# Coming to America: My Journey From Greece to the United States and to the Fascinating World of Electromagnetics and Antennas

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Many of you are familiar with my research-related publications and the books I authored, as they are used worldwide as textbooks in electromagnetic (EM) and antenna classes. While I am fortunate to have pursued professionally the path of research and teaching, it was not planned when I started my life as a young man. This article is about my journey from Greece as a teenager immigrating to the United States and overcoming various obstacles, including the language barrier, to study and pursue a challenging and rewarding career as an electrical engineering and EM researcher and teacher. It is intended to provide motivation and inspiration to IEEE Young Professionals who are pursuing their graduate studies and early careers. With intellectual curiosity, determination, and hard work, success comes your way! This article is an extended version of my interview broadcast originally on 4 May 2021 by the IEEE Electromagnetic Compatibility (EMC) Society [1].

## EDITOR'S NOTE

CJ Reddy

In this issue of *IEEE Antennas and Propagation Magazine*, we are very fortunate to have an invited article by Prof. Constantine A. Balanis on his journey from Greece to the United States as a young man with very little knowledge of English and becoming a world-famous researcher and author of an antenna book that is used as a reference and textbook in numerous antenna classes around the world. This is an inspiring story for all IEEE Young Professionals around the world to read and take motivation from. I would like to thank Prof. Balanis for taking the time and contributing such a great article for the column.

We have many more exciting articles planned for this column in future magazine issues. Anyone who would like to contribute to the "Young Professionals" column or has 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 IEEE Antennas and Propagation Society Young Professionals.

## COMING TO AMERICA

The plan for my journey from my native country, Greece, to the United States began in the early 1950s and materialized in March 1955. After World War II, many European countries, especially Greece, were experiencing poverty due to the aftermath of the war. To overcome family financial issues, some people decided to emigrate to other countries. The countries that many Greeks left for were the United States, Australia, Canada, Germany, and South Africa. Australia, Canada, Germany, and South Africa were considered, at that time, "open countries" to immigration.

At that time, I had an uncle, one of my father's brothers, who had arrived in the United States in the early 1920s. Since my parents had seven kids, my uncle asked my parents whether he could invite one of my parents' three boys to the United States to eventually help the family financially. After my parents accepted the invitation, my older brother, when asked to be the one, decided not to travel abroad.

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Since I was the second in line, I jumped at the opportunity. The entire process of getting the visa and clearing other obstacles took a few years. However, finally, all the papers were completed, and my trip to the United States was finalized, and it took place in March 1955. The mission of most, if not all, was to "work, not play." We knew that and accepted it. My ultimate destination was Newport News, VA, USA, where my uncle and his family lived.

Since, at that time, there were no transatlantic flights, travel was mostly accomplished by ships, and so it was in my case. The ship that I traveled on to the United States, *New Greece*, shown in Figure 1(a), departed Greece in the late afternoon on 5 March 1955; in Figure 1(b), you can see me highlighted on the right side of the photo. The ship brought more Greek immigrants to the United States than any other ship; sadly, this was its last trip from Greece to the United States.

Our first destination, after departing Piraeus, Greece, was the island of Malta. After leaving Malta in the evening, we passed at night the straights of Messina, Italy, and arrived in the morning at Naples, Italy. Because the ship had some propeller problems, we stayed at Naples 10–12 h for the propeller issues to be resolved. Because I was seasick—it was my first time on a ship, especially traveling such a long distance—I disembarked and went nearby to buy some oranges; I made sure I came back before the ship departed.

**While I am fortunate to have pursued professionally the path of research and teaching, it was not planned when I started my life as a young man.**

After departing Naples, our next destination was Halifax, NS, Canada. Many passengers were going to disembark at Halifax, as it was their final destination; remember, Canada was an "open country," and it was easier to emigrate to. All was well while cruising in the Mediterranean, until we arrived at and passed the straights of Gibraltar and entered the Atlantic Ocean, and the ship basically became a "dolphin," especially during the month of March. For some of us who were not used to the Atlantic's waves and turbulence, it was a rough time. At night time, maybe 2–3 days before we arrived in Halifax, we could see the lights on the mainland, and many of us could not wait to put our feet on "solid ground." Finally, after "trials and tribulations," we arrived in Halifax. Wow! At Halifax, most of the passengers were not allowed to disembark; only those whose destination was Canada were permitted off the ship.

After leaving Halifax, the ship's next and final destination was New York City, NY, USA. Since it was the weekend, the ship slowed down so that it would arrive on Monday, avoiding having to deal with immigration and other issues over the weekend. Finally, early Monday morning, 21 March 1955, we were one of the first ships to enter New York Harbor. As the ship was entering the harbor, it passed to the right of the Statue of Liberty and Ellis Island. In the background, we could see Manhattan and the Empire State building, which we had all read about and now were a reality! It was a momentous occasion for many of us. The ship finally docked at Manhattan, as Ellis Island had closed, on 12 November 1954. As we docked, I looked over the ship and saw my uncle, who was waiting for me. After disembarking, I remember that my uncle took me to Macy's, in New York; what an experience for me to have Macy's be the first store I visited and shopped at in the New World; those are pleasant and "cemented" memories. As a validation of our arrival in New York and the New World, I am attaching the ship's manifesto, with its name, dates, and places of departure and arrival, and its list of passengers. My name, listed as "Balanis, Konstantinos" (Konstantinos translates

