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'Building' Smart EM Environments for Future Wireless Systems Through AI

Paolo ROCCA
ELEDIA Research Center (ELEDIA@UniTN - University of Trento), DICAM, Trento, Italy
ELEDIA Research Center (ELEDIA@XIDIAN - Xidian University), Xi'an, Shaanxi Province, China
Big Data and AI Working Group, CEIT, World Federation of Engineering Organizations (WFEO)
paolo.rocca@unitn.it

The Smart Electromagnetic Environment (SEME) is a revolutionizing concept envisioning the future of wireless connectivity for new-generation mobile systems and applications [1], [2]. It is based on the idea that the objects in the environment are not considered, like in the past, as impairments to the propagation of the electromagnetic (EM) signals but they are key enablers. The environment becomes the fundamental and necessary degree-of-freedom for tailoring the propagation of the EM waves and enhancing the coverage, the data throughput, the quality of service, and thus the users experience.
In this framework, a research line focused on the design of innovative MIMO array antennas where a capacity-oriented optimization strategy has been proposed fully considering the environment in the design phase, unlike addressing the antenna synthesis by neglecting the channel effects and just taking into account the classical free-space features such as gain, sidelobe level, beam width [3], [4]. However, it is becoming more and more evident that future wireless networks will be hybrid and will comprise both active (e.g., base stations, smart repeaters) and passive (e.g., reconfigurable intelligent surfaces, smart skins) technologies. Accordingly, there is nowadays a wide research interest towards the study and development of reconfigurable intelligent surfaces (RIS) [5] and static passive EM skins (EMSs) [6], [7] to be installed or integrated in the walls of building and/or along the streets for improving the propagation of the EM waves in complex urban scenarios.
The design, optimization, and planning of such hybrid and complex wireless networks and of the technology therein will not be possible without the use of innovative methods based on Artificial Intelligence (AI) [8], [9]. In this talk, a set of selected and recent advances on AI-driven solutions and technology towards the 'building' of the future SEME idea will be presented and discussed.

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