The Importance of Good Men in Your Life!

Eva Antonino-Daviu

EDITOR'S NOTE

Francesca Vipiana

This month's "Women in Engineering" column is authored by Eva Antonino-Daviu, associate professor at the Polytechnic University of València, Spain, and the vice-director of research at the Institute of Telecommunications and Multimedia Applications. She leads the European Association of Antennas and Propagation Working Group on Small Antennas, and she was the recipient of the 2019 IEEE Antennas and Propagation Society Lot Shafai Mid-Career Distinguished Achievement Award "for her contribution to the systematic design of antenna systems for practical applications using characteristic modes and promoting access of women to engineering."

Prof. Antonino-Daviu describes for us a little bit about her professional and personal life, highlighting the importance for a researcher—even if she is a woman with children—to live abroad and work in other laboratories, underlining that "men can take care of their children as well as women."

When I was asked to write about my experiences, it was hard for me to think about what I could tell that would be interesting or impactful to other people. Of course, I will talk about the scientific achievements that led me to winning the 2019 IEEE Antennas and Propagation Society (AP-S) Lot Shafai Mid-Career Distinguished Achievement Award, which I consider a great acknowledgment for a midterm scientific hard-working career. At the time, I was 40 (just at the age limit) when I applied, and it was probably the right time to do so, as I was honored to receive such a prestigious award. Figure 1 shows a picture of my family and me at the 2019 IEEE AP-S awards ceremony after receiving the award.

As the daughter of a mathematics professor, I was raised with a very strict focus on education as well as important values like effort, dedication, sacrifice, a healthy ambition, and a love for well-done work. These values have been vital throughout my life and career, but in this article, I would like to remark on the importance of the person who mentors your career as well as the person with whom you share your life, especially when you are the mother of two kids (now seven and nine years old). I will tell you a little bit about my professional and personal life and why I think these people (two men, in my case) have had such a profound impact on my career.

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It all began in 2002 when I received an Erasmus grant to finish my M.Sc. degree in electrical engineering at the Institute of Radio Frequency Technology at the University of Stuttgart, Germany. Personally, I found that living abroad for seven months was an extraordinarily rewarding experience that allowed me to learn about life and culture in another country, something that I have always found very valuable for both personal and professional growth. During this time, I met my future husband, who at the time was a Spanish engineer working in a research center in Stuttgart. Despite having a few job offers in Germany, I decided to go back to València, Spain, mainly because I was not cut out for Germany's cold, cloudy winters!

So I returned to the Polytechnic University of València (UPV) to start pursuing my Ph.D. degree on the theory of characteristic modes (TCMs) under the supervision of Prof. Miguel Ferrando-Bataller, the head of the Electromagnetic Radiation Group at UPV. I met my supervisor a year earlier while completing an undergraduate grant with his research group for several months. Prof. Ferrando-Bataller's encouragement and his ability to convey his passion for the beauty of antenna research as well as his enthusiasm for research and hard work were crucial factors in me deciding to enroll in the Ph.D. program. I began my Ph.D. studies in 2003 after being awarded a four-year grant from the Spanish Ministry of Science.

FIGURE 1. My family and me during the award ceremony at the 2019 IEEE International Symposium on Antennas and Propagation in Atlanta, Georgia.

FIGURE 2. Me (back row, center) with some other members of the Electromagnetic Radiation Group in Washington, D.C. while attending IEEE AP-S 2005.

Since then, I have focused my research on the application of the TCMs to antenna design. This theory, originally introduced by Prof. Robert John Garbacz, Prof. Robert F. Harrington, and Prof. Joseph Mautz in the late 1960s [1]–[3], had slipped into oblivion and was virtually unknown within the antenna scientific community. Between 2003 and 2008, our research group revisited the TCMs and successfully applied it for antenna designs in modern applications. After developing our own method-of-moments-based program for the computation of CMs in perfect electric conductor bodies with arbitrary shapes, we realized the potential of CM attributes (eigenvalues, modal significance, and eigencurrents) and their physical interpretation as a foundation to

