the University of Massachusetts, Boston, USA, in 2021 and her M.Sc. degree in electrical and computer engineering from the University of Oklahoma (OU), Norman, USA, in 2023. Currently, she is a Ph.D. student at the Advanced Radar Research Center, OU. She is expected to graduate in 2026. She is a recipient of the IEEE Antennas and Propagation Society (AP-S) 2023 Doctoral Research Grant. She is a Graduate Student Member of IEEE and is currently serving as chair of the MTT-S Student Chapter Branch at the OU. Her research interests include reconfigurable active and passive devices for RF and microwave applications, with a focus on the design of integrated RF front-end architectures.

### *Project Description*

The overall noise floor is increasing for all RF applications, placing more stringent requirements on RF hardware to actively mitigate noise and interference. One method for improving the sensitivity of the RF front end is to adopt a co-design approach, in which several functionalities are seamlessly accommodated in a single, compact module. This project aims to push the boundaries of RF co-design to integrate all of the essential functionalities—frequency upconversion, amplification, filtering, and radiation—into a stand-alone compact device. The proposed device, called SoA, will demonstrate a fully co-designed and integrated RF front end, reaching fundamental limits on noise performance, interference rejection, and spectral efficiency.

**Vishal Balasubramanian**

*School*: University of British Columbia, Canada.

*Advisor*: Prof. Mohammad H. Zarifi.

*Project topic*: Internet of Things (IoT)-ready microwave-based smart coatings for real-time coating damage detection.

Vishal Balasubramanian hails from Chennai, Tamil Nadu, India, where he received his B.Eng. degree in electronics and communication engineering from Anna University. He is currently pursuing his Ph.D. degree in electrical engineering under the supervision of Prof. Mohammad Zarifi at the University of British Columbia, Canada. He aims to defend his thesis by early 2025, post which he wishes to continue his research in the microwave domain with an aim to commercialize it.

His research focuses on the development of microwave sensor-integrated battery-free smart coatings that can detect structural erosion and corrosion.

### *Project Description*

The erosive wear of coated structures poses a severe threat across industries, including those in the fields of aviation, marine, and renewable energy. Historically, the catastrophic failures resulting from mechanical wear and chemical degradation underscore the urgent need for preventive measures. Vishal's work introduces a real-time, nondestructive coating inspection system integrating artificial intelligence-driven microwave sensors with IoT-enabled monitoring circuitry. By detecting erosive wear in coatings, this system aims to mitigate risks and enhance safety. Notably, it can distinguish between the eroding layers in multilayer coatings and estimate wear depth and rate using neural network-based predictive analytics. This novel approach showcases a practical potential for addressing real-world challenges in coating wear applications.

**Giulia Battistini**

*School*: University of Bologna, Italy.

*Advisor*: Prof. Diego Masotti.

*Project topic*: Fully 3D-printed dual-port rectenna for wearable simultaneous wireless information and power transmission (SWIPT) applications exploiting multisine excitation.

Giulia Battistini was born in Bologna, Italy, in 1997. She received her M.S. degree (with honors) in telecommunications engineering in March 2022. Since 2022, she has been with the Department of Electrical, Electronic and Information Engineering "G. Marconi," University of Bologna, Italy, as a research fellow within the framework of the Wireless Power Transfer for Wearable and Implantable Devices Project. Since 2023 she has been a Ph.D. student under the supervision of Prof. Diego Masotti and Prof. Alessandra Costanzo. She is expected to graduate in March 2026. Her research interests focus on the implementation of 3D printing technologies and materials for the design and fabrication of electronic devices for wearable/implantable wireless power transfer applications.

### Project Description

This project concentrates on taking advantage of 3D printing technology in terms of ease of use, cost-effectiveness, and design degrees of freedom for the fabrication of a wearable, fully 3D-printed, completely passive RFID tag for indoor localization and SWIPT. A dual-mode rectenna is able to harvest power from a multisine excitation and to backscatter a passively generated and modulated quasi-ultrawideband (UWB) signal communicating inertial information of the subject wearing the tag, collected by a sensor.

