Computational Electromagnetics: across the simulation river

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Electromagnetic simulation is a key component of all current and future technologies, and computational electromagnetics (CEM) is the obvious scientific and technological backbone of simulation.

While simulation is the most perceived embodiment of CEM by the layperson, CEM may be a game changer in other technological applications.

In the first place, CEM can revolutionize antenna testing in challenging applications.

The use of CEM integral equation tools has been recently proposed by the authors as a way to significantly reduce the measurement time of antennas, by exploiting all the existing a-priori information in a fully Maxwellian manner. Conversely, it can allow testing when only a few samples can be measured. The use of of integral equations, or other similar CEM approaches, allows to reduce the necessary number of samples for a given accuracy, significantly below the Nyquist limit. A recent research in this direction addresses the measurement of antennas placed on a complex structure whose geometrical envelope is known with some accuracy (i.e. via a commercial laser scan); the aim is to employ information on the platform geometry to significantly reduce the necessary number of samples for a given accuracy. The resulting hybrid numerical-measurement technique is based on expressing the field via a set of numerically-generated basis functions; these basis functions are related to the radiation of specific sources placed on the platform.

The background CEM methods need to be well-posed and well conditioned, with proper connection to fast solvers. Finally, some remarks are also relevant to CEM as part of a design/optimization loop; there the overall efficiency has to be considered, which might leads to specific approaches; an example is the re-vamping of entire-domain basis functions, or synthetic functions, that enhance the optimization-oriented simulation of metasurfaces.