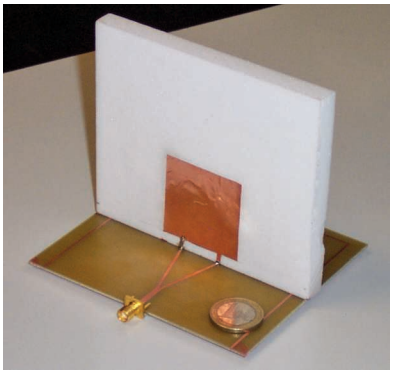

FIGURE 3. A prototype of the square monopole with double feed. (Used with permission from [5].)

perform systematic antenna designs. Moreover, our investigation also focused on the use of efficient mechanisms for the appropriate excitation of CMs, which led to an improvement of the antenna's behavior [4].

My supervisor has always encouraged me to attend international conferences (see Figure 2) and workshops to present and share our group's research. I traveled a lot during my Ph.D. studies and learned much from other researchers' work while establishing many interesting connections with members of the antenna research community. On a personal note, I can still remember my first conference, the 2004 IEEE AP-S International Symposium in Monterey, California, where I was stunned by the fact that only a few women were in attendance. As I soon observed, this was the rule at antennas and propagation conferences at the time, but today, it makes me happy to see how many more women attend international conferences or workshops. Luckily, things have changed a lot in 15 years.

In our research on the TCMs, we advocated for the application of CM analysis (CMA) to a systematic antenna design strategy based on the physical understanding of the potential radiating characteristics of antennas, a powerful aspect unmatched by other existing approaches. We proposed significant designs of antennas based on CMs, including a novel feeding technique for planar monopole antennas (the double-feeding technique, as displayed in Figure 3) [5], which substantially improves their performance. We also proposed different designs of multimode antennas based on

the use of multiple feeding ports [6] and worked on symmetry conditions for the excitation of modes in a mobile handset chassis [7].

At the 2004 IEEE AP-S Symposium, for the first time, I presented to the scientific community the CMs of a mobile phone chassis (see Figure 4) [8], a work that has garnered many citations and become a breakthrough in the design of antennas for mobile handsets. During the last decade, the CMs of

