"It's a Wonderful Time to Be an Antenna Engineer": An Interview With Prof. John Volakis

Asimina Kiourti

EDITOR'S NOTE

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In this issue of *IEEE Antennas and Propagation Magazine*, we have a fascinating interview by Prof. Asimina Kiourti with Prof. John Volakis, past president of the IEEE Antennas and Propagation Society (AP-S) and currently dean of the College of Engineering at Florida International University. It is truly inspiring to learn about Prof. Volakis's journey from a small island in Greece to become a world-renowned researcher as well as great mentor for his students and others.

By the time you read this article, we will have already announced "IEEE AP-S Young Professional Ambassadors." We will be highlighting them in the April 2022 issue of the *Magazine*. We have many more exciting articles planned for this column in future issues. If you would like to contribute to the "Young Professionals" column or have any suggestions on topics of interest, please contact me at cjreddy@ieee.org. Follow us on LinkedIn at https://www.linkedin.com/company/ieee-aps-yp for the latest updates and events that are of interest to AP-S Young Professionals.

In a podcast published by *IEEE Open Journal of Antennas and Propagation* (*OJAP*) in June 2021, Prof. John (Yiannis) Volakis [past president of the IEEE Antennas and Propagation Society (AP-S), and dean of the College of Engineering and Computing at Florida International University] engaged in a conversation with Prof. Asimina Kiourti (*OJAP*'s senior editor and assistant professor at The Ohio State University) about his exciting career path and the incredible advances that the field of antennas and propagation is currently seeing [1]. This article provides a transcript of the key parts of the podcast with Prof. Volakis. The interview has been edited to fit the scope of the "Young Professionals" column of *IEEE Antennas and Propagation Magazine*. Figures are also included highlighting some of Prof. Volakis's major research contributions. His story is truly inspiring and motivating for young professionals.

Prof. Asimina Kiourti: It is my great pleasure and honor to host Prof. Volakis today and talk about his career path, ongoing research, and vision. Let me start by asking you what got you interested in electromagnetics, and what has been your career path to date?

Prof. John L. Volakis: Thanks for inviting me. It is a pleasure to be part of this podcast. AP-S is a Society that I have been associated with since 1978 and served as president in 2004. It is a pleasure to contribute to the students, Society, and technologies that AP-S represents. A big question, and an appropriate one, that you asked me is how I got started in electromagnetics, and the short answer is, "There isn't anything that jumps out." It was a process. It was actually a long process, and I think that this is likely true for most of us.

I started by having a dream to become an electrical engineer since the 1960s, when I was in high school in Chios, Greece. That dream came about because I grew up without electricity, and I kept that dream. Indeed, I received a lot of help from my parents, who decided to send me to a high school away from our small village—about 30 km away—connected with mostly unpaved roads. There, I was able to get a great education with motivation from my teachers. Along the way, I found out that mathematics and the sciences were easier for me, and writing was very difficult. But I kept up with everything, and, when the opportunity came to come to America (this happened when I was on my last year of high school), I jumped at the opportunity (Figure 1). When I came to the United States, I was faced with even bigger challenges, but the dream to become an electrical engineer grew even stronger.

I attended Youngstown State, the university close to the town I traveled to in the United States. While an undergraduate, I met a professor, Dr. Skarote.

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FIGURE 1. A passport photo of John Volakis from around the mid 1970s.

FIGURE 2. John Volakis (right) with Leon Peters (center) and Dennie Burnside (left) while working at Rockwell International North American (now Boeing Co.).

He saw in me certain capabilities and encouraged me to go to Ohio State and pursue my Ph.D. degree. I received financial aid and an assistantship to attend Ohio State. But most importantly, I met amazing people, like my advisors, Leon Peters and Dennie Burnside [Walter D. Burnside] (Figure 2), who taught me electromagnetics, radars, communication systems, and underground imaging. My first-ever graduate student problem is shown in Figure 3. It was an amazing period of my life, as I was exposed to real-life technologies that I had only dreamt of. Simply put, The Ohio State ElectroScience Lab was a cookie jar of technologies and opportunities that motivated me to pursue something more. At the same time, I met and worked with many excellent students, professors, and scientists who became part of my life in later years.

