Electromagnetic Frontiers in Modern Space Industry

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20 years ago when I was starting my career as a research scientist in the field of computational electromagnetics, I was puzzled by a noticeable disconnect between our research topics in fundamental science and problems of everyday life. Only later, after working at NASA and several commercial space companies, dealing with a wide spectrum of people ranging from scientists to investors, did I start to grasp reasons behind this gap. I realized how one can bridge it in order to find exciting and important research topics, and what may transpire if research efforts are dedicated to solving real life challenges.

This is my first conference talk after leaving the field of fundamental science some 15 years ago for this exact reason. I joined the space industry in search of more "down to Earth" problems to solve, only then understanding that fundamental science is the answer in most cases. However, it is far from trivial to formulate "real life" problems to be accepted and appreciated by the world of academia. In this session, I hope to convey a few electromagnetic challenges in today's space industry, which I believe may be solved only by scientists.

During last decade, the space industry transformed faster than at any time since space exploration began. It was mostly due to external factors such as advances in terrestrial mobile communications and other various economic and political reasons, which altogether led to amazing multidisciplinary innovations and completely new space applications. Most importantly, almost all successful stories of recent new space ventures are tied to finding a clever technological solution to an existing problem, often with a person with advanced scientific degree in the driver seat.

In this talk, I will attempt to outline some of the "hottest" electromagnetic problems in the space industry. If solved, they could become the next technological breakthroughs and have potential to improve the lives of many.

To set the stage, we will briefly overview the recent history and the current landscape of the international space industry, describe its key drivers and players, and outline what it takes to bring terrestrial technology to space.

With this perspective in mind, we will dive into some "state-of- the-art" space technologies and challenges as they relate to the broader field of electromagnetics and radio science, with the hope of inciting the interest in the research of the following:

- ***Internet from Space for all of humanity*:** big promise versus reality check - antennas, signal processing, spectrum, and interference.
- ***Earth Observation, from Hz to THz*:** which data can be collected today, and what this data is actually good for: a strong case for advanced RF sensors coupled with big data analytics and machine learning.
  - As a special subtopic, we will touch on a humanitarian research project, QuakeFinder, sponsored by my company, Stellar Solutions, which aims to develop technology and methods for detection and analysis of ultra-low frequency electromagnetic earthquake precursors to produce earthquake forecasts.
- ***Other new space trends*:** Internet of Things, orbital infrastructure, space debris, Moon exploration, and more!

Natalia Saidoglu, PhD, is a Space Communication Systems Architect at Stellar Solutions, Inc. She received a PhD degree from Kharkov Institute of Radio Physics and Electronics of the National Academy of Sciences of Ukraine in 2001. Then, she joined Fields and Waves Laboratory at the University of Pennsylvania for a postdoctoral research in microwave and optical metamaterials and electromagnetic scattering on objects in multilayered media.

She started her career in space in 2004 at NASA Jet Propulsion Laboratory, performing scattering and multipath analysis of low gain communication antennas. She contributed to several NASA missions including Phoenix, the Mars Polar Lander, and the Mars Rover Curiosity. After that, she worked at the two of the largest US satellite manufacturing companies, Orbital Sciences Corporation and Space Systems Loral. At the beginning, her duties as an antenna subsystem lead for commercial satellites included everything from RF antenna design to in-orbit performance testing. Eventually, her interests expanded to the design of communication systems for various commercial space missions. At ABS Global, she was leading payload system design and procurement of the new satellites, technical management of in-orbit anomalies on existing satellites, and was involved in spectrum coordination.

Currently, she is with Stellar Solutions, Inc., advising multiple customers on GEO, LEO, MEO, and HEO communication system architectures in frequency band ranging from sub 1 GHz to 70-80 GHz and optical band; as well as advising on mission designs for a wide range of Earth Observation systems. Her customer base includes both large corporations and small start-ups, investment and insurance firms, and the banks. She is a member of an advisory board of Xona Space Systems, future provider of an independent high-performance satellite navigation and timing system.

Natalia is a URSI Commission B member and a Senior Member of Antennas and Propagation, MTT, Communications, and Aerospace and Electronic Systems Societies of IEEE. She has over 40 publications, and was a recipient of MTT-S Graduate Student Microwave Fellowship Award and URSI Young Scientist Award..