**Xibi Chen**

*School*: Massachusetts Institute of Technology (MIT), USA.

*Advisor*: Prof. Ruonan Han.

*Project topic*: High-angular-resolution sub-terahertz (THz) imaging system with antenna-in-package (AiP) technology.

Xibi Chen is currently a Ph.D. student under Prof. Ruonan Han in the Department of Electrical Engineering and Computer Science, MIT, Cambridge, MA, USA. He is expected to graduate in 2025. He received his B.S. and M.S. degrees from Tsinghua University, Beijing, China, in 2017 and 2020, respectively. His current research interests include sub-THz integrated electronic systems, sub-THz imaging/sensing, and electromagnetics under mainstream CMOS. He was the recipient of an ISSCC 2022 Student Travel Grant Award and an Analog Devices Outstanding Student Designer Award.

### Project Description

This project proposes a sub-THz 4D imaging system that decouples the designs of active circuits and a large passive antenna array, which naturally circumvents the challenges of high circuit complexities, electronic density, and computation power in traditional phased/multiple-input, multiple-output (MIMO) array systems. AiP technology, which has a much higher radiation efficiency than on-chip solutions, is implemented for both the reflectarray and the radar transceivers. Digital circuits and memories are integrated on massive tiny chiplets and mounted on multiple package modules to reduce the total silicon area. A full-duplex technique is further applied to combine the two subsystems. Meanwhile, a multitransceiver (multistatic) topology is designed for a lower system profile, higher total radiated power (TRP), and better flexibility of signal processing. The proposed 250-GHz 4D radar imaging system is expected to have <1° angular resolution, with >100 m of detection range.

**Jie Deng**

*School*: Polytechnique Montréal, University of Montreal, Canada.

*Advisor*: Prof. Ke Wu.

*Project topic*: Multichannel, multifunction, and multiport interferometric waveguide transmitter and receiver systems for THz communication, sensing, and imaging applications.

Jie Deng was born in Sichuan, China. He received his M.S. degree from the University of Electronic Science and Technology of China, Chengdu, China. He is currently pursuing his Ph.D. degree in the Department of Electrical Engineering, Polytechnique Montréal, University of Montreal, Montreal, Canada. His current research interests include THz multiport interferometric transceivers, THz sensors, THz waveguide components, multifunction wireless systems, reconfigurable RF front-end architectures, THz imaging, and wireless sensing. He was a recipient of the IEEE MTT-S IWS 2022 FLASH Competition Best Paper Award.

### Project Description

To develop THz multifunctional, multistandard, and multimode wireless systems, many RF challenges involving the hardware circuits and transceiver architectures should be addressed. In fact, these significant challenges in building THz hardware and systems have turned the THz spectrum into the widely acknowledged "last frontier." Conventionally, these challenges are solved according to the technologies used at microwave frequencies adapted to higher frequencies. However, the effects of propagation losses, parasitics, and mechanical limitations are significant, making them unacceptable in the THz frequency range. Therefore, it is imperative to develop a highly effective and low-power consumption wireless platform that can support the development of various THz applications. In this research, several multiport architectures based on interferometric technology are proposed and developed with the minimum possible power consumption while maintaining excellent performance. The main research goals are to propose, explore, and develop highly original interferometric transmitters and receivers for future wireless communication, sensing, and imaging systems.

**Jasmin Gabsteiger**

*School*: Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany.

*Advisor*: Prof. Fabian Lurz.

*Project topic*: Design of flexible MIMO radar sensors to improve angle estimation.