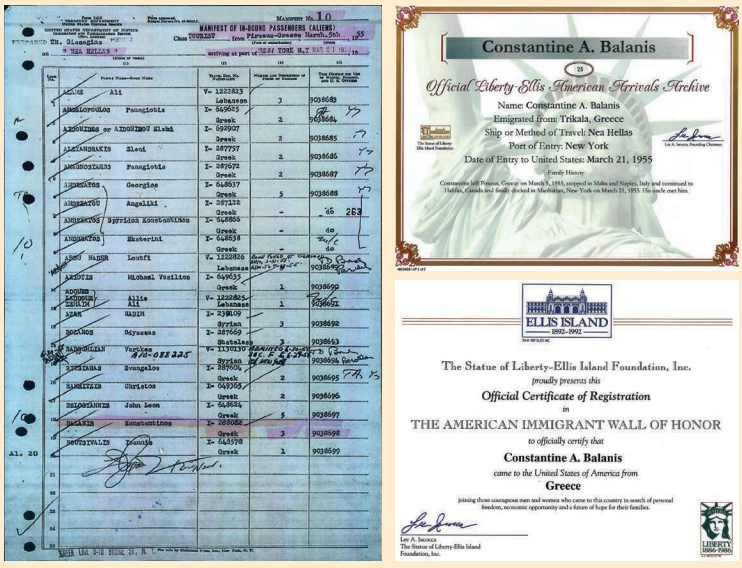

(a) (b)

**FIGURE 1.** The *New Greece* before departure for the United States from Piraeus, Greece, on 5 March 1955. The (a) overall view and (b) stern view (author highlighted in upper right: Me).

to Constantine in English), is highlighted next to the last one on page 10 of the manifesto (Figure 2). Also, I am including a couple certificates from the Ellis Island Foundation as evidence of our arrival in the New World. My name and that of my uncle are listed on the American Immigrant Wall of Honor, on Ellis Island, on plaque 25.

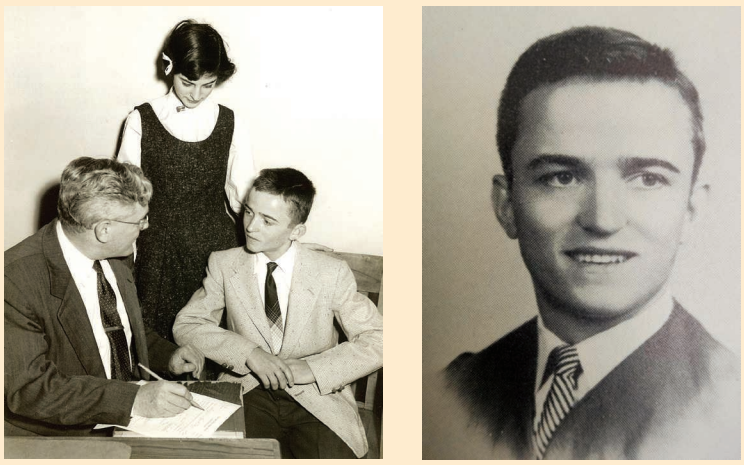
Late on 21 March 1955, my uncle and I flew, aboard a propeller-driven small airplane, from New York City to Newport News. Since I did not know English, after about one week, I was enrolled in Newport News High School (NNHS). See the photo in Figure 3(a) of my first day at NNHS, with Assistant Principal Thomas O. Keesee and my first cousin Priscilla. Since it was already the end of March, the main mission in high school was to sit in classes and listen to lectures and discussions, with not much understanding and participation initially. Because I came as a 10th grader in the middle of the semester and did not know the language, I stayed an extra year in high school to make up for the loss of time and learn the English language better. Finally, I graduated in 1958. While I was at NNHS, I experienced an unprecedented welcome from the teachers and students. A couple of the teachers took time from their classes to teach me English; in one of the classes, taught by a drama teacher, I was going once a week for 2 h solely to learn English. Where in the world will teachers from regular classes take the time to teach an immigrant English? As they say, "only in America, a great country."

After my June 1958 high-school graduation, I worked for my uncle in a clothing store; that was the objective of me coming to America. However, after a couple of years, my uncle took the initiative to ask me whether I wanted to attend college, as many of my high-school friends had done so. This was an "opening/initiative" on my uncle's part, and I "jumped" on it, as initially, there were no plans to attend university/college; I had come to work and help financially my family in Greece. So, in 1960, the year I became a U.S. citizen (in June), I began to attend Virginia Tech; during my freshman year, I was enrolled as a math major and switched to electrical engineering at the start of my sophomore year. I graduated in 1964 and had job offers from many companies and agencies, including IBM, GE, NASA, and others; I chose to join the NASA Langley Research Center (LaRC), Hampton, VA, USA, starting in June 1964. While at Virginia Tech, I was active in professional and honorary societies, such as IEEE, Eta Kappa Nu, Tau Beta Pi, and Phi Kappa Phi, and I also served as an officer in both IEEE and Eta Kappa Nu. This activity was an invaluable experience, as it gave me an opportunity to interact with




(a) (b)

**FIGURE 2.** The (a) *New Greece* manifesto of the author's trip from Piraeus (5 March 1955) to New York (21 March 1955) and (b) Ellis Island Foundation certificates of arrival in the New World.



(a) (b)

**FIGURE 3.** The NNHS. (a) The author's first day (with Assistant Principal Thomas O. Keesee and his cousin Priscilla), in March 1955. (b) The author's graduation photo from June 1958.

classmates and faculty; until recently, I still exchanged messages with the faculty advisor of Eta Kappa Nu, where I had served as student vice president of the chapter. One of the elective classes that I took during my senior year, on microwaves, had a laboratory. I really liked its laboratory, and ultimately, that was the decisive factor in determining which area I would pursue as a professional; it was EM: antennas and microwaves.

