Feature Article

*How should we excite non-engineers about our professions as antenna engineers and researchers?*

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In today’s society, we tend to size people up almost immediately. Among the most quintessential questions we ask in order to formulate our opinion is simply, “what do you do?” In our profession, this is a rather tough question to answer and several years ago, when I was the Department Chair at the Electrical Engineering Department at UCLA, I had to do just that. I was invited to give a luncheon talk at the Beverly Hills Rotary Club at the famous Beverly Hills Hotel. The luncheon guests were some of the top business professionals such as bank executives, hotel managers, doctors, lawyers, etc. After a delicious lunch in a beautiful setting, it was then my turn to talk for about forty five minutes about what I do as an electromagnetic/antenna scientist and engineer. You can probably imagine how unusual it is to excite this kind of audience about the nature of the work we do!

*Like Van Gogh who used his brushes to create paintings, Electromagnetic Scientists are artists who are able to paint the radiation of electromagnetic waves with their antennas.*

The night before, I pondered as how I should start my talk to keep these sophisticated non-engineers and certainly non-antenna specialists excited and engaged. Expectedly, I
prepared colorful and interesting material to be presented; however, the opening slide was the most difficult one! My opening remark was, “Like Van Gogh who used his brushes to create paintings, Electromagnetic Scientists are artists who are able to paint the radiation of electromagnetic waves with their antennas”. This analogy between a brush and an antenna, accompanied by some interesting graphics, put everyone at ease as who I am and what I do. Next I defined my version of electrical engineering, “Science and technology of phenomena, devices and algorithms resulting from the motion of and radiation by electrons and photons in disciplines covering vast areas of applications in modern society.”

Maxwell: The father of electromagnetic (EM) Waves

One of the most profound discoveries by the human race.

Maxwell was able to capture the nature’s secret of the electromagnetic waves phenomena into “4” mathematical equations known as “Maxwell’s equations”.

The modern society has tremendously benefited from these mathematical equations!

Global connectivity anytime, anyplace and with anyone.

The rest of my presentation progressed quite effectively and was engaging. After reviewing some of the early history with the triumphant discovery of Maxwell’s four equations and describing the profound outcomes of these equations, I was able to instill a powerful appreciation as to how amazing it is that we as human beings have been able to capture the electromagnetics laws of nature into these simple mathematical equations. Most astonishing, is that Maxwell and others progressed far beyond to discover new things purely by manipulating these equations. I could sense how they were amazed to learn about the extraordinary power of these mathematical equations. I then recited Einstein’s famous quotation, namely, “Politics is for the present but an equation is for eternity”.
In order to give them a sense of how fast the electromagnetic waves travel, I brought some simple examples. Making the assumption that some of the attendees may own Ferraris, I told them one could go at most 300 miles an hour in this car. Next, I told them that an airplane flies nearly 600 miles an hour and that the speed of sound is about 720 miles an hour. Finally, I told them how fast the EM waves travel as predicted by Maxwell’s equations, namely, 666,000,000 miles an hour. I emphasized that this is also the speed of light and hence, light is part of the vast spectrum of electromagnetic waves. I observed from the nature of the questions that were asked, that they were truly engaged and interested. I concluded this part of my talk by saying that according to Einstein’s theory of relativity, this is the ultimate speed and nothing can go faster.

I shared with them that from an early age, the cosmos and the vastness of space and the universe fascinated me. When I became exposed for the first time to the amazing postulate of Einstein that the speed of light is the ultimate speed, and to Maxwell’s discovery that all electromagnetic phenomena, including light, could be captured in four simple mathematical equations, I knew that this was the area for me to focus upon. My dream took me from the University of Tehran to the University of Illinois to the NASA/Jet Propulsion Laboratory, and then to the University of California, Los Angeles. I sincerely appreciate all these organizations, which challenged me to learn about the new frontiers in science and engineering. These organizations also created an environment in which my research could and did flourish.
I continued my talk by providing ample examples as how uniquely electromagnetic waves painted by antennas as our brushes have changed the way we live, play and protect ourselves. I told them that at the dawn of a new millennium, one bound to evolve and progress by advances in science and technology as at no time in history, science and engineering will play a central role in creating wealth, prosperity, and freedom. I strongly believe that electromagnetic phenomena and antennas are key components in this progress. For this audience, based on their age group, it was appropriate to road map them from the rooftop TV antenna to more recent cell phone antennas. I told them we are at the era that one of the most inspiring dreams of the mankind, namely, “Global connectivity anywhere, anytime, with anyone, and with any amount of information” has been fulfilled. I emphasized upon them that “Your cell phone is an engineering marvel with tremendous complexity. Next time you use your cell phone please look at it with a great sense of gratitude directed towards the many pioneers who made this engineering marvel a reality”. Occasionally when I use this statement, I ask the audience to stand up and have a short moment of silence in remembrance of earlier pioneering scientists and engineers who helped us to fulfill this dream.