Jasmin Gabsteiger was born in Fürth, Germany, in 1996. She received her B.Sc. and M.Sc. degrees in electronics engineering from Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany, in 2019 and 2021. Since 2022, she has been with the Institute for Electronics Engineering as a Ph.D. student under the supervision of Prof. Fabian Lurz. She is expected to graduate in June 2025. Her main research interest is antenna design for millimeter-wave (mm-wave) radar systems and machine learning. She received second place in the Self-Interference Cancellation Coupler Student Design Competition at the IEEE IMS in 2022.

### *Project Description*

Radar-based sensors are ubiquitously applied in an uncountable number of different applications. To enhance the systems, Gabsteiger's research aims to further investigate radar-based machine learning. The basis of the work is a state-of-the-art fast-chirp frequency-modulated continuous-wave 60-GHz MIMO radar. In this system, the angular resolution will be improved compared to state-of-the-art radar systems. To achieve this, a special waveguide antenna design with beam-squinting capability is proposed. Since radar data processing is not possible with the usual signal processing for a beam-squinting antenna, machine learning is an essential component of this research. In this way, with the help of machine learning, it is easier to identify objects within one field of view, even when they are closely spaced.

**Chunyu Hu**

*School*: Chongqing University, China.

*Advisor*: Prof. Weimin Shi.

*Project topic*: Research on multimode outphasing power amplifiers (PAs) for multiband applications.

Chunyu Hu received her M.S. degree from The School of Microelectronics and Communication Engineering, Chongqing University, in June 2023, where she is currently pursuing her Ph.D. degree, under the supervision of associate professor Weimin Shi. She is expected to graduate in June 2027. Her research is focused mainly on highly efficient PA theory and design. She ranked first among the 200 applicants for a doctoral degree at Chongqing University in 2023.

### *Project Description*

To process wideband modulated signals more efficiently, not only saturation but also back-off drain efficiencies (DEs) are highly expected by a broadband PA to reduce the power consumption in wireless communication systems. Therefore, PA architectures maintaining high back-off DEs are recently being widely developed and investigated, for example, the outphasing PA (OPA), Doherty PA (DPA), and load-modulated balanced amplifier (LMBA). Compared to the DPA and LMBA, the OPA offers a better efficiency profile in theory. However, the frequency coverage of the OPA should be improved. Therefore, it is interesting to perform research on multiband OPAs with the goal of covering a large frequency range. This work will focus on the theory and design of multiband OPAs based on multiple operation modes.

**Anand Kumar**

*School*: Indian Institute of Science, Bengaluru, India.

*Advisor*: Prof. Debdeep Sarkar.

*Project topic*: Design and analysis of spatiotemporal modulation-based nonreciprocal filters, antennas, and metasurfaces using the finite-difference time-domain (FDTD) method.

Anand Kumar received his B.Tech. degree (with honors) in electronics and communication engineering from the Indian Institute of Technology (Indian School of Mines), Dhanbad, in 2020. He is currently pursuing a Ph.D. degree in electrical communication engineering at the Indian Institute of Science, Bengaluru, under the supervision of Prof. Debdeep Sarkar. He is expected to graduate in July 2025. Additionally, he is a visiting student at the Tyndall National Institute, University College Cork, Ireland. His research interests encompass using computational electromagnetic methods, such as the FDTD approach, to model and analyze dielectrics and metamaterials with spatial and temporal dependence, MIMO antenna design, and radar systems. Anand received the prestigious Prime Minister's Research Fellowship from the Ministry of Education, Government of India, in 2022 and was awarded the IEEE AP-S Fellowship in 2023.

### *Project Description*

Nonmagnetic nonreciprocal electronic devices are advancing rapidly, leveraging spatiotemporal modulation techniques for compact and efficient designs. Our project focuses on designing and analyzing nonreciprocal filters, antennas, and metasurfaces, disrupting reciprocity between transmission and reception. Through tailored FDTD simulations, we aim to enhance modeling capabilities for these devices, offering practical solutions for communication, radar technology, and sensing challenges.

**Shuyang Li**

*School*: Tsinghua University, China.