## PROFESSIONAL AND ACADEMIC CAREER

### *NASA LaRC (1964–1970)*

After graduating from Virginia Tech (Figure 4), in June 1964, I joined the NASA LaRC. The NASA LaRC is the oldest NASA center, founded in 1917. NASA was originally called the National Advisory Committee for Aeronautics (NACA); on 1 October 1958, it was renamed NASA, due to space-related activities. At NASA, I was asked as to which area I was interested in working, and I chose to join the microwave section, due primarily to my interest in EM and my experience in my undergraduate microwave class and its associated laboratory. During my tenure in the microwave section, I chose initially to work in millimeter technology. My first project was to investigate and measure, at millimeter frequencies, the dielectric properties of materials, such as Teflon, polystyrene, and plexiglass/Lucite. To perform the millimeter-wave measurements, I designed, and had fabricated, a Fabry–Pérot interferometer cavity to operate in the 60–90-GHz region, a unique design and fabrication. The microwave source selected was a klystron, which was placed in an oil bath container to maintain the structure at a nearly constant temperature to keep the klystron resonator dimensions nearly constant for frequency stability. The measurements obtained were the first of their kind, and they were used to extend the frequency range of the tables of data contained in the classic handbook by Von Hippel [2]. The obtained results were published in *Microwave Journal* [3]. After a three-year tenure in the microwave section, I joined the antenna section, due to my interest in antenna technology. During my tenure in the antenna section, I worked primarily on extending and applying the geometrical theory of diffraction, an extension of geometrical optics, to complex structures, including, eventually, airframes. It was a most exciting time to work at NASA during the 1960s, as it was the peak of the U.S. space program, including Alan Shepard's mission as the first American in space, on 5 May 1961; John Glenn's orbit of Earth, on 20 February 1962; and, ultimately, on 20 July 1969, Neil Armstrong's *Apollo 11* landing on the moon.

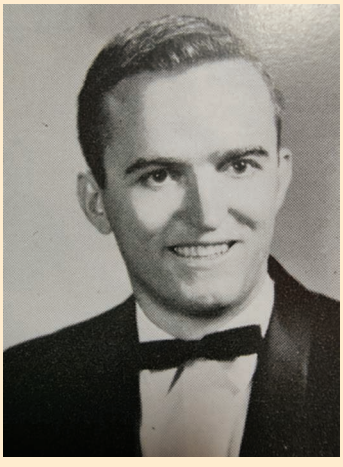
While at NASA, I was able to obtain advanced degrees through the NASA graduate program: my M.S. degree in electrical engineering (1966) from the University of Virginia and my Ph.D. degree (1969) from The Ohio State University (OSU). Also, at the NASA LaRC, there was a graduate program offered by George Washington University (GWU) whereby NASA employees could take graduate classes to pursue advanced degrees (M.S. and Ph.D. degrees) and for professional development. The GWU classes were taught primarily by NASA employees. I was asked, by the GWU graduate program, to teach, on a part-time basis, a couple classes on antennas. I really enjoyed doing this, even on a part-time basis, and this experience piqued my interest in teaching, which eventually led to my full-time teaching career.

### *WEST VIRGINIA UNIVERSITY (1970–1983)*

My tenure at NASA was outstanding, and I really enjoyed my colleagues and administrators and the topics that I worked on. However, my part-time teaching for GWU of a couple classes at NASA piqued my interest in a full-time academic career. This became a reality when the Department of Electrical Engineering at West Virginia University (WVU) invited me to present a seminar and offered me a full-time position, which I eventually accepted. When, in July 1970, I announced my departure from NASA, I told my superiors at NASA that if I did not like full-time teaching, I hoped they could take me back. I guess it worked out, and I never looked back! When I joined the electrical engineering faculty, it was the start of my full-time academic career, which lasted 50.5 years: 13 years at WVU and 37.5 years at Arizona State University (ASU). In addition, I had a six-year tenure with NASA.

While at WVU, I was able, with my colleagues, to revisit and revise the EM curriculum, including undergraduate and graduate EM classes. We initiated new

(a)



(b)

**FIGURE 4.** The author's graduation in electrical engineering from Virginia Tech, in June 1964. (a) The author's uncle and aunt at the graduation. (b) The author's graduation photo.

graduate classes in EM, antennas, and microwaves. Since the Department of Electrical Engineering at WVU did not have many EM faculty, I taught, at one time or another, all of the classes, undergraduate and graduate. Because of this experience, I was able to develop notes in preparation for the lectures, especially for antenna-related classes. In addition, we initiated and expanded research in EM with sponsorship from the NASA LaRC, Federal Aviation Administration (FAA), Bureau of Mines, and National Radio Astronomy Observatory in support of the astronomical observatory facility at Green Bank, WV, USA, including its 100 × 110-m reflector. For the FAA, our research activities were to investigate and identify the best locations to position antennas on modern aircraft, such as the Boeing 737 and others, for the newly developed FAA Microwave Landing System (MLS), with its scanning beam concept of ±60° azimuth and 0–30° elevation coverages and operation around 5.1 GHz; see Figure 5. The MLS was to replace the fixed- and narrow-beam Instrument Landing System, introduced in 1949. Because of our research activities in support of the MLS, the FAA bestowed on my research group the 1976 William E. Jackson Memorial Award, sponsored by the Radio Technical Commission for Aeronautics, for a master's thesis, "Analysis of Aircraft Radiation for Microwave Landing System," by Yuk-Bun Cheng. In addition, because of our activities related to the MLS system and research funded by the FAA, I was invited to join, in 1983, a U.S. government delegation on aeronautics to the People's Republic of China, where we visited and lectured at a number of agencies; see Figure 6(a) for a photo of me with some of our Chinese hosts. Our stay in China lasted about three weeks, mostly visiting and lecturing.

While at WVU, I built a room-size anechoic facility to complement and verify some of our antenna-related analytical predictions and simulations. Also, during this period, we invited, through our local IEEE Chapter, a number of renowned speakers, including Prof. John D. Kraus, an antenna pioneer and author of the classic antenna book *Antennas*, first published in 1950; see Figure 6(b).