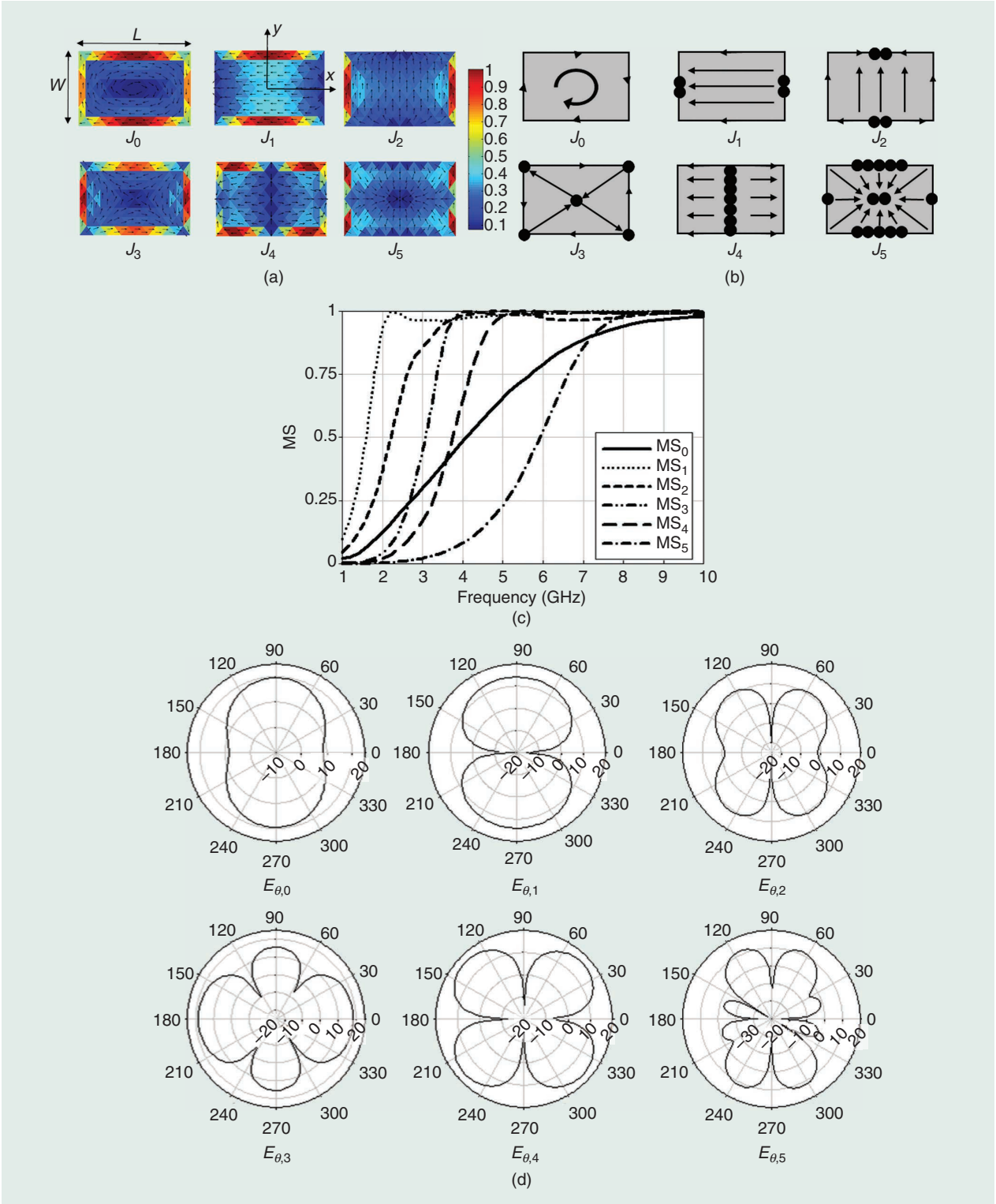

FIGURE 4. (a) The normalized current distribution at first resonance (f = 2.4 GHz) of the first six eigenvectors J_n of a metallic handset chassis of W = 4 cm and L = 6 cm. (b) The current schematics of the six modes. (c) The modal significance (MS) versus frequency for the six modes. (d) The radiation pattern associated with the six modes [4].