*Advisor*: Prof. Wenhua Chen.

*Project topic*: Broadband energy-efficient silicon-based THz circuits and systems.

Shuyang Li received his B.S. degree in electronic information

science and technology from Tsinghua University, Beijing, China in 2020, where he is currently pursuing his Ph.D. degree in electronic science and technology under the supervision of Prof. Wenhua Chen. He is expected to graduate in July 2025. His current research interests include silicon-based mm-wave and THz integrated circuits and systems for radar, wireless communication, and electronic measurement.

### Project Description

To meet the ever-growing demand for wireless services in the B5G/6G era, it is essential to push wireless communication and sensing systems toward the THz band. With the rapid advance of silicon-based semiconductor technology in recent years, it has become possible to implement THz circuits and systems with low cost and high integration. However, because of the low breakdown voltage, limited $f_{max}$ of silicon-based transistors, and high loss of on-chip passive devices, it still remains challenging to implement high-performance silicon-based THz circuits and systems with wide bandwidth and high efficiency, especially in the aspects of signal generation, power amplification, and system integration. Focusing on these challenges, this project plans to explore key techniques to improve the comprehensive performance of THz silicon-based circuits and propose practical solutions for realizing broadband energy-efficient silicon-based THz systems.

**Tian Liang**

*School*: University of California San Diego, La Jolla, CA, USA.

*Advisor*: Prof. Gabriel M. Rebeiz.

*Project topic*: High-linearity phased array receiver system for 5G/6G applications.

Tian Liang received his B.S. degree in electronic engineering from the University of Electric Science and Technology of China, Chengdu, China, in 2021. He is currently pursuing his Ph.D. degree in the Department of Electrical and Computer Engineering, University of California San Diego, La Jolla, CA, USA, under the supervision of Prof. Gabriel M. Rebeiz. He is expected to graduate in 2025. His research interests include reconfigurable antennas, UWB beamformer transceivers, and phased arrays.

### Project Description

As the new phase of 5G/6G moves toward the frequency band of 6–18 GHz, communication systems are expected to support multiple frequency bands with a single unit. In this work, a 6–18-GHz high-linearity beamformer receiver chip will be tested and used to design a 16-by-1 demonstration phased array. The RF beamforming system contains a Vivaldi-based wideband antenna array, two beamformer chips, and Wilkinson combiners. The wideband receiver system gain, G/T ratio, receiver pattern, and power consumption will be measured to evaluate the system performance. The modulation measurement will demonstrate the 5G communication system performance with the presence of interference. This work will be the first compact wideband system that supports future 5G/6G band multistandard micro base station applications.

**Matko Martinic**

*School*: KU Leuven, Belgium.

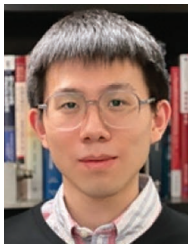
*Advisor*: Prof. Tomislav Markovic.

*Project topic*: Microwave heating and dielectric characterization for flow chemistry.

Matko Martinic was born in Zagreb, Croatia, in 1997. He received his B.Sc. and M.Sc. degrees in electrical engineering and information technology from the University of Zagreb, Zagreb, Croatia, in 2018 and 2020, respectively. He is currently pursuing his Ph.D. degree at KU Leuven with a focus on microwave heating in flow chemistry, dielectric modeling, and microwaves for life science applications. Matko is now vice chair of the IEEE Antennas and Propagation, Communications, and Microwave Theory and Technology Student Branch Chapter at KU Leuven.