While teaching EM-related classes at WVU, especially those on antennas, I was developing notes related to the class lectures. Even though there were good books on antennas, and I used a few of them as either a student or a teacher, it seemed that none fit my sequence and contents of presentation. This is a natural tendency in almost all of us, as we all

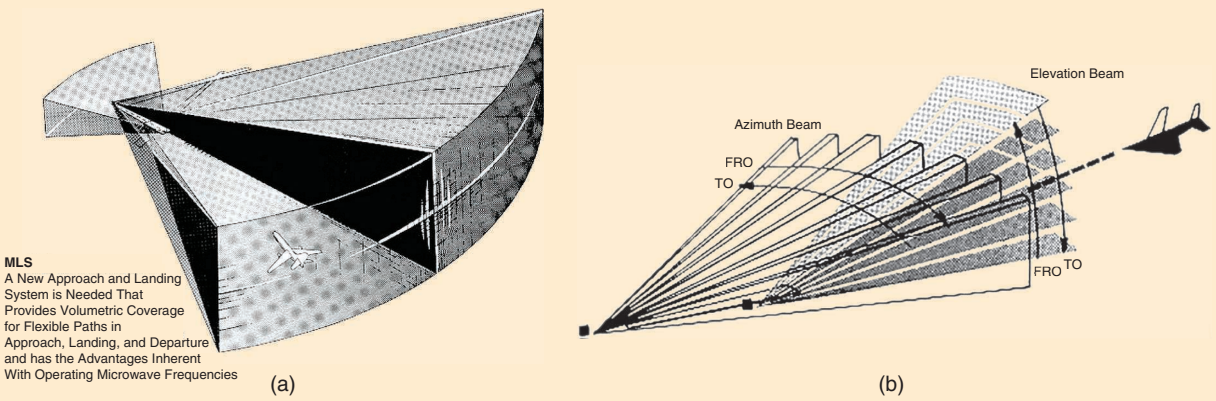



**FIGURE 5.** The FAA MLS: the (a) overall coverage and (b) scanning beam concept. FRO TO: Forward and backward.

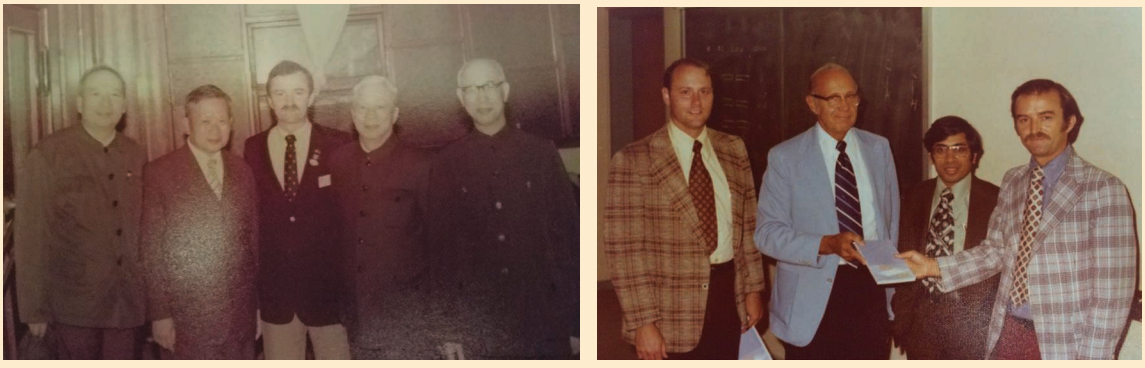



**FIGURE 6.** (a) The author (center) with his hosts in China (spring 1983). (b) Prof. Kraus (second from left) at WVU and the author (right).

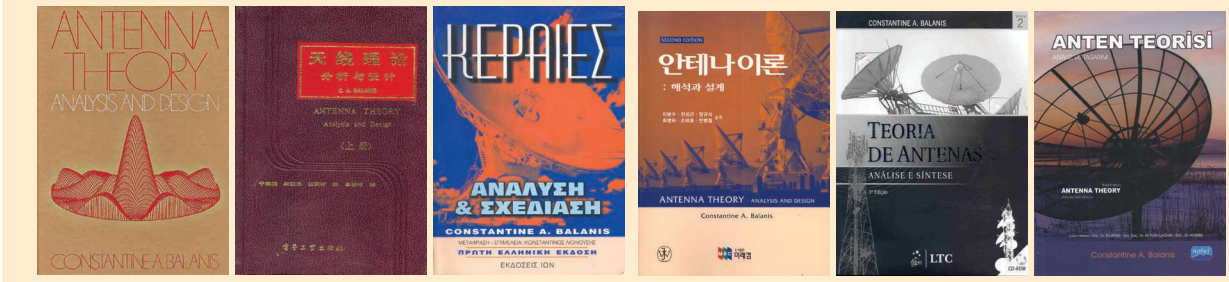



**FIGURE 7.** The first edition of *Antenna Theory: Analysis and Design* (1982) and the associated five translations of the first, second, and third editions: (a) English, (b) Chinese (first edition), (c) Greek (second edition), (d) Korean (second edition), (e) Portuguese (third edition), and (f) Turkish (third edition).

have our own style of presentation and teaching. Therefore, around the mid-1970s, I decided to undertake another major task: write a book on antennas, a topic for which I developed a technical, rewarding, and enriching interest. It took me quite a few years, about five or six, before this monumental task came to fruition; it was a daunting undertaking, as it was my first such venture, but at the end, it was very fulfilling and gratifying. The notes, after review and revisions, were converted and published as a first edition, in 1982, of a book, *Antenna Theory: Analysis and Design*; see Figure 7(a). There were three additional editions of the book: second (1997), third (2005), and fourth (2016); the fourth edition was in color; see Figure 8. The book was well received as a textbook and as a reference, and eventually, it was translated into five languages: Chinese, Greek, Korean, Portuguese, and Turkish. The first edition of the book in English and the associated five translations are displayed in Figure 7. From all the tasks that I have undertaken in life, and there have been quite a few, the publication of this book, especially with it being my first venture, was very pleasing and gratifying, and it certainly made my top 5 list.