Notably, when I called my mother and told her that I wanted to pursue graduate studies, her answer was, "What is wrong with you? Why don't you just go to work? Aren't you tired of going to school?" I think many of us might have experienced something similar, particularly if coming from a rural background, as I did. In any case, I pushed through, and the rest is history.

I do want to say that, along the way, I enjoyed everything that I did. I tried to pursue excellence, but, most importantly, I did my best to pursue quality. That's something that I learned from my early years. I wanted to do things very well. I did that when I was farming, and, since then, I learned that time and hours were not important in delivering quality work. So, when it came to being able to

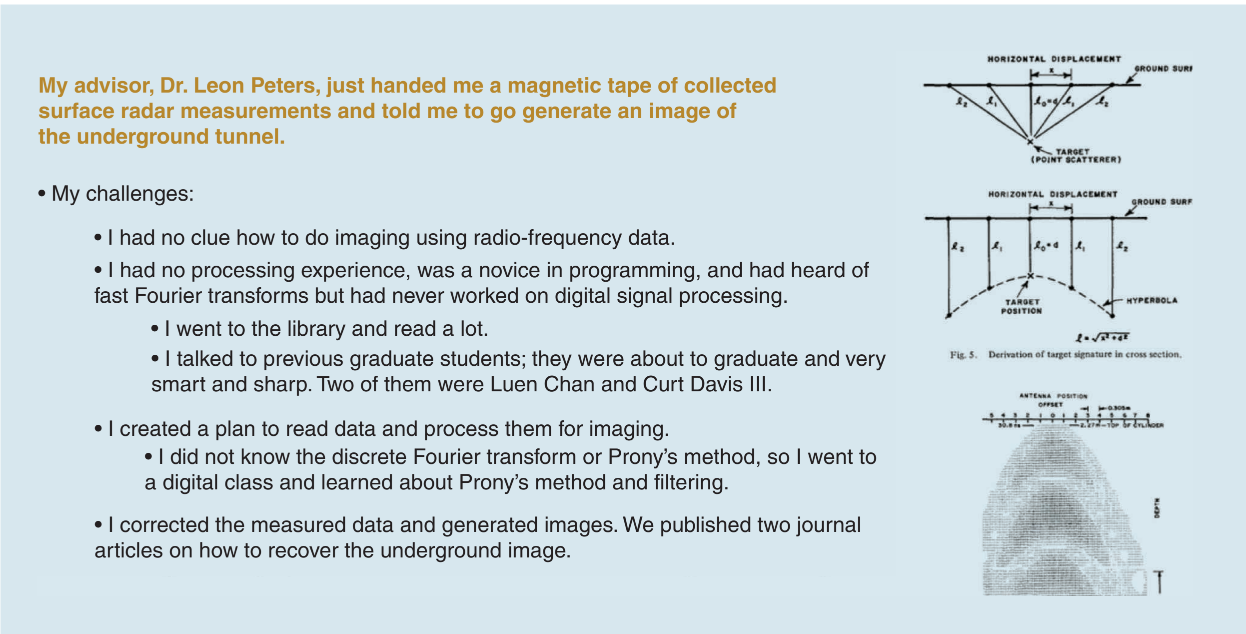

FIGURE 3. Challenges faced by Prof. Volakis for the first project as a graduate student on underground imaging [7].

learn English very well, I did it. I pursued long hours and techniques to acquire the proper pronunciation and writing skills as well, which I knew were important. During my graduate school years, I also met my wife, Maria, while she was pursuing her pharmacy degree. Maria has supported me throughout my career.

FIGURE 4. John Volakis, starting as a faculty member at the University of Michigan, Ann Arbor, in 1984.