Then I continued to share more examples as to how communications via electromagnetic waves have allowed us to have satellite communications, stay in touch with robots on Mars, use radar to identify foes and friends, check the health of our planet through remote sensing from space, listen to faint signals coming from the dawn of the creation of our universe at the Big Bang, and more recently, use implantable and ingestible devices to
improve medical diagnosis and assist doctors. I showed them how powerful computer simulations based on Maxwell’s equations allow us to predict interactions of electromagnetic waves from their cell phones with the human brain.

It took scientists and engineers nearly 150 years to fulfill this dream of mankind!

Your cell phone is an engineering marvel with tremendous complexity.

Next time you use your cell phone please look at it with a great sense of gratitude directed towards the many pioneers who made this engineering marvel a reality.

It is clear that the public at large does not appreciate and perhaps does not know how critical the role of scientists/engineers has been in creating a much better environment for all of us to live, play, enjoy and feel protected. It is our collective responsibility to be excited about what we do and to inform the public in a creative way about our profound contributions. Perhaps Goddard’s words, “It is difficult to say what is impossible for the dream of yesterday is the hope of today and the reality of tomorrow” summarize it all.

I finished my talk by re-stating my opening remark, “Like Van Gogh who used his brushes to create paintings, Electromagnetic Scientists are artists who are able to paint the radiation of electromagnetic waves with their antennas”. At this point it was obvious that they had a good understanding as to what we do as electromagnetic/antenna engineers. There is nothing wrong with the public looking at us as electromagnetic artists if this is an easier way for them to relate to us and appreciate what we do. I received many supporting words after my talk and they all were very appreciative that I was able to inform them about our profession in this manner. I must tell you that I use similar strategies to get our undergraduate students excited about electromagnetic waves and antennas. It works!
I would like to thank Steve Best for giving me the opportunity to share this experience with you in this inauguration column of feature notes in our new IEEE AP-S website. May Maxwell’s equations be with you!

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Yahya Rahmat-Samii is a Distinguished Professor, holder of the Northrop-Grumman Chair in electromagnetics and the past chairman of the Electrical Engineering Department at the University of California, Los Angeles (UCLA). Before joining UCLA, he was a Senior Research Scientist at NASA’s Jet Propulsion Laboratory. Dr. Rahmat-Samii was the elected 1995 President of IEEE Antennas and Propagation Society and also appointed an IEEE Distinguished Lecturer presenting lectures internationally. He is the current Chairman of the United States National Committee of the International Union of Radio Science (USNC-URSI)I, 2009-2011. Dr. Rahmat-Samii was elected as a Fellow of IEEE in 1985, a Fellow of IAE in 1986 and the Edmond S. Gillespie Fellow of AMTA in 2007. He also served as the Vice President of AMTA. Dr. Rahmat-Samii has authored and co-authored over 800 technical journal articles and conference papers and has written 30 book chapters and four books entitled, Electromagnetic Band Gap Structures in Antenna Engineering, Implanted Antennas in Medical Wireless Communications, Electromagnetic Optimization by Genetic Algorithms, and Impedance Boundary Conditions in Electromagnetics. He is also holder of several patents. His pioneering research contributions cover diverse areas of modern analyses, designs, optimizations and measurements in electromagnetics engineering and antennas. Many of his original concepts have been used in NASA’s planetary and earth observation missions and commercial personal communication systems. Rahmat-Samii has received numerous awards, including the 1992 and 1995 Wheeler Best Application Prize Paper Award for his papers published in the IEEE Antennas and Propagation Transactions, 1999 University of Illinois ECE Distinguished Alumni Award, IEEE Third Millennium Medal, and AMTA’2000 Distinguished Achievement Award. In 2001, Rahmat-Samii was the recipient of an Honorary Doctorate in Physics from the University of Santiago de Compostela, Spain. In 2001, he was elected as a Foreign Member of the Royal Flemish Academy of Belgium for Science and the Arts. In 2002, he received the Technical Excellence Award from JPL and in 2005 he was the recipient of the URSI Booker Gold Medal. He was the recipient of the 2007 Chen-To Tai Distinguished Educator Award of the IEEE Antennas and Propagation Society. In 2008, he was elected to the membership of the National Academy of Engineering (NAE). Prof. Rahmat-Samii is the designer of the IEEE AP-S logo which is displayed on all IEEE AP-S publications. He received the B.S. degree in electrical engineering from the University of Tehran with the highest honors and the M.S. and Ph.D. degrees in electrical engineering from the University of Illinois, Urbana-Champaign.