

Microwave Education by the MTT-S Student Branch Chapter IIT-BHU Varanasi

■ Somak Bhattacharyya 

“The object of education was to produce a desire to serve the community as a whole and to apply the knowledge gained not only for personal but for public welfare.”—*Pandit Jawaharlal Nehru, the first prime minister of India*

This quote always inspires the thought that our knowledge should not just be useful to an individual but that it will spread to our entire nation—a nation where diversity is our integrity. Because of the Covid-19 pandemic, life has still not been normalized, but we cannot stop. Rather, we have to keep moving to find a new way to enhance our knowledge building, and the online mode is the best platform in which to do this. For this purpose, the IEEE Microwave Theory and Technology Society (MTT-S) Student Branch Chapter (SBC) at the Indian Institute of Technology (IIT), Banaras Hindu University (BHU) in Varanasi arranged seven webinars covering a broad range of microwave engineering topics (Figure 1). All of the talks were followed by lengthy discussions, and all of the webinars were very successful, thanks to the efforts of the volunteers of the MTT-S SBC IIT-BHU Varanasi. Owing to this, we have been selected for the IEEE MTT-S Outstanding Chapter Award 2022.

The first webinar, “Optoelectronics: History of Electronics Leading to Infrared Detectors & Applications,” was held on 18 March 2021. The speaker of the webinar was Prof. A.G. Unil Perera from Georgia State University, United

States, and it was attended by nearly 50 participants. In the talk, Prof. Perera described quantum well detectors that can be developed to detect long-wave infrared (IR) and very long-wave IR detectors by continuously extending the threshold. He further described heterojunction interfacial work-function internal photoemission IR detectors. Different experimental facts regarding the applications of quantum dot detectors in the electronics, photonics, and communication domains were also covered very clearly in the lecture.

The second webinar, “Opportunity in Chaos,” on 22 June 2021, was delivered by Dr. Tushar Sharma, a staff RF engineer at Renesas Electronics, San Diego, CA, USA, as well as a visiting assistant professor at IIT Bombay. The webinar was attended by more than 60 participants from various academic institutes, research institutes, and other industries from both inside and outside India. Dr. Sharma shared his personal experiences in reaching success. He spoke about the challenges he faced while doing research work as a Ph.D. student and the ways to overcome those challenges. He inspired the attendees by mentioning the opportunities that young engineers/scientists can grab to achieve their goals in the fields of electromagnetics and radio astronomy. He then concluded his talk by describing some



research work he had done. The talk was followed by some fruitful discussions in which the audience raised a few clarifications.

The third webinar, “Multifunctional Filtering Antennas for Radiation on Demand,” was delivered by Dr. Jawad Yaseen

Siddiqui, an associate professor at the Institute of Radio Physics and Electronics, University of Calcutta, India, as well as a visiting faculty member, Royal Military College of Canada. The webinar was on 14 July 2021. Dr. Siddiqui gave an overview of the research area that he is working on and the industrial needs of filtering antennas. He also talked about the work his research group has carried out, explaining it in a very simple manner. The talk was

followed by fruitful discussions in which the audience raised questions for further insight. The main objective of his talk was to explain the technical aspects of his research work and motivate young engineers/scientists to pursue their careers in the area of electromagnetics, and Dr. Siddiqui did this

perfectly. After the technical discussion, Dr. Siddiqui talked about the Special Interest Group on Humanitarian Technology activities sponsored by IEEE, which his team had set up in the rural areas of West Bengal, helping rural people by providing medical support using the Internet of Things. He also discussed future plans regarding

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Somak Bhattacharyya (somakbhattacharyya.ece@iitbhu.ac.in) is with the Indian Institute of Technology, Banaras Hindu University, Varanasi 221005 India.

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this kind of social work encouraged by IEEE. The talk was appreciated by the participants and the organizer.

The fourth webinar, “Radio Frequency Micromachined Devices and Circuits for Microwave to Submillimeter Wave Applications,” was held on 7 August 2021. The speaker was Dr. Sukomal Dey, an assistant professor in the Department of Electrical Engineering, IIT Palakkad, India. Dr. Dey

described the technology of micromachining. Initially, he talked about the basics of the improvements on microelectromechanical systems (MEMS)-based switching networks and digital phase shifters. In the second module, he described the development of tunable bandpass filters utilizing MEMS switches for the present 5G applications. In the third module, he talked about the potential of a CMOS–MEMS

oscillator and mixer using capacitive MEMS resonators. The webinar was concluded by discussing current research activities of RF MEMS in the submillimeter-wave regime.