A couple of points for young students to know is that time and dedication are essential elements of your success. Also, it is important to think of everything as a career and not as a job. This thinking was reflected upon by an IEEE medal winner who was asked, "What is the most important thing you would say to students and future career people that made you successful?" His succinct answer was, "Well, every job I took, I did it as if it was the last one that will ever be given to me." I followed that motto, and I think it worked well for me. Along the way, I challenged my students (Figure 4). At the same time, I was very fortunate to have graduate students and work with people who were dedicated and delivered things in amazing ways (Figures 5 and 6).

FIGURE 5. The research group in the late 1990s at the University of Michigan, Ann Arbor with well-known (by now) students and postdoctoral researchers: (from left to right): Yunus Erdemli, Taesik Yang, Eng-Swee Siah, Kubilay Sertel, Erdem Tospakal, Dejan Filipovic, Dimitris Psychoudakis, Zhifang Li, Michael Carr, Gulu Kiziltas, and Rick Kindt.

Also, when I pursued research, I looked at problems that needed to be solved. I remember the hybrid finite element methods that our group is known for introducing. Indeed, finite elements had been well known since the 1960s in other disciplines, and we started working on it toward the end of the 1980s to allow for material modeling. But the method had issues that did not make it successful in electromagnetics. Being able to find the Achilles heel (e.g., the edge elements, accuracy, speed, problem realism, and truncation boundary conditions) and solve the right problem at that particular time was critical (Figure 7).

The same thing was true with the ultrawideband antennas that we are working on today. Being able to identify the problem and develop a solution for practical realizations was critical. In this particular case, we focused on making antennas small and ultrawideband as well as conformal. This is something we were able to accomplish, and, today, we can say that it is a standard antenna across the world (Figure 8). Wearables that Asimina and I have worked on are also a technology that's needed, and we are still pursuing innovations as we

FIGURE 6. The research group at the ElectroScience Lab of The Ohio State University in 2013.

move forward (Figure 9). Nothing is abrupt. It is a process, and sometimes it takes decades.

Kiourti: What are some of the "hot" research areas that you are working on these days?

Volakis: This is also a very important question. First, let me start by saying that I want to be a student again. This is an incredible moment in technology and innovation. It is like being in a cookie jar of opportunities. I also want to compare what we had available in the early 1980s and what we have now.

When I started as an assistant professor, I wanted to get some research funding. I went to the National Science Foundation (NSF) and tried to push some ideas. The NSF program director whom I spoke to told me that, and I quote, "We have had incredible leaders in electromagnetics, and they pretty much developed everything that was needed." Of course, this individual did not predict the incredible revolution associated with wireless communications and the cell phone, which changed our lives. At the same time, research was pursued in the context of large government or industry programs, like the Apollo program and IBM computer (a big computer that took several rooms to be housed in). That is, technology was being developed by large corporations and the government, so individual innovations were not as easy at that time as they are now.

Today, we have challenges and technologies such as automation and artificial intelligence. We are going to see automated freeways and driving becoming accessible in the near future. We are also going to see virtual reality, virtual offices, and spectrum access in ways that we have not imagined. After the introduction of the microprocessor, the Intel 8080 and Motorola 6800 (introduced in 1974), things changed dramatically. Today, we have technologies and capabilities that are impacting individual people and are not large corporation or government driven. As a result, an individual or a team of people can make a transformational impact, and that is an incredible capability for our future generations. This is why I said that we are in a cookie jar of opportunities. Indeed, it is a wonderful time to be a student again. We can pursue basic technology development based on needed applications or we can pursue evolutionary technology developments that target applications.