### Project Description

The chemical industry lags in the transition to greener practices because of the use of old-fashioned and inefficient reactors. To overcome this, microwaves are increasingly being used to intensify organic synthesis reactions and improve their outcome in terms of product purity. However, these improvements have been demonstrated mostly on the scale of milliliters using commercial equipment that relies on high-power 2.45-GHz reactors. Even though the advantages of microwave-based heating have been clearly demonstrated, we believe that this is merely the tip of the iceberg, and further significant improvements can be achieved by 1) moving to flow-based systems, 2) using optimized signal waveforms (power and frequency) for a given reaction, and 3) using dielectric sensors for in situ monitoring. By truly exploring the entire design space available for advanced microwave-based thermal control systems on the microscale, we aim to automate chemical reactions and their optimization. Finally, transitioning to resonant cavities will allow us to scale flow devices that can generate compound libraries with high throughput in a fast and energy-efficient manner.



**Shutong Qi**

*School*: University of Toronto, Canada.

*Advisor*: Prof. Costas D. Sarris.

*Project topic*: Physics-informed neural networks for time-domain electromagnetic and multiphysics modeling.

Shutong Qi received his B.Eng. degree (with honors) from Beihang University in June 2020. Since 2020, he has been with the Department of Electrical and Computer Engineering at the University of Toronto, Canada, as a Ph.D. student under the supervision of Prof. Costas D. Sarris. His research focuses on developing efficient computational techniques for electromagnetic and multiphysics modeling using physics-informed machine learning.

### Project Description

Physics-informed neural networks (PINNs) combine the power of machine learning algorithms with computational physics to accurately model the underlying physical systems with reduced or even no reference data. While PINNs have gained popularity in computational electromagnetics, their practical applicability has been limited to simplified toy cases. This project aims to advance PINNs for practical microwave simulations by delving into important areas, such as performance benchmarking and the integration of complex media and open boundaries into PINN-based electromagnetic solvers. Our research will explore optimal neural network architectures and efficient training strategies to develop fast and accurate solvers for microwave/RF device modeling and uncertainty quantification. Furthermore, we intend to accelerate multiphysics modeling by coupling PINN solvers with other computational techniques, aiming to offer an efficient alternative for large-scale 3D electromagnetic and multiphysics simulations. This work is expected to lead to significant improvements in the capabilities of PINN solvers for realistic electromagnetic and multiphysics applications.

**Li Wang**

*School*: Xi'an Jiaotong University, China.

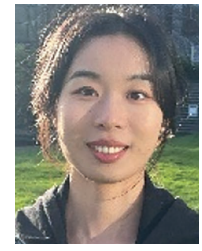
*Advisor*: Prof. Xiue Bao.

*Project topic*: Theories and techniques for a real-time monitoring microwave ablation (MWA) system.

Li Wang received his B.E. degree in information engineering from Xi'an Jiaotong University, Xi'an, China, in 2019, where he is currently pursuing his Ph.D. degree in electromagnetics and microwave technology under the supervision of Prof. Xiue Bao. He is expected to graduate in July 2025. His current research interests include radar nondestructive testing technology, UWB time-domain imaging, and MWA techniques.

### Project Description

MWA is considered one of the most promising tumor treatment techniques because of its minimal invasion. However, it is still challenging to accurately control and determine the boundary of the ablation zone during the tumor treatment. Considering that a temperature difference can lead to an obvious permittivity difference, which is the foundation of a microwave imaging system, a time-domain real-time monitoring system is planned to be developed. For the preliminary experiments, a simple imaging platform is built, and a series of focused images has been obtained. To increase the measurement accuracy and speed, multiple antennas are required to improve the proposed system to provide a large amount of observation information from different angles without using mechanical rotation. In addition, a switch matrix and a UWB sampling unit are planned to be developed, and then the primary focus will be on the improvement of real-time imaging algorithms.



**Qian Wu**

*School*: University College Dublin, Ireland.

*Advisor*: Prof. Anding Zhu.

*Project topic*: Linearization angle widened digital predistortion (DPD) for multiuser MIMO systems.

Qian Wu received her M.E. degree from Southeast University, Nanjing, China, in 2022. Since September 2022, she has been with the RF and Microwave Research Group at University College Dublin, Dublin, Ireland, as a Ph.D. student under the supervision of Prof. Anding Zhu. She is expected to graduate in June 2026. Her main research interests include linearization techniques for PAs and beamforming systems.