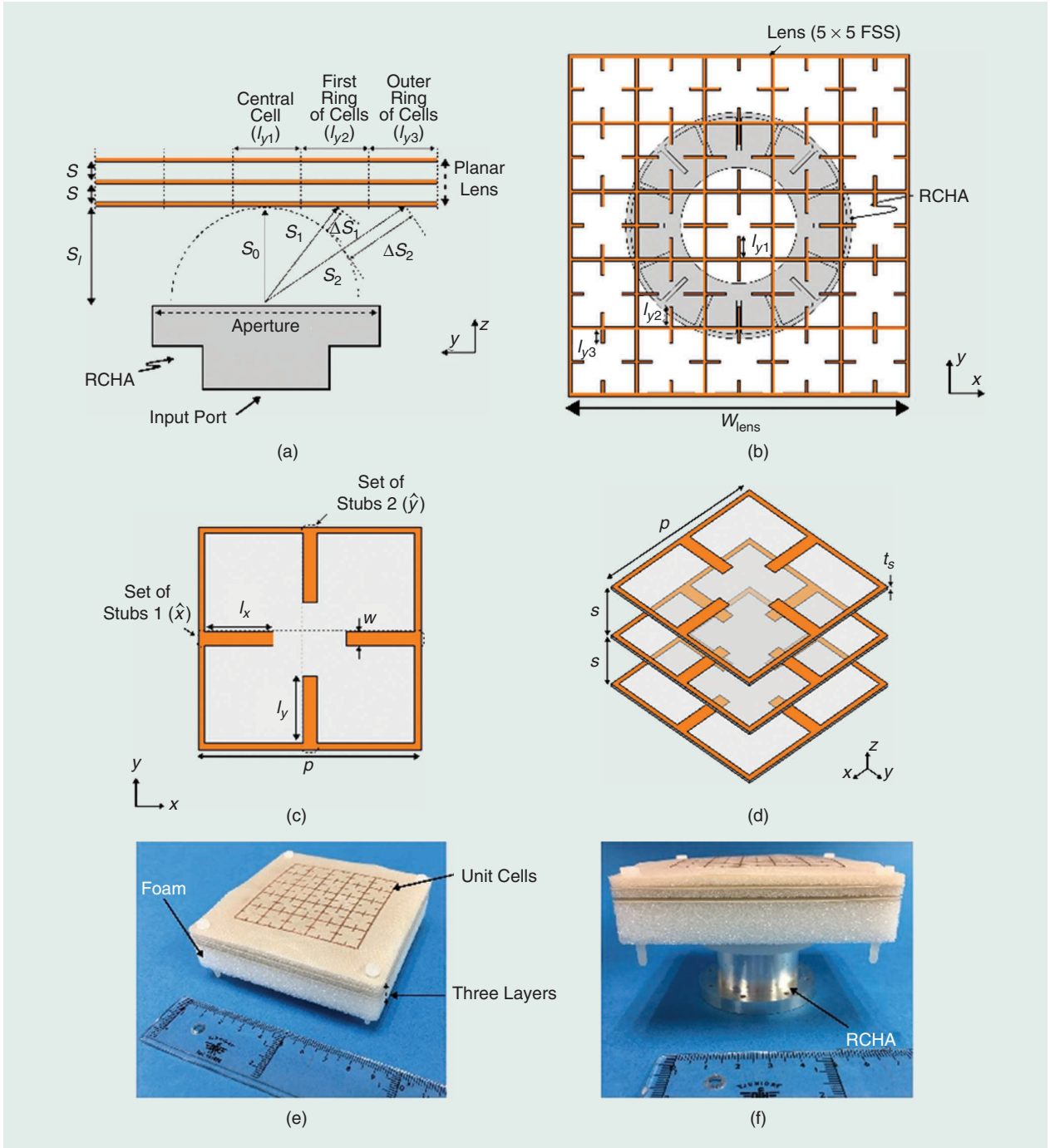

FIGURE 5. (a) A lateral view of the proposed 5 × 5 frequency-selective surface (FSS) illuminated by a radially corrugated horn antenna (RCHA). (b) The upper view. (c) The upper view of the unit cell of the proposed lens. (d) The three-layer unit cell. (e) The fabricated prototype of the three-layer lens. (f) The prototype lens fed by the RCHA. (Used with permission from [12].)

the chassis have mostly been used for the design of multiple-input, multiple-output terminals.

In 2005, I earned an assistant professor position at UPV and started acquiring experience as an academic lecturer while continuing my research. I ended my Ph.D. studies in 2008, the same year I married my husband who had moved back to Spain a few years earlier. Having a very supportive boyfriend—and later, husband—has helped me considerably and greatly contributed to my success.

After 2008, the useful and appealing properties of CMs and the ever-increasing computational power available spurred fast-growing interest on this topic within the antenna community [9]. As a result, CMA has become a powerful tool for antenna designs in the last decade, further boosted by the recent inclusion of CMA features in today's most successful commercial electromagnetic simulation

