Awards

Combat Fear, Cherish Your Champions: In Conversation With the 2023 IEEE Electromagnetics Award Recipient, John Bandler

■ **Anding Zhu**

IEEE Technical Field Awards are bestowed for contributions and leadership in specific fields of interest to the IEEE. Each year, the most prestigious honors are awarded to individuals whose exceptional achievements and outstanding contributions have made a lasting impact on technology, society, and the engineering profession [1]. Following a 60-year career span in microwave engineering, starting with his 1963 undergraduate project, "Abrupt Transitions in Rectangular Waveguides," the 2023 IEEE Electromagnetics Award goes to John Bandler, professor emeritus at McMaster University, Hamilton, ON, Canada, "for contributions to electromagnetic optimization and the modeling of high-frequency structures, circuits, and devices."

Space Mapping and Risky Endeavors

Bandler is the inventor of the space mapping technology that drastically accelerates electromagnetic optimization by enabling optimal high-fidelity design of devices and systems at a cost of only a few high-fidelity simulations [2], [3].

Figure 1. *Bandler (2012): the 2023 IEEE Electromagnetics Award recipient.*

"It came as a complete surprise," Bandler says when asked about the IEEE Electromagnetics Award. "The idea that I would get the Electromagnetics Award seemed absurd because I don't solve Maxwell's equations."

However, Bandler admits that, although he didn't engage directly in computational electromagnetics, "we made significant advances in electromagnetic optimization in spite of the skeptics. Experts in computational electromagnetics didn't believe it was possible."

The computers of the 1980s and early 1990s were significantly slower than today's. "The idea of putting a commercial electromagnetic simulator into an optimization loop seemed nonsensical to the experts then," Bandler says. "I still remember the time and occasion, in 1993, when I asked Hewlett-Packard (HP) reps to allow me to link my optimization process to their commercial simulator HFSS; they laughed in my face."

However, "Jim Rautio, of Sonnet Software, graciously offered us their

Anding Zhu (anding.zhu@ucd.ie) is with the School of Electrical and Electronic Engineering, University College Dublin, D04 V1W8 Dublin, Ireland.

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planar electromagnetic simulator. We were able to work with it and soon showed that electromagnetic optimization was indeed possible."

Of course, the electromagnetic optimization process took a long time: Bandler says it would have taken weeks to optimize his filter test example using the existing approaches on his available Sun SPARCstation 1 workstation. The shock of seeing the optimization process unfold slowly inspired him to invent space mapping.

Space mapping made electromagnetic optimization practical. It also turned out that space mapping explained the engineer's mysterious "feel" for a problem, something Bandler says had eluded him for 30 years [2], [3].

Bandler founded his company, Optimization Systems Associates (OSA), in 1983 and pioneered the space mapping technology in 1993. HP acquired OSA in 1997, and OSA became part of the HP EEsof Division, then passing down to Agilent Technologies and now Keysight Technologies, in Santa Rosa, CA, USA [4].

Spacing mapping proved to be a successful design tool, but in the early days, Bandler faced significant challenges. Did he always believe in himself and insist that things were going to work out and be successful? Had he ever been skeptical of himself?

"Well, you know, it's very easy for me to say now, to rewrite history, 'Oh, I was really very clever, and I knew exactly what was going to happen.'" Bandler laughs. "Yes, the thing was, I encountered skeptics about using computers for optimization all of the way from my Ph.D., starting with my Ph.D. supervisor. I had skeptics, yes, but … also, I had champions, the right people, who were on my side."

He continues, "If I had good people who were actually optimistic about what I was doing, maybe there was a chance. So, yes, things could fail, fail badly, but I would just get a feeling … we were heading in the right direction."

Over the 30 years since Bandler pioneered space mapping, his technology has been adopted into design portfolios across the entire spectrum of engineering, including optimal design of antennas, aircraft wing curvature, and vehicle crashworthiness.

Bandler's advice to the younger generation of engineers who might be attempting risky research paths is simple: don't give up, and keep your eyes on the prize.

"Keep trying, I think the main thing is. Don't drift from topic to topic. Stay focused on what you started out with and what you are good at, and keep working on it. You will be amazed by what you discover. And there are, of course, always ups and downs. There are bad times, and there are good times, but stay with a certain topic, and keep working on it. My view is, you will always succeed in something."