### Project Description

Multiuser MIMO (MU-MIMO) stands out as a significant enhancement, optimizing transmitter capacity utilization by enabling simultaneous communication with multiple users. PAs, being the most power-intensive components in transmitters, typically operate in high-efficiency mode, resulting in a nonlinear distortion that degrades communication quality.

The purpose of this research is to develop a DPD method for MU-MIMO that widens the linearization angle. First, we will derive a model from the magnitude-selective affine functions to address distortions arising from multiple user data streams and employ a cross-terms shared architecture to reduce the operation complexity of the model. Second, we will propose

a linearization angle widened DPD to further enhance the TRP-based adjacent channel leakage ratio.

**Yin Zeng**

*School*: Chalmers University of Technology, Sweden.

*Advisor*: Prof. Jan Grahn.

*Project topic*: Pulsed low-noise amplifiers (LNAs) for quantum information systems.

Yin Zeng received his M.Sc. degree in wireless, photonics, and space engineering from Chalmers University of Technology, Gothenburg, Sweden, in 2020. He is currently working toward his Ph.D. degree at the Terahertz and Millimeter Wave Lab at Chalmers, with an expected graduation date in the spring of 2025. His main supervisor is Prof. Jan Grahn. His main research interests include low-power LNAs for quantum computing, transient noise measurement, and semiconductor modeling. He was among the finalists of the Best Paper Award at the Asia-Pacific Microwave Conference in 2022, and he received a Best Student Paper Award (second place) at Swedish Microwave Days 2023.

### *Project Description*

In the rapidly expanding field of quantum computing, integrating more qubits requires lower power consumption in readout amplifiers, making the dc power of LNAs a critical design constraint. This research proposes a novel approach to significantly reduce the power consumption of LNAs used in superconducting qubit readout at 4 K. By implementing pulsed operation of qubit readout, the project aims to decrease the power consumption by two orders of magnitude without sacrificing the noise performance. The methodology includes developing a technique for nanosecond-resolution transient noise characterization under cryogenic conditions and designing LNAs with enhanced recovery time. The anticipated result is a 100-fold reduction in dc power consumption while maintaining a noise temperature below 2 K, thereby overcoming a crucial hurdle in the scalability of superconducting quantum qubits for future quantum computing advancements.

## 2024 Graduate Student Fellowship in Medical Applications Awardees

**Anne Calvel**

*School*: University of Toulouse, France.

*Advisors*: Prof. David Dubuc, Dr. Marie-Pierre Rols, and Dr. Katia Grenier.

*Project topic*: Noninvasive real-time analysis of electroporation phenomenon of individual cells with microwave dielectric spectroscopy.

Anne Calvel received her M.S. degree in biophysics from the Université Toulouse-III-Paul-Sabatier, Toulouse, France, in 2021 and her engineering degree in physics from the Institut National des Sciences Appliquées de Toulouse, France, in 2021. She is currently working toward her Ph.D. degree with the Laboratory of Analysis and Architecture of Systems-CNRS, Toulouse, France, and with the Institute of Pharmacology and Structural Biology-CNRS, Toulouse, France. Her research interests include the use of microwave-based dielectric spectroscopy for the study of electroporation of single cells.

### *Project Description*

Electroporation, a method allowing transient permeabilization of plasma cell membranes through the controlled application of electrical pulses, raises new hopes in the medical field in the fight against cancer. Combining electroporation with the administration of anticancer agents enables the targeted and efficient delivery of the latter, hence enhancing their cytotoxicity. Early prediction of cellular response to electrochemical treatments could help optimize electrical parameters and chemical concentrations, with the aiming of achieving personalized medicine. Microwave dielectric spectroscopy offers an attractive and innovative approach to characterize cells subjected to various treatments, nondestructively, noninvasively, in real time, and at the single-cell level. This project endeavors to dielectrically analyze the electroporation phenomenon on individual cells submitted to different stimulated electrical conditions. It includes the development of dedicated instrumentation, combining electrical stimulation applied at the single-cell level, accurate and reproducible microwave sensing, and fluorescent-based observation, to correlate both biological modifications and the dielectric responses of cells. Its validation and application to different cell models are under study.