### *ASU (1983–2021)*

After spending 13 years at WVU, it was time to make a major decision: stay at WVU forever or make one more, and final, move. My *Antenna Theory: Analysis and Design* book was used worldwide as a textbook at many colleges and universities; the publisher (Wiley) and I estimated that, at one time or another, the book was adopted as a textbook at about 2,000 universities and colleges worldwide. One U.S. university that used it as a textbook was ASU. In the early 1980s, the College of Engineering (CoE) at ASU, now referred to as the Fulton School of Engineering (FSE), was undergoing a major makeover: it was transitioning from a primarily teaching university to a major education and research center. This was necessitated by the local high-tech industry in the Phoenix, AZ, USA, metropolitan area. Major high-tech companies, such as Motorola, Intel, Boeing Helicopters (formerly McDonnell Douglas), Honeywell, and others, were expanding and wanted their employees to attend a major university for advanced degrees and professional development.

In the early 1980s, one of the antenna/EM professors at the ASU CoE was Prof. Thomas E. Tice, who also served at as chair of the ASU Department of Electrical Engineering. Prof. Tice was at OSU for many years and got his Ph.D. degree in antennas there; Prof. Kraus was his advisor. Prof. Tice also served at OSU as director of the ElectroScience Laboratory (initially known as the Antenna Laboratory) before moving to the Phoenix area, initially at Motorola and eventually joining ASU. Prof. Tice was the one who was primarily teaching the antenna classes at ASU and using my antenna theory book. The expanded research activities in the ASU CoE along with the presence of Prof. Tice, an OSU fellow alumnus, are what attracted me to ASU. After some communications, I was invited to visit ASU, where I gave a seminar, and the trip ultimately resulted in an offer as a full professor of electrical engineering, which I eventually accepted, joining ASU in August 1983; bestowed the Distinguished Regents Professorship in 1991.

One of the first things that we did when I joined ASU was review and update the electrical engineering EM curriculum and undergraduate and graduate courses. The Department of

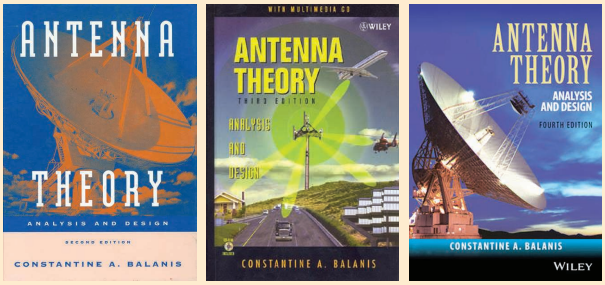
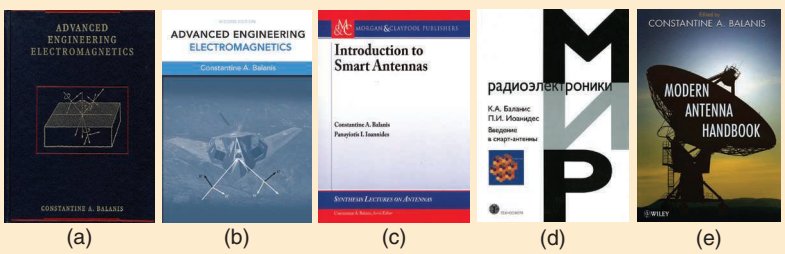



**FIGURE 8.** The (a) second (1997), (b) third (2005), and (c) fourth (2016) editions of *Antenna Theory: Analysis and Design*.

Electrical Engineering at ASU, even in the early 1980s, had remote TV/online classes. They were called "TV" classes because they were broadcast locally to about 15 locations of high-tech companies in the Phoenix area, using a microwave link; later, when the Internet was introduced, they were expanded to national and international audiences and were now and then referred to as "online" classes. I took an active role in the preparation and presentation of TV/online classes, both undergraduate and graduate. Eventually, I had prepared notes and delivered and taped five classes: two antenna classes (one undergraduate and one graduate) and three graduate EM classes; one of the EM classes was on advanced topics in EM radiation. These classes were taught on a regular basis. As a result of the preparation of notes for the graduate EM classes, especially delivered as TV classes, I developed notes that eventually were converted to a manuscript. It was published, in 1989, as *Advanced Engineering Electromagnetics*, now in its second edition; see Figure 9(a) and (b). This book was also well accepted and adopted as a textbook as well as a reference book at about 600 universities and colleges worldwide; the book was revised to its second edition in 2012 and presently (2022) has about 12,000 Google Scholar citations. In addition, during the early 2000s, I coauthored a short book, *Introduction to Smart Antennas* [2007; Figure 9(c)], which was translated to Russian in 2012 [Figure 9(d)]; I also edited a handbook, *Modern Antenna Handbook* [2008; Figure 9(e)].

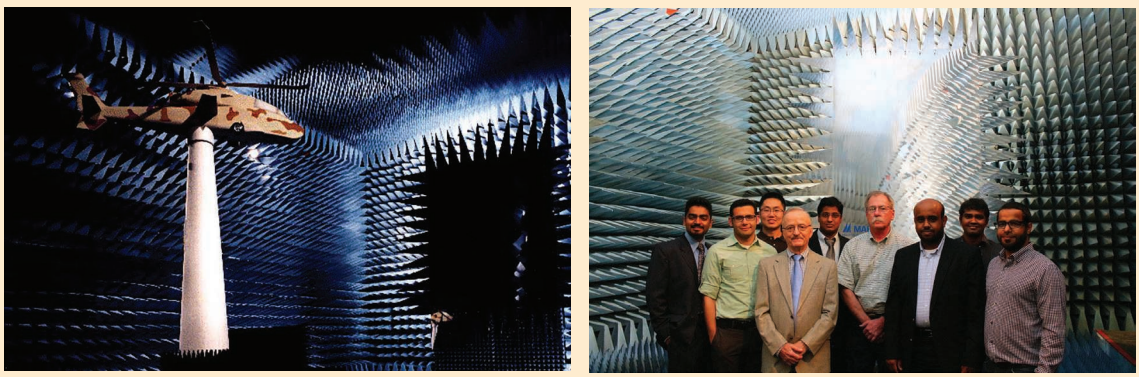
A major and pride-inspiring accomplishment during my academic tenure was the publication of *Antenna Theory: Analysis and Design*, whose first edition was published in 1982 [Figure 7(a)] and translated into five languages [Figure 7(b)–(f)]. The success of the book, as a text and reference book, is evident from its nearly 40,000 Google Scholar citations as of 2022, a very high number of citations for a book on a specialized topic, such as antennas. The book was revised three times after its initial publication, in 1982: second edition [1997 Figure 8(a)], third edition [2005 Figure 8(b)], and fourth edition [2016 Figure 8(c)]; the fourth edition was published in color.

