Talking 5G mobile, wireless pills and personal area networks with Marta Fernández, postdoctoral researcher at the University of the Basque Country

Question: You're co-chair of the new IEEE BTS Young Professionals committee. How did you wind up in that role? And what do you hope to accomplish?

Fernández: When I was a student, I had the opportunity to get involved in some of the BTS activities focused on students and young professionals. For example, in 2014 I was a student volunteer helping at the BTS booth at the IBC trade show in Amsterdam. This activity gave me the opportunity to attend this show, meet professionals in the field and, of course, get to know more about the society.

I decided to get more involved as a YP co-chair to give more visibility to young members of the society. I also wanted to help give them the opportunity to get involved in BTS activities, such as participating in the trade shows as I did when I was a student.

As YP co-chairs, we found that there is a generation gap in the society because most of IEEE BTS members have a long professional career. For this reason, our main goal is to try to show students, and those who are starting their careers, what the BTS can offer them, such as the programs aimed at providing them with career assistance, technical skills or opportunities for networking.

Question: How did you choose a career in telecom technology, particularly wireless?

Fernández: Since I was very young, I knew I wanted to study something related to technology. Then during my bachelor's degree studies, I became quite interested in the field related to wireless communications, and the whole process of sending and receiving wireless signals.

For that reason, I decided to do a Ph.D. in this area. During that period, I learned a lot, not only about wireless communications, but also about the different applications of these technologies and how they can help to improve our lives. I think it is amazing what we can achieve using wireless communications.

Question: Some of your research focuses on how the human body affects antenna performance. What are the most interesting or surprising things you've discovered? And how might that research be applied to personal area networks, such as what law enforcement and soldiers are starting to use, or to wearables for applications such as health care patient monitoring?

Fernández: The design of wearable antennas is a challenge. One of the main drawbacks when designing an antenna to be used in a personal area network is due to the interaction between the body and the antenna. The human body itself can reduce significantly the antenna efficiency because the body absorbs part of the power radiated from such antenna.

When I was involved in this area, we worked on designing suitable antennas for different applications. We could check that the improvement on the radiation efficiency was related to the reduction of the power absorbed by the body. We also designed some antenna models whose performance was hardly affected by the body mass of the different users.

When working with personal area networks, considering aspects such as improving antenna efficiency or choosing the proper location of each node can reduce the number of nodes and the transmitted power. So, in my opinion these are aspects that should be considered in order to build more efficient personal area networks, rather than settle for just getting the network to work. This can be applied to any of the existing wireless body area networks (WBANs).

Question: Your current research focuses on indoor propagation at millimeter wave frequencies, especially 60 GHz. How might that research be applied to 5G, which will use 60 GHz and other mmWave spectrum?

Fernández: Signals at these frequencies are extremely sensitive to obstacles that block or cause fluctuations in the received signal. Every movement or change in the environment affects the received signals.

For this reason, and in order to be able to benefit from this spectrum availability, it is essential to study signal behaviour at mmWaves. Among others, it is important to investigate the influence of potential obstacles of the local environment on the received signal, or how a user or third person can affect link performance. Currently, I am involved in this kind of activities, which will be very beneficial in order to design efficient 5G networks.

In the past few years, a lot of progress has been made regarding the understanding of mmWave propagation and channel modeling at these frequencies, but still there is work to do in that field. Without this type of research work, 5G networks using mmWaves would be more inefficient and unstable.

Question: You've also done research on antennas for gastro-intestinal radio pill tracking. What are some of the challenges (e.g., bodyfat percentage) to maintaining a reliable, high-performance connection as the pill moves around the GI tract? And what types of applications could be possible in the future? For example, could this eliminate the need for some types of exploratory surgery?

Fernández: When working with these devices that are on or inside the body, the antenna design itself is a challenge because of the interaction between the body and the antenna. Moreover, in the case of the radio pill, the antenna pattern can change while it moves around the GI tract.

Another challenge when tracking a pill inside the body lies in the algorithms developed for radio localization accurately, which also implies receiver distribution. Each person has a different body, different mass and different dielectric properties, all of which makes it challenging to develop algorithms and antennas suitable for all the cases.

It is difficult to know what applications could be possible in the future, but regarding medical applications, a lot of research is being carried out. The development of this type of applications can provide significant benefits. For example, the capsule endoscopy, which is already in use, can substitute the traditional examination for small and large intestine diseases, which involves using a flexible tube. Some other applications include diabetes control, artificial retina or cardiovascular diseases. I am sure that some of the wireless communications applications will help at least to make easier the medical interventions.

Question: One of the hurdles to building out 5G networks quickly and widely is growing concerns about RF exposure, especially at the mmWave frequencies that previous generations of cellular have never used. What are you learning about that risk from your research?

Fernández: In my opinion, it is essential to continue working on this area, measuring exposure levels, checking compliance with the permitted limits, and updating guidelines to upcoming networks. Another key point is to give clear information to society.

In the past few years, compliance assessment methods have been revised in order to fit them to future networks. Some experts have stated that the existing measurement methods can lead to significantly overestimated exposure levels if they are applied to 5G networks because of the use of new techniques and higher frequencies.

But this is not new. Exposure assessment methods also provided overestimated exposure levels in the case of some services, such as Wi-Fi, because measurement methodologies did not take into account that Wi-Fi signals are not continuously transmitted. In the past few years, new approaches are being proposed in order to get more realistic results.