**Shuping Li**

*School*: Rutgers University, USA.

*Advisor*: Prof. Chung-Tse Michael Wu.

*Project topic*: Spectrum-efficient multitarget vital sign monitoring using a metamaterial-integrated space–time-coding transmitting array.

Shuping Li received his B.S. degree in electronic science and technology from the University of Electronic Science and Technology of China, Chengdu, China, in 2019. He received his M.S. degree in electrical and

*(continued on page 108)*

Amateur Radio Transmitters' Society, for their unwavering support throughout the duration of these projects.

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computer engineering from Rutgers University, New Brunswick, NJ, USA, in 2020, where he is currently pursuing his Ph.D. degree and is expected to graduate in the fall of 2025. His current research interests include metamaterial antennas, RF/mm-wave circuits, and wireless radar sensors.

### *Project Description*

As wireless health monitoring technology advances, the need for monitoring the health of multiple individuals becomes increasingly significant, particularly in overcrowded and resource-limited clinic situations. However, the leverage of the mechanical rotors or the phase shifters increases the hardware complexity and cost of a radar system. Meanwhile, the utilization of metamaterial leaky-wave antennas occupies a significant portion of the frequency spectrum, contributing to spectrum congestion in the 5G communication environment. In response to these challenges, we introduce the space–time-coding transmitting array for direct antenna modulation to detect the vital signs of multitargets within a significantly narrow frequency range. By leveraging the steering harmonics of the time-modulated transmitting array, we can achieve concurrent health monitoring of multiple targets while satisfying the spectrum coexistence in the era of continued 5G evolution.

**Folk Narongrit**

*School*: Purdue University, USA.

*Advisor*: Prof. Joseph Rispoli.

*Project topic*: Development and integration of a general-purpose automatic tuning and matching circuit for stretchable coils.

Folk Narongrit received his M.S. degree in electrical engineering from the University of Southern California, Los Angeles, USA, in 2021. He is currently pursuing his Ph.D. degree in electrical and computer engineering at Purdue University, West Lafayette, IN, USA, where he is also concurrently pursuing his M.S. degree in biomedical engineering. His expected graduation date is July 2025. Since 2021, he has been a research assistant at the Magnetic Resonance Biomedical Engineering Laboratory under the supervision of Prof. Joseph Rispoli. His research interests include the development of magnetic resonance imaging (MRI) hardware for clinical and research use.

### *Project Description*

Recent research in RF hardware for MRI involves utilizing stretchable and flexible coils, which provide adaptability to various anatomical structures, potentially enhancing imaging quality and patient comfort. However, these coils suffer from frequency shifts from changing impedance during stretch, compression, and bending. Despite prior research exploring potential solutions to this issue, a stable, general-purpose automatic tuning and matching system for these coils remains elusive, limiting their clinical viability. This work aims to bridge this gap by innovating and evaluating an automatic tuning system to retune the resonance frequency across all stretchable coils. The work will shape research on conformable antennas and devices, extending its impact beyond MRI to various wearable devices.

## Deadlines for the 2025 MTT-S Graduate Student Fellowship Awards

In 2025, the MTT-S will sponsor up to 12 graduate fellowships in the general category and two graduate fellowships in the medical applications area. Travel supplement funds will again be available for the awardees to attend next year's IMS.

The MTT-S strongly encourages students in microwave and RF engineering to apply for the fellowships. As noted previously, the next application deadline is 15 October 2024. Please consult the detailed instructions for the graduate fellowship program at https://mtt.org/students/.