One of the commitments made by both sides during my interview at ASU was to build an antenna measurement facility, an antenna anechoic chamber. This "pledge" was fulfilled in the mid-1980s (around 1985) when the ASU ElectroMagnetic Anechoic Chamber (EMAC) was completed and became operational (http://balanis.faculty.asu.edu/EMAC); see Figure 10(a). The EMAC is a modern and spacious facility with compact range capability and a quiet zone of nearly 3 m. The facility was completed and became operational with funding from the Office of Naval Research (ONR) and matched by ASU and with major donations from March Microwaves, The Netherlands (Dr. Joe Vokurka, then president), which contributed the compact range cylindrical reflector and associated software, and the NASA LaRC, which gave instrumentation and microwave absorbers used to line the walls. The facility became an indispensable laboratory for developing and supporting antenna and EM research funded by industry and government as well as for measurements performed in support and verification of designs and analytical and




(a) (b) (c) (d) (e)

**FIGURE 9.** *Advanced Engineering Electromagnetics*: the (a) first edition (1989) and (b) second edition (2012). *Introduction to Smart Antennas*: the (c) English edition and (d) Russian translation. (e) *Modern Antenna Handbook*.



(a) (b)

**FIGURE 10.** (a) The ASU EMAC facility with a cylindrical compact range reflector. (b) The author (fourth from left) and Craig R. Birtcher (fourth from right) with a few graduate research assistants, in 2015. From left: Anuj Modi, Mikal A. Amiri, Wengang Chen, the author, Subramanian Ramilingam, Craig R. Birtcher, Saud Saeed, Sivaseetharaman Pandi, and Mohammed Alharbi.

simulated data of many ASU antenna/EM graduate students pursuing M.S. and Ph.D. degrees. Over 35+ years, the facility was managed by Craig R. Birtcher, featured in Figure 10(b), which shows me and a few graduate research assistants, in 2015, inside the EMAC facility, in front of the compact range reflector.

During my 37.5-year tenure at ASU, I had many research projects funded by government and industry. One of the major projects was the ASU Advanced Helicopter Electromagnetics (AHE) program, a three-way partnership among industry, government, and ASU; see Figure 11. The AHE program's industry and government members were Boeing Helicopters, Sikorsky, Rockwell International, Trivec-Avant, IBM, the NASA LaRC, the Naval Air Warfare Center, the U.S. Army Aviation Applied Technology Directorate (AATD), the Space and Naval Warfare Systems Center, the Army Research Office, and the U.S. Army Communications Electronics Command. The mission of the AHE industry/government/ASU consortium, as its name implied, was to focus on research, develop technologies, and support EM projects related to helicopters. Some of the topics and associated results are displayed in Figure 11: antenna technology (microstrips, flexible and reconfigurable designs, and cavity-backed slots), flexible and curvilinear high-impedance surfaces (HISs), metasurfaces for antenna performance enhancement, checkerboard HIS designs for radar cross-section control, GPS antennas, rotor modulation, cosite interference, high-intensity radiated fields, composite materials, computational EM, smart antennas, measurements, and others. The program was initiated on 1 January 1990 and lasted 28 years. The long tenure of the program was aided by the interest and support of many individuals and their companies and centers, especially those of Dennis DeCarlo, NAVAIR, Patuxent River, MD, USA, and George C. Barber, Army AATD, Ft. Eustis, VA, USA.

## PROFESSIONAL DEVELOPMENT AND SERVICE, AWARDS, AND HONORS

One of the objectives in an academic and professional career is to become active in and support professional societies. In the area of EM, antennas, and microwaves, the professional society is IEEE; formerly the Institute of Radio Engineers, which, on 1 January 1963, merged with the American Institute of Electrical Engineers and was renamed IEEE. I became active in IEEE as a Student Member, starting in 1962 as an undergraduate electrical engineering sophomore; I became an IEEE Member in 1968, Senior Member in 1974, Fellow in 1986, and Life Fellow in 2004. I took active roles at the local, national, and international levels. I attended