A recommendation to students is to find what is going to be the next big thing: spectrum access; virtual offices; big data; ultrawideband technologies; the Internet of Things (IoT) and being able to have sensors that interact with all aspects of our bodies, which therefore enable wearable electronics; unmanned aerial vehicles and small vehicle technologies; CubeSats that are expected to provide data on demand; a cell phone that is in your earbud; and many more. Work on miniaturization, the IoT, and ultrawideband systems, including software radios. Also, do not focus on a single item or an isolated technology. You may, but, in the end, your vision should be to see the entire system. Today, our research group is working on sensor systems; software radios and simultaneous transmit/

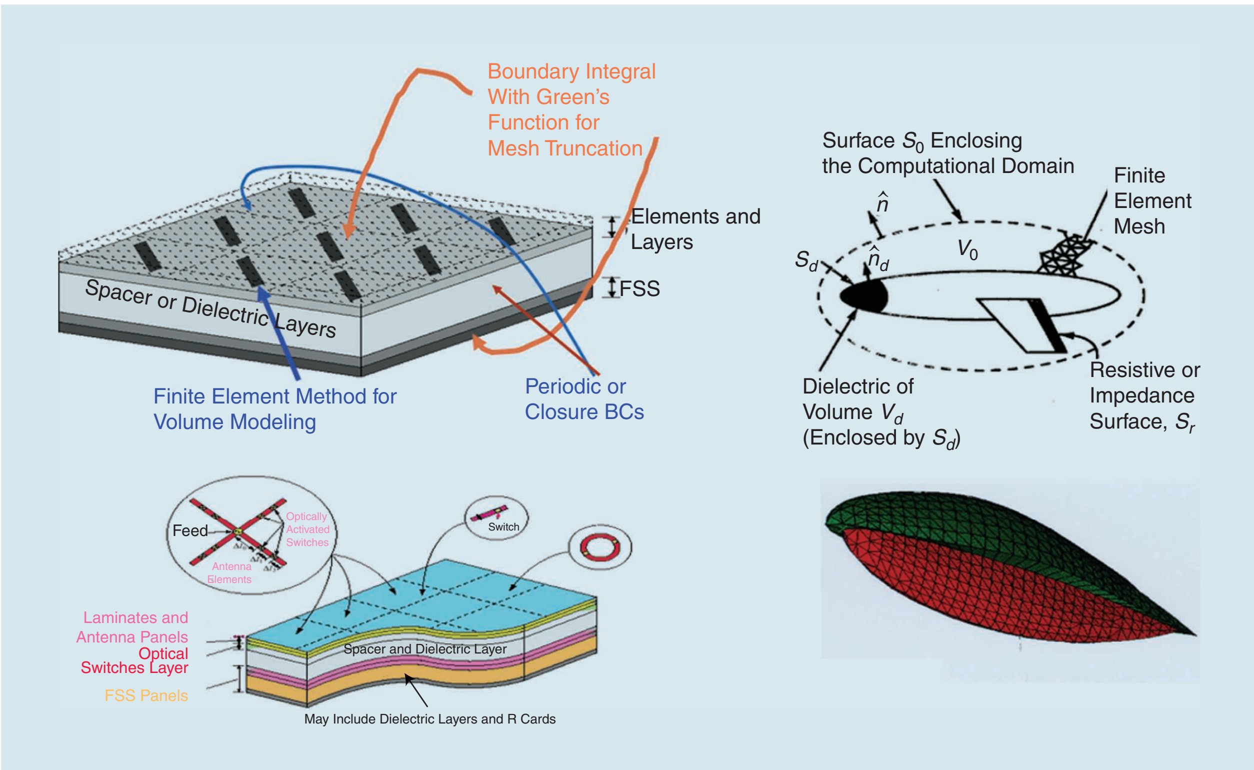

FIGURE 7. The early development of hybrid finite element methods and mesh truncation schemes. (Source: [2].) FSS: frequency-selective surface; R: resistive; BC: boundary conditions.

receive radios (the so-called full duplex); multiple-input, multiple-output radios; and technologies that will impact augmented reality and automation. Also, we work on secure communications across the entire spectrum, a capability that we have a responsibility to enable.

I cannot wait for the day when a farmer will have an earbud phone and say, "I don't have water here," or "I measured, and we need some more fertilizer," and these will be delivered to the field by some small airborne vehicle. We will be able to help people very quickly via satellite imaging or by calling for help immediately when there is a need for water or food, a disaster happens, a flood occurs, a fire breaks out, and so on. Being able to deliver technologies easily and utilizing technology that works seamlessly with our day-to-day living is a goal still to be attained.

