Antenna Learning and Research for Students and Young Professionals in the Post-COVID-19 Era

Debdeep Sarkar

Collective research on antenna design and their application in challenging propagation environments has come a long way indeed, starting from the days when Maxwell–Heaviside equations were conceptualized, and experimental breakthroughs were made by scientists such as H. Hertz, G. Marconi, A. Popov, and J.C. Bose (to name a few). In the present world, antenna-enabled systems have emerged as inseparable components of our daily lives, since we are becoming increasingly dependent on consumer electronics products. In fact, anything that is connected to the wireless network (for example, cellular handsets, laptops, Wi-Fi devices, Fitbits, and so on), requires necessary integrated antenna systems. Antenna design and analysis problems play a key role in diverse sectors such as space (satellites), radio astronomy, security/defense (aircrafts, missiles), sensors, vehicular radars, biomedical systems, and the Internet of Things. Therefore, some basic knowledge about antennas and the underlying electromagnetics behind their installation with other integrated platforms have become extremely essential for students and IEEE Young Professionals (YPs) from diverse backgrounds including circuits, communication, artificial intelligence, machine learning, and so on.

However, the use of traditional whiteboards and projection of equations and complex derivations often renders the subject of electromagnetics less appealing to the common student or YP from an electronics, communication, or computer science background. In general, this initial learning barrier pertaining to the antennas and propagation (AP) domain also impedes the enthusiasm of many students and young researchers who might have some initial interest to work in this field. As the present discussion is about education and research activities in AP, we must acknowledge the impact of the recent unprecedented COVID-19 crisis on students and the

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EDITOR'S NOTE

C.J. Reddy

I would like to thank Prof. Hao Xin for his service and leadership to the IEEE Antennas and Propagation Society (AP-S) Young Professionals Committee (YPC). Prof. Xin was also instrumental in starting this column in *IEEE Antennas and Propagation Magazine* (*APM*). As the new chair of the YPC, I would like to follow Prof. Xin's guidance and encourage YPs in the AP-S to be more engaged and actively participate in the Society. I am pleased to announce that the following 10 members have just officially joined the YPC: Nacer Chahat (NASA Jet Propulsion Laboratory), Jiang Zhu (Google), Debdeep Sarkar (Indian Institute of Science), Khaled Obeidat (Amazon), Konstantina Nikita (National Technical University of Athens), Asimina Kiourti (The Ohio State University), Andrea Alu (The City University of New York), Qammer Abbasi (University of Glasgow), Nelson Fonseca (European Space Agency) and myself (Altair), chair of the YPC. Please visit the AP-S YP webpage at https://www.ieeeaps.org/committees/yp for updates on YPC activities. In this issue of *APM*, we have an interesting and relevant contribution from Dr. Debdeep Sarkar on challenges and opportunities presented to students and YPs in the post-COVID-19 era. Anyone who would like to contribute to the "Young Professionals" column or have any suggestions on topics of interest, please contact me at cjreddy@ieee.org.

IEEE YP community (both in industry and academia) as a whole. Implementation of strict social distancing and safety regimes due to the COVID-19 pandemic led to experiments getting stalled in many academic and industrial R&D labs, thereby hampering research progress, affecting industry productivity, and disturbing employment scenarios in many instances. The imposed lockdowns unsettled society as a whole, leading to a state of anxiety and depression (especially among YPs). To cope with the pandemic crisis, emphasis on conscious practices of mindfulness and the building of inner strength was a necessity [1].

The COVID-19 pandemic also posed significant challenges for the higher education community worldwide, necessitating educators and students across all levels of education to adapt quickly to "online education" (for example, virtual courses/emergency remote learning), traditionally viewed as an alternative pathway and well suited mainly to adult learners seeking higher education opportunities [2]–[5]. The main characteristics of such online education mechanism can be summarized as follows:

- The learner and the instructor/tutor are at a distance.
- The instructor/tutor creates study material (pedagogical content knowledge or PCK) in digitally crafted slides, or live presentations through eplatforms (for example, tablets).
- Some form of Internet-based technology is utilized by the learner to access the study materials.
- Virtual interaction and doubt-clearing sessions between learner and instructor/tutors or between other fellow learners happens over the Internet.

In some cases, the mode of instruction also oscillated between "online" and "physical classroom" due to fluctuations in the rate of infection and corresponding reactions in the form of government restrictions. In many institutions, a combination of face-to-face and remote delivery of instruction was also deployed, whereby students could attend classes either in-person or online (often called the "HyFlex" model [3]), depending on their presence on campus. The online education mechanism definitely suffers inadvertent issues like lack of direct connectivity with students, which makes it very difficult to create the often desired mutually interactive feedback between instructors and students. However, a transition toward this digital and online mode of disseminating information can actually be a blessing in disguise for the AP community.

The emphasis on online networking modes can also enhance cross-country interactions and remote internship modalities, adding a new dimension to AP research culture.