Education and Creativity

Bandler was born in Jerusalem, the only child of parents who escaped from Vienna, Austria, prior to World War II. He attended the Junior School in Nicosia, Cyprus, and completed his schooling in London, England. He entered Imperial College London in 1960, graduating in 1963, with first-class honors, in electrical engineering and in 1967 with a Ph.D. degree in microwaves. In 1976, he received the D.Sc. (Eng.) degree in microwaves, CAD, and the optimization of circuits and systems from the University of London [5]. He joined McMaster University in 1969. He served as chair of his department and dean of the Faculty of Engineering. He is now a professor emeritus. Bandler has published more

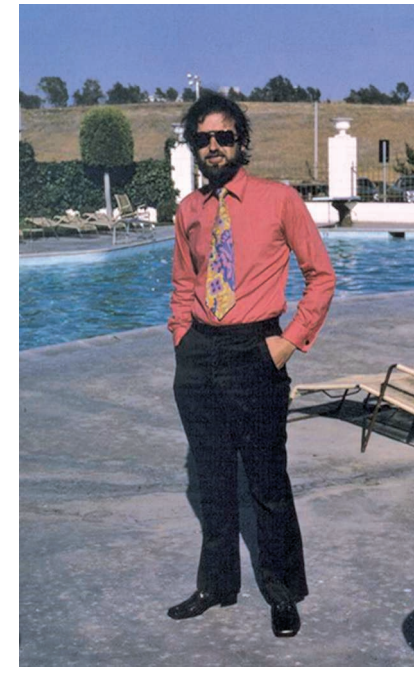

Figure 2. *Bandler in 1970 at the IEEE International Microwave Symposium, Newport Beach, CA, USA.*

Figure 3. *Bandler at his desk in the Microwave Laboratory, Imperial College London, in 1965, amid IBM punched cards and an S-band waveguide experimental setup.*

Figure 4. *Bandler in 1998, painting at the Dundas Valley School of Art.*

than 500 technical papers and contributed to several books.

Among many factors in his life that impacted his success, Bander credits his early education. "One of the things that really influenced me a lot was the culture at Imperial College. They let graduate students work independently. Research supervisors stayed very much in the background; they made suggestions, but they didn't interfere with what the graduate students were doing. It meant that the moment you started out as a grad student, you became independent quickly. That allowed you to explore new directions. A problem with today's supervision is that there's too much control by supervisors; too much control stops creativity. It may mean that you will likely only make incremental improvements, not substantial advances."

"Of course, the problem with becoming independent very quickly is that you'll make mistakes. You may go in a wrong direction. But so long as you focus on your discipline and stick to what you are doing, you are OK. You have to try different things and then find the right solution. Like when you shop for a T-shirt. You start by trying on various shirts, then you find the one that is not too big, not too small, just right."

Another piece of advice he gives: "Don't overload yourself. I didn't attend many courses myself as a graduate student. When we overload students with courses, it has both a positive and negative impact. The positive is that you learn existing material, you learn the background to many topics. But the negative is, it saturates your mind. Your mind is then full of established techniques, and it's difficult to come up with something new." Novel ideas can come from reading "just two or three key papers," and if you get an idea, "it doesn't matter if you reinvent the wheel. In the end, you will discover something new to you."

It's the creative process that matters.

Bandler is not only an engineer and an entrepreneur but also an artist, a

Figure 5. *A promotional image from Bandler's 2021 film,* The Caffeine Rabbit Hole, *depicting Steph Christiaens and the talking-heads logo on the coffee cup. Photo by John Bandler.*

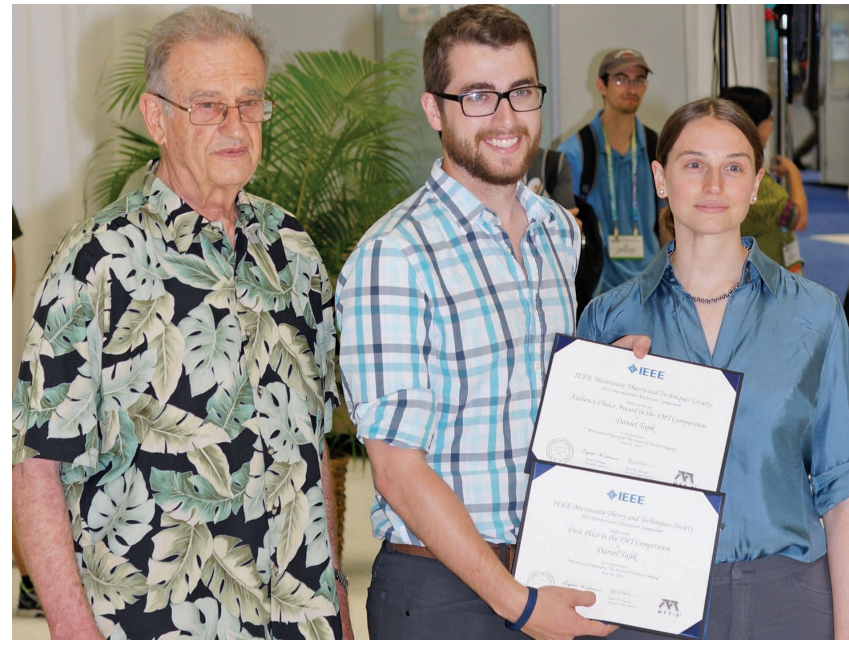

Figure 6. *Cochairs John Bandler and Erin Kiley celebrating with the first IMS 3MT winner, Daniel Tajik, in Honolulu in 2017. Photo by Denys Shumakov.*

public speaker, and an author of fiction, including stage plays. He wrote and directed several theatrical works. For example, his play *The Trial of Naomi Verne* can be found on his YouTube channel [6].