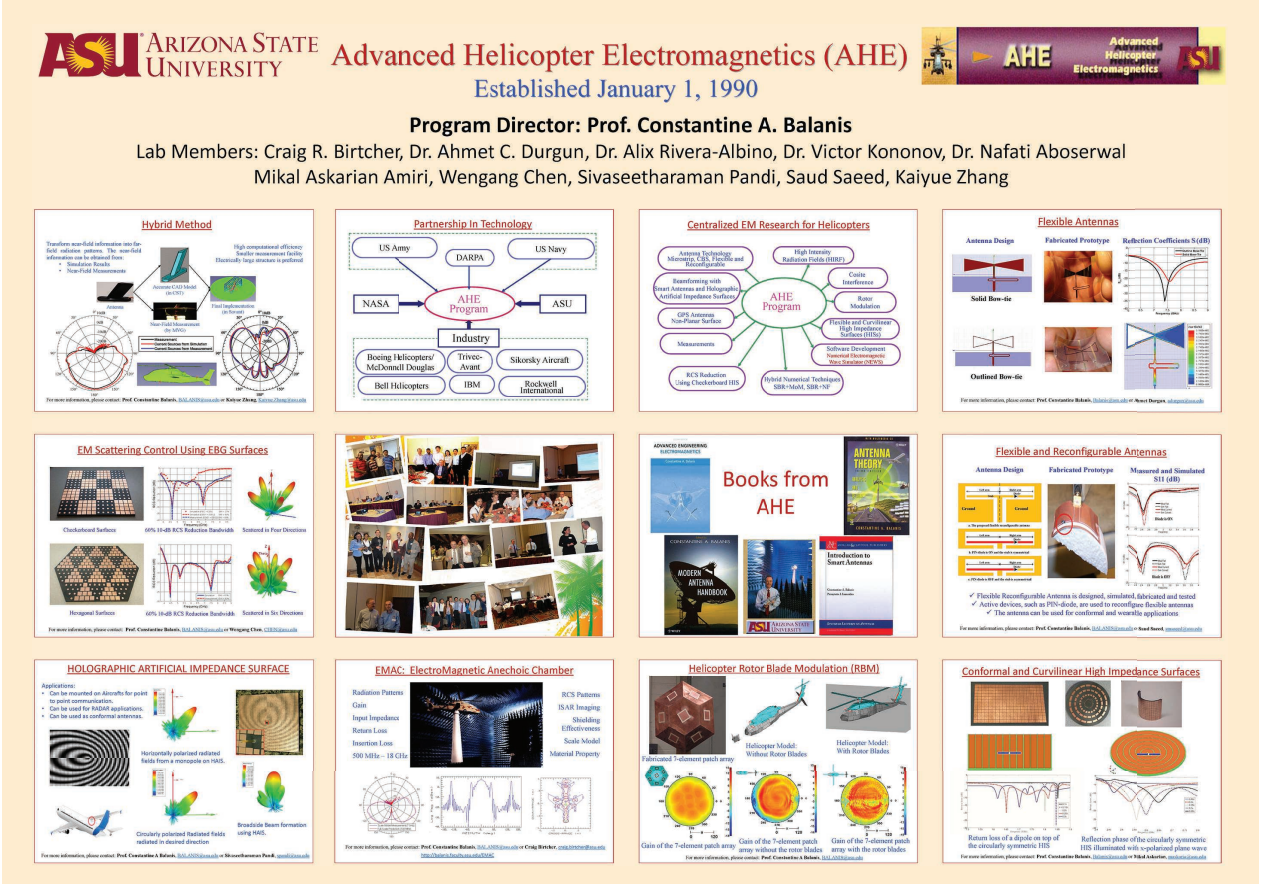



**FIGURE 11.** The ASU AHE program: a three-way partnership of ASU, industry, and government. HIRF: high-intensity radiated field; HIS: high-impedance surface; RCS: radar cross section; MOM: method of moments; ISAR: inverse synthetic aperture radar; dBsm: decibels per square meter.

IEEE-supported local, national, and international conferences and symposia, especially those supported by the IEEE Antennas and Propagation Society (AP-S), IEEE Microwave Theory and Technology Society, IEEE Electromagnetic Compatibility Society, and IEEE Geoscience and Remote Sensing Society.

The one IEEE Society in which I took a most active role and published extensively in its transactions and *IEEE Antennas and Wireless Propagation Letters* was the AP-S. The first IEEE conference that I attended and where I presented at my first paper was the 1969 IEEE International Symposium on Antennas and Propagation (APS), held in Austin, TX, USA. Even though I was well prepared to deliver the paper, I was "terrified" knowing that the session would be attended by those that I had read about and respected for their contributions. As it turned out, it worked very well. Basically, those that ask questions do so not to embarrass the speaker but, rather, to make the presentation interesting. During that symposium and many of the others that followed, I met many other colleagues and with some even became friends, too many to name. Since the first one in 1969, I attended all of the APSs except the one in 2014; I developed a conflict during that period.

I took an active role also in publishing as well as serving the AP-S at different levels. In particular, I served as associate editor of *IEEE Transactions on Antennas and Propagation* (1974–1977) and *IEEE Transactions on Geoscience and Remote Sensing* (1981–1984); editor of *IEEE Geoscience and Remote Sensing Magazine*, which, at the time, was a newsletter (1982–1983); second vice president (1984) and member of the GRSS Administrative Committee (AdCom) (1984–1985); and Distinguished Lecturer (2003–2005), chair of the Distinguished Lecturer Program (1988–1991), member of the AdCom (1992–1995 and 1997–1999), and chair of the Awards and Fellows Committee (2009–2011) within the AP-S.

Because of my technical and educational contributions, I was recognized with many awards. Some of the most notable are listed in the following in chronological order, starting with the most recent:

- 2021 IEEE Electromagnetics Technical Field Award
- 2017 IEEE Rudolph E. Henning Distinguished Mentoring Award
- 2014 James R. James Lifetime Achievement Award of the Loughborough Antennas and Propagation Conference
- 2012 Distinguished Achievement Award of the IEEE AP-S
- 2012 Distinguished Achievement Alumnus Award from the OSU CoE
- 2005 Chen-To Tai Distinguished Educator Award of the IEEE AP-S
- 2000 IEEE Millennium Award
- 1996 Graduate Mentor Award of ASU
- 1992 Special Professionalism Award of the IEEE Phoenix Section
- 1989 Individual Achievement Award of IEEE Region 6


**FIGURE 12.** The 2021 IEEE Electromagnetics Technical Field Award: the (a) description, (b) and (c) medal, (d) presentation of the award to the author by IEEE President K.J. Ray Liu, and (e) author and his wife, Helen, at the ceremony.


**FIGURE 13.** The presentation of the 2004 AUTH honorary doctorate: (a) Dr. John G. Antonopoulos, AUTH rector (left) with the author and (b) address to AUTH faculty and attendees.