The fifth webinar, “Microwave-Radiation Safety Standards vis-à-vis Physiological Basis,” was delivered by Dr. Subrata Kumar Datta, a scientist at the Microwave Tube Research and Development Center, Defence



Figure 1. The webinars presented by (a) Prof. Perera, (b) Dr. Sharma, (c) Dr. Siddiqui, (d) Dr. Dey, and (e) Dr. Kobayashi.

Research and Development Organisation, Bengaluru, India, on 25 September 2021. He discussed the advent of telecommunication technologies and industrial applications of microwaves that have seen an enormous increase in electromagnetic radiation that endangers both professional and public lives. The talk discussed recommended safety limits along with the physiological basis for working out the standards. Hopefully, the talk will help in creating awareness and safety consciousness among microwave practitioners.

The sixth webinar, “Nanostructured Metasurfaces and Fiber-Based

Devices via Controlled Fluid Instabilities,” was delivered by Dr. Tapjyoti Das Gupta, assistant professor, Department of Instrumentation and Applied Physics, Indian Institute of Science, Bangalore, India, on 30 October 2021 in association with the IEEE Photonics Society SBC IIT-BHU. Dr. Gupta talked about the demonstration of unprecedented control over the fluid instabilities of thin glass films as a simple approach for the self-assembly of advanced dielectric metasurfaces.

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He then discussed modeling for tailoring the position, shape, size, and interparticle distance of nano-objects for feature sizes below 10 nm. This approach can generate optical nanostructures over tens-of-centimeters-sized rigid and soft substrates, with a better optical performance and a resolution on par with that of advanced lithography-based processes. The ability to fabricate the metasurfaces on stretchable substrates without undergoing any liftoff process finds application in



Figure 2. The two-day workshop on the occasion of IEEE Day Celebration 2021. The webinars presented by (a) Dr. Basu, (b) Dr. Agrahari, (c) Dr. Choudhury, and (d) Samantaray and Veera Babu.

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The circuit scheme is so primitive that we just need Kirchhoff's voltage law and primary calculus to reach the solution. However, because a nonlinear device is involved, it should better be considered in the time domain than

in the frequency domain. Use a mental circuit simulator rather than asking a computer for aid. The correct answer will appear next month in this column.



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mechanochromic sensors. Lastly, he discussed the ability to have unprecedented control over the lattice and particle size and demonstrated sharp Fano resonances with the highest quality factor (~300) in the visible range to date.

The seventh webinar was delivered by Dr. Kazuya Kobayashi, a professor in the Department of Electrical, Electronic, and Communication Engineering, Chuo University, Japan, and the International Union of Radio Science (URSI) vice president. Dr. Kobayashi spoke on "Radar Cross Section Analysis of a Finite Parallel-Plate Waveguide With Material Loading: A Rigorous Wiener-Hopf Approach." Initially, he provided an overview of URSI, followed by a discussion of the Hopf technique—a rigorous method of solution for electromagnetic wave problems—and its application to a specific scattering problem. He stated that the Wiener-Hopf technique is known as a powerful, rigorous approach for analyzing scattering and diffraction problems involving canonical geometries. He then talked about a finite parallel-plate waveguide with four-layer material loading as a geometry that can form cavities and analyzed the plane wave diffraction rigorously using the Wiener-Hopf technique

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under both E and H polarizations. He explained that by introducing the Fourier transform of the scattered field and applying boundary conditions in the transform domain, the problem is formulated in terms of the simultaneous Wiener-Hopf equations. The results presented by Dr. Kobayashi were valid over a broad frequency range and can be used as a reference solution for validating other analysis methods, such as high-frequency techniques and numerical methods.

Four webinars were also conducted on the theme "Technical Paper Writing" as a celebration of IEEE Day 2021 on 1 and 2 October 2021. The topics for the webinars were research paper writing, research pathways, research paper writing using Latex, and an introduction to software, such as Origin and Visio, which are used in the compilation of illustrations in manuscript preparation (Figure 2). The speakers at the webinars were Prof. Baidyanath Basu, a former professor in the Electronics Engineering Department at IIT-BHU, Varanasi; Dr. Pankaj Kumar Choudhury, a professor at the Institute of Microengineering and Nanoelectronics, Universiti Kebangsaan Malaysia; Dr. Rajan Agrahari, assistant professor, National Institute of

Technology (NIT) Patna, and our two senior research scholars, Diptiranjana Samantaray and Vangalla Veera Babu. Each of the webinars was attended by nearly 50 participants from various research institutes in India (several IITs, NITs, universities, and research organizations).



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