He says he actually fell into creative writing accidentally. He was in Finland in the year 2000, unable to sleep because of jet lag, and started writing a story on his laptop. He put it aside for a few weeks and then mentioned his attempt at story writing to a friend, who suggested he attend a workshop on creative writing. Bandler followed through and has written a novel, short stories, plays, and screenplays.

"Creative writing fuels my imagination," he says. "I write science fiction, for example, and one of the things about science fiction is that you have to stretch your mind to imagine something that might seem completely irrational."

He believes that there is more need for the arts and humanities in our engineering discipline, as interactions with other disciplines not only increase creativity but can help explain and expand applications of engineering.

He shows me the talking-heads image on his coffee cup, an image he, and his colleague Rachelle Ho, created for his 2021 short film, *The Caffeine Rabbit Hole*, which he wrote, produced, and directed [7].

"If you look very carefully, you'll see two heads talking to each other, and inside each brain, there is a model of the brain of the other person. When you and I are speaking, we can communicate quickly because I have a model of your thinking process in my head and vice versa. In other words, we actually have models of each other's brains within our minds. I don't have a complete model of your brain. It is not completely here." He points to his head. "But there's a coarse model of your brain that allows me to make very quick decisions and responses to your questions. This is exactly how space mapping works, using surrogate coarse models to solve complex electromagnetic optimization problems." He concludes, "I see space mapping everywhere."

Bandler has reached out to mathematicians, psychologists, and neuroscientists. He even speaks to linguists about space mapping. He says these people often think he is crazy, and why is he the only person doing this? But "when people think I'm crazy, I say to myself, maybe there's something there."

The Three Minute Thesis

Along with Erin Kiley, Bandler spearheaded the Three Minute Thesis (3MT) competition at the 2017 IEEE Microwave Theory and Technology Society International Microwave Symposium (IMS) and has continuously co-organized the event since then. He has coached and mentored hundreds of candidates in the art of the 3MT, benefitting students and

Figure 7. *At the closing session of IMS 2022, in Denver, CO, USA, 3MT cochairs Aline Eid and Jimmy Hester thank Bandler for his contributions to the 3MT. Photo by Tammy Lyle.*

Figure 8. *On one of their many trips to the Caribbean, Bandler and his wife, Beth, wreck dive in the Cayman Islands.*

Figure 9. *Bandler and his wife snorkel in the Galapagos Islands in 2015.*

young professionals throughout several communities.

"I was really concerned about how bad the technical presentations given by graduate students in my department were. Communication is incredibly important. There are so many aspects to communication. It's not just being able to give technical presentations to experts like your supervisor. You have to be able to deliver your ideas clearly to general audiences, too."

Bandler is not only an engineer and an entrepreneur but also an artist, a public speaker, and an author of fiction, including stage plays.

Starting more than 12 years ago, Bandler has created seminars and workshops on creativity, creative thinking, first impressions, persuasion, presentation skills, professional success, and more, all to provide advice to graduate students. He gave seminars in different locations and venues around the world, including the United States, Canada, China, Mexico, and Iceland, before bringing the 3MT to the IMS in Honolulu, HI, USA, in 2017. Although the 3MT is already very successful, he says, "We have really only touched the tip of the communication iceberg on this. I still see tremendous development, not just in the 3MT itself but also in moving the art of presentation to new dimensions, like from one-way presentations to dialogues."

"The bottom line is, if you're going to create a team with people focusing on a certain subject, the team members need to understand each other quickly."

Personal Life

Over the years, Bandler spent time on many other activities, including art, opera, travel, swimming, skiing, table tennis, scuba diving, and playing chess. Live onstage opera and art and art history, he says, fuel his imagination. He is the proud father of two daughters and grandfather to five grandchildren.

Final Words and Takeaways

So, how does Bandler summarize his decades-long career?

"Exciting. Inspiring. Challenging. Satisfying. Benchmarked by amazing colleagues and champions. I constantly found myself swimming against the current."

About the keys to success and his words to young professionals, he says, "Embrace risk. Give yourself permission to fail. Combat your fear, and beware of flattery, guilt, and resistance. Beware of your inevitable detractors and experts' agendas, even your supervisor's agenda! Remember that experts (and you too!) resist change. Find your champions—they are out there—cooperate with your team, and do your best to acknowledge your champions and collaborators. Resist secrecy between yourself and your colleagues; respect and empathize with your audience(s). Recognize the work and success of others. Bottom line: your breakthrough is staring you in the face!"

Acknowledgment

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