- 1987–1988 Graduate Teaching Excellence Award from the ASU School of Engineering.

The most recent one, and perhaps the most notable, is the 2021 IEEE Electromagnetics Technical Field Award, which recognizes individuals for contributions to the theory and/or applications of EM. In my case, as shown in


**FIGURE 14.** Scenes from sports venues and AP-S symposia (2005–2022): (a) St. Andrews Old Course (1988 International Geoscience and Remote Sensing Symposium); (b) Pebble Beach Golf Links (2013 International Symposium of the Applied Computational Electromagnetics Society); (c) Coeur d'Alene Resort Golf Course (2011 APS); (d) Puerto Rico (2016 APS); (e) Coeur d'Alene Resort Golf Court (2022 IEEE Global Electromagnetic Compatibility Conference); (f) 1999 Fiesta Bowl; (g) Super Bowl XLIX; (h) 2006 Notre Dame football game tailgating; (i) 2005 APS, Washington D.C., USA; (j) 2012 APS, Chicago, IL, USA; (k) 2012 APS, Chicago; (l) 2019 APS, Atlanta, GA, USA; (m) 2022 APS, Denver; and (n) 2022 APS 2022 Denver.

Figure 12(a), it was awarded "for contributions to electromagnetics through excellence in book authorship, teaching, and antenna research." The award includes a certificate as well as a medal, picutred in Figure 12(b) and (c). The medal in Figure 12(b) includes four of Maxwell's Equations in differential form and the cross section of a horn antenna with its internal electric field distribution, taken from my book *Antenna Theory: Analysis and Design*. The initiator of the award and designer of the medal, Dr. Kiyo Tomiyasu, a colleague and dear friend, sent me an e-mail, on 23 January 2008, concerning the design of the medal and, in particular, the inclusion of the horn antenna with its internal field distribution from my *Antenna Theory: Analysis and Design*, and he said, "Didn't you think the horn looked familiar?" The award was presented to me at the 2022 IEEE APS, held in Denver, CO, USA, on 10–15 July 2022; see Figure 12(d) and (e).

While all the awards are very special, one that comes from your native country is also most notable. In 2004, the Aristotle University of Thessaloniki (AUTH) bestowed upon me an honorary doctorate (see Figure 13) for "ΕΞΑΙΡΕΤΗ ΠΡΟΣΦΟΡΑ ΤΟΥ ΣΤΗ ΘΕΩΡΙΑ, ΤΙΣ ΕΦΑΡΜΟΓΕΣ ΚΑΙ ΤΗ ΔΙΔΑΣΚΑΛΙΑ ΤΟΥ ΕΛΕΚΤΡΟΜΑΓΝΗΤΙΣΜΟΥ," which translates to "his excellent contribution to the theory, applications, and teaching of electromagnetics."

The main mission of attending conferences and symposia, such as those of IEEE, is to present papers, listen to presentations by others, meet colleagues and graduate students, attend banquets, visit exhibits, and discuss topics of technical and educational interests with colleagues. However, some of us took the opportunity during off hours, especially when conferences and symposia were held at unique venues, to showcase our "athletic prowess" and "spotlight" the other side of us; in my case, I am primarily a golf and football fan. In what follows, I want to convey that we as engineers are not "nerds" consumed only by engineering but have interests beyond technology. In Figure 14, there are samples of scenes of me with some of my colleagues when IEEE and other conferences were held at or near renowned golf courses, such as those at St. Andrews, U.K. (the birthplace of golf); iconic Pebble Beach, CA, USA; Coeur d'Alene, ID, USA (with the unique movable green at hole 14), and scenic Puerto Rico. Also, there are some views of me attending the 1999 Fiesta Bowl, played at ASU Sun Devil Stadium (my name flashed on the stadium scoreboard as a guest!); the 2015 National Football League Super Bowl; and a 2006 Notre Dame football game. Also, due to space limitations, there are a few scenes with friends, colleagues, and family at AP-S international symposia.

## FUTURE OF ANTENNA TECHNOLOGY

According to Prof. Kraus, an author and pioneer of antenna technology, "antennas are the electronic eyes and ears of the world." Just as eyes and ears are critical to humans for efficient communication and activity, antennas are critical to wireless communication systems. Since the early days of modern antenna technology, dating back to the 1920s and the introduction of the Yagi–Uda array [4], antennas have undergone a revolution and played pivotal roles in the NASA space program to allow humans to land on the moon, in 1969, and send messages, photos, and videos of the Neil Armstrong walk on the moon. Today, antennas are the critical devices that permit wireless communication systems to send text messages, e-mails, news, photos, GPS coordinates, weather reports, and other information from personal handheld devices, such as cell phones, from anyone to anyone in the world.

Today, there is a plethora of research topics and applications of antenna technology, such as

- small antennas
- antennas for 5G wireless communication
- conformal low-profile designs
- flexible antennas
- reconfigurable designs
- ultrawideband multiband designs
- wearable antennas
- antennas for biomedical applications
- reflectarrays
- terahertz antennas
- others.

One current topic of intense interest and activity is the integration of EM devices, such as antennas, and the interaction of their EM waves with *metasurfaces*. Since the inception of metasurfaces, in 1990s, which are special types of artificial/synthetic surfaces with unique and intriguing characteristics, they have been integrated with EM devices, such as antennas, to enhance their functional characteristics and lead to superior performance. This topic has created and continues to generate and produce extensive interest, fascination, and excitement in the antenna and EM societies.

Antenna technology is a science with a bright future and immense challenges. For its advancement, we need to exercise creativity, imagination, and science. I highly recommend it to anyone who is looking for future advancements and challenges. It has served me extremely well. I am lucky and most proud to have pursued the fundamental and fascinating area of EM, with an emphasis on antenna technology; I would not have done it any other way!

## AUTHOR INFORMATION

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