While there is no way to avoid the mathematical artifacts of antennas and applied electromagnetics, it is advisable to judiciously utilize the computational electromagnetic (CEM) enabled visual tools to better understand "antenna-physics." While these CEM-based tools have been meticulously developed over the past three to four decades as a culmination of concurrent effort by numerous engineers and developers, the COVID-19 pandemic has given the necessary push toward their effective use in conjunction with the online education paradigm. This CEM-augmented mechanism of going around the complex math at the beginning and motivating young brains to follow the underlying physics in an intuitive manner has the potential to have a far-reaching impact (especially in terms of training the pool of professional antenna engineers in the future). The emphasis on online networking modes can also enhance cross-country interactions and remote internship modalities, adding a new dimension to AP research culture. In fact, many CEM solvers now support cloud-based operations using servers (for example, the MATLAB Online Toolbox [6]), which can definitely enable graduate students and YPs to contribute better as "online-interns," guided by professors or application engineers from the industry.

In addition to providing new tools for teaching and research relevant for AP, the push toward online modes of interaction during the COVID-19 crisis also bolstered networking opportunities for students and YPs. Since March 2020, when the pandemic started peaking in various parts of the world, physical traveling naturally got restricted; then, we witnessed a boom in the occurrence of online events such as webinars/online workshops. Without social gatherings and face-to-face interactions, these online events became more like focused knowledge-sharing platforms. So despite being locked down in their rooms, students and YPs were in a unique position whereby they could learn more about the complex concepts of antennas and applied electromagnetics from experts belonging to globally leading universities and industries. Some of these webinars on fundamental concepts as well as futuristic specialized research directions were attended by more than 250 participants. Such attendance through online platforms was unimaginable (it was not impossible, though, as technology was there but intent was missing.) for small-scale event organizers in the pre-COVID-19 era, especially IEEE Student Branch Chapters (SBCs), which could now reach out to distinguished speakers and attendees beyond their geographical limits, bypassing budgetary limitations.

One may argue that simply having more event attendees does not necessarily translate into a higher quality of events. While all of the online webinars and workshops might not have resulted in similar positive feedback, some specific cases illustrate the effectiveness of such online events when compared with their physical counterparts. At this juncture, the author would like to share couple of relevant experiences with virtual workshops and research conclaves, organized under the aegis of the IEEE Bangalore and IEEE Kerala sections (interestingly, both in the top three sections in the world based on the number of IEEE Members).

During February 2021, a six-day online workshop on "Antenna Modeling and Simulation using FEKO and IEEE Authorship" was organized by the IEEE Antennas and Propagation Society (AP-S) SBC of Rashtreeya Vidyalaya College of Engineering, Bangalore and the IEEE AP/MTT Joint Chapter (Bangalore), IEEE Bangalore Section, along with support from Altair Engineering, Inc. With an opening lecture by Dr. C.J. Reddy (vice president, Altair), the entire virtual workshop was a captivating experience for students and YPs, all of whom enjoyed the consequent technical lectures by application engineers from Altair, Soundarya Venkatesan and Kartik Goyal. In addition, the antenna research and IEEE authorship-oriented lectures by Dr. Ashutosh Kedar (LRDE, DRDO, India) and the author were well received by the audience, who had the chance to interact with all of the representatives from industry, academia, and government R&D organizations.

The "All Kerala Antennas and Propagation Society Students Conclave (AKAPSSC)" in September 2020 was organized jointly by a number of IEEE AP-S SBCs from India: (i) Government Engineering College, Barton Hill, Trivandrum, (ii) Indian Institute of Space Science and Technology (IIST), Trivandrum, (iii) Cochin University of Science and Technology, (iv) Ahalia School of Engineering and Technology, Palakkad, and (v) Model Career Center, Trivandrum. In addition to a few technical lectures, the student volunteers and young researchers were very happy to engage in one lively panel discussion that the author was part of, along with the panelists Prof. Yahia Antar (IEEE AP-S 2020 president-elect at that time), Dr. Jawad Y. Siddiqui (IEEE AP-S Region-10 Coordinator), Dr. Chinmoy Saha (IIST Trivandrum), Dr. Saptarshi Ghosh (Indian Institute of Technology, Indore). The panel discussion in AKAPSSC 2020 received excellent feedback from the students and YPs, as it shed light into a number of pertinent topics including

- AP-S opportunities and new initiatives for YPs
- connecting the academic research in AP to industry
- innovative teaching using CEM-based software tools.

To conclude, the post-COVID-19 era has brought in some unique opportunities to the global community of students and YPs, especially in the AP domain. The shift toward online mechanisms can foster an atmosphere for interactive and visually rich learning as well as globally collaborative research on antennas and applied electromagnetics. Although traveling and conference visits will possibly resume in future with increased vaccinations down the line, virtual workshops/webinars can be held on a bigger scale, empowering and benefiting students and YPs.

AUTHOR INFORMATION

Debdeep Sarkar (debdeep@iisc.ac.in) is with the Indian Institute of Science, Bangalore, 560012, Karnataka, India. He is a member of the IEEE Antennas and Propagation Society Young Professionals Committee. He received the Young Investigator Grant from Infosys Foundation, Bangalore, in 2020.

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