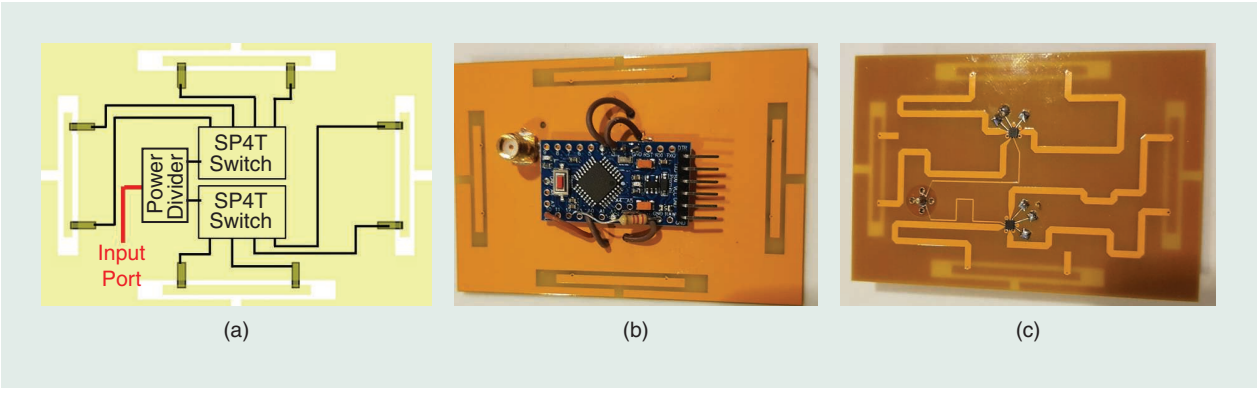

FIGURE 6. (a) The feeding scheme for a multimode antenna for IoT devices. (b) and (c) The upper and lower views of the prototype, respectively. (Used with permission from [13].)

packages, including CST, HFSS, and Altair FEKO. I have continued working intensively on the design of antennas using CMA, focusing my research on the systematic design of magnetic structures embedded in finite platforms [10], the design of lens antennas for 5G systems (e.g., in Figure 5) [11], [12], and the design of electronic-integrated antennas for Internet of Things (IoT) devices (as presented in Figure 6) [13], [14]. I have been very active in the diverse activities related to CMs, including courses organized by the European School of Antennas [15], the organization of convened sessions at several international conferences, participation in the special interest group on TCMs [16], and the presentation of invited papers on CMs at multiple international conferences.

As I mentioned previously, since my Erasmus experience as a student, I have always believed that living abroad and having the chance to work in other laboratories is vital for the further development of any career in research. In 2005, during my Ph.D. studies, I spent four months at IMST, Kamp-Lintfort, Germany, working on mobile handset antenna design.

In 2011, my daughter was born, and she was soon followed by my son in 2012. Of course, this had an undeniable impact on my career: even though I had a very helpful and supportive husband, two small children required a lot of attention, and I also wanted to enjoy being a mom. In those years, my scientific production decreased, and it took me a great deal of time and effort (much more than expected!) to get back into full-fledged research work.

Meanwhile, in 2012, I earned a permanent position as an associate professor at UPV, and afterward, I started to get involved in management activities by becoming the vice-director of research at the Institute of Telecommunications and Multimedia Applications [17] at UPV (2016) and the coordinator of the European Association of Antennas and Propagation Working Group on Small Antennas [18] (2018). I strongly believe that it is crucial to increase the visibility of women in management positions (especially in technical fields), and we must not shirk this responsibility.

Although I have been in a very comfortable academic situation, over the last several years, I have felt the need to continue growing and evolving as a researcher. Therefore, I decided to visit the Laboratory of Electronics, Antennas and Telecommunications at the University of Nice Sophia Antipolis, France, for two months in 2018, where I worked on the design of antennas for IoT devices using CMs (Figure 6) [13]. During this two-month research stay, I was in France on my own while my two kids stayed at home with my husband. He understood my need for continuous learning and eagerness for knowledge and has always supported my being abroad for lengthy periods of time. Of course, I had to cope with situations where some people (outside the university) told me that I should stay home and take care of my children instead of moving abroad, but this is something all women must endure until society accepts the fact that men can take care of their children as well as women. Prof. Ferrando-Bataller was also very supportive of this challenging adventure of being abroad for a research stay, and he has always encouraged me to move forward and leave my comfort zone.

My experience in France was so great from a research perspective that I decided to travel to the United States in 2019, where I spent four months in Prof. Manos Tentzeris' Agile Technologies for High-Performance Electromagnetic Novel Applications group at the Georgia Institute of Technology in Atlanta, working on additive manufacturing techniques [19]. After being on my own for the first two months, my husband and our two kids came to Atlanta and stayed there for the remaining two months. It was an unforgettable time for the whole family, especially for the kids, who learned a lot from this international and multicultural experience. Once again, I counted on the unconditional support of both my husband, who took two months of unpaid leave from his job to come to Atlanta, and my mentor, who strongly encouraged me to start this new adventure.

CONCLUSIONS

From my experiences, I have learned that having men in your life who encourage, support, and understand your needs and inquisitiveness is very important for women's success today—especially married women. In my case, I say "thank you" to these two men!

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