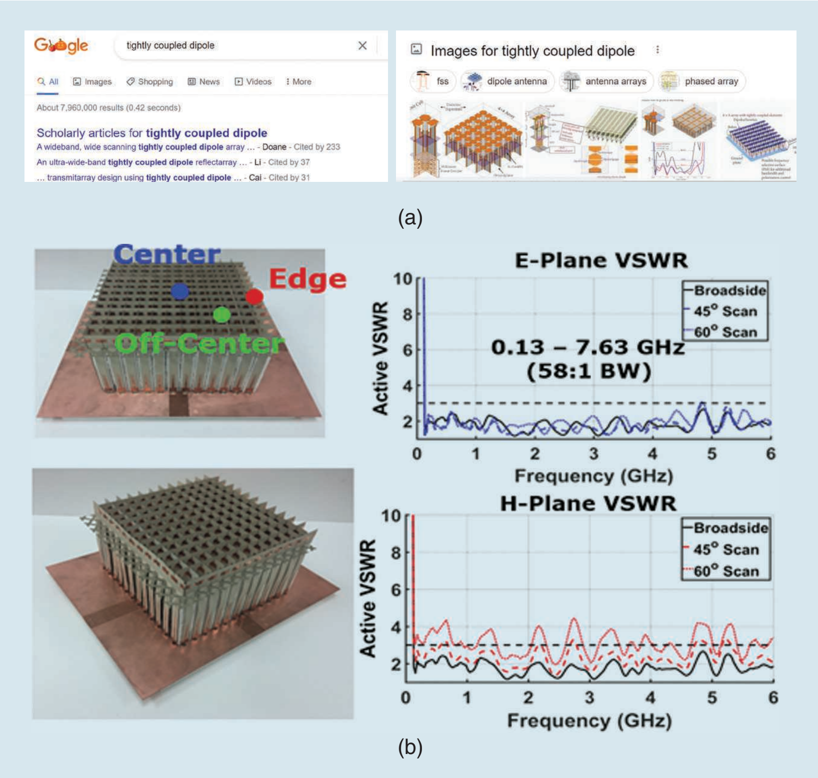

FIGURE 8. (a) A Google search demonstrating the impact and utility of tightly coupled dipole arrays for addressing the issue of conformal and wideband performance in a small footprint. The term *tightly coupled dipole arrays* was first introduced in [3], and its ultrawideband performance was later established in [4] and related papers. It was further developed and demonstrated in the dissertations of as many as 10 Ph.D. students. (b) The shown 58:1 bandwidth (BW) array is based on [5]. VSWR: voltage standing-wave ratio.

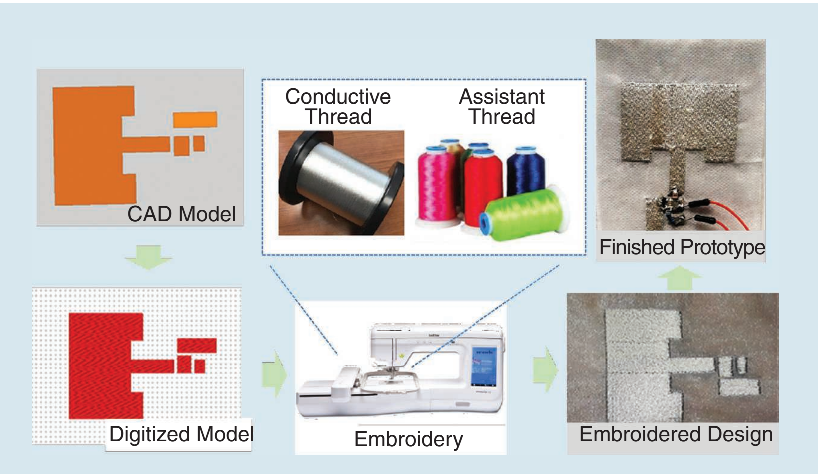

FIGURE 9. The weaving method for wearable antennas and electronics. (Source: [8].)

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