An optimized alternative to sample and reconstruct any harmonic radiated electromagnetic field

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Abstract:

The presentation deals with an alternative technique for sampling and reconstructing the electromagnetic field radiated by any kind of antenna or equivalent currents, and measured in its far field region. Based on the electrical size of the radiating object, it truncates the vector spherical modal field expansion series. Then, each component of the field is projected on the classical Fourier space for the polar dependency. This is carried out by minimizing the variance of the residual noise, or, in other words, by applying the Tikhonov-Phillips regularization scheme. Afterwards, the azimuth dependency is projected on the real valued Gegenbauer, also known as ultra-spherical, polynomial family, once again following the Tikhonov-Phillips regularization scheme. This results in not only a numerically well-posed problem, but also in the statistical independence of the resulting spherical modal coefficients as their co-variance matrix is diagonal. Moreover this double regression technique leads to the smallest two-dimensional Cartesian grid of angular sampling positions, a very useful result for the far field antenna characterization industry where measurement time has to be reduced as much as possible. Additionally to this, both optimum estimators and stable regularizer are also extracted. Then, a statistical analysis of the residual error is performed by extracting and analyzing the noise properties and also creating a statistical filter that rejects any mode that is not statistically significant through the definition of a modal signal-to-noise ratio.