Antenna Far Field Characterization with Reduced Number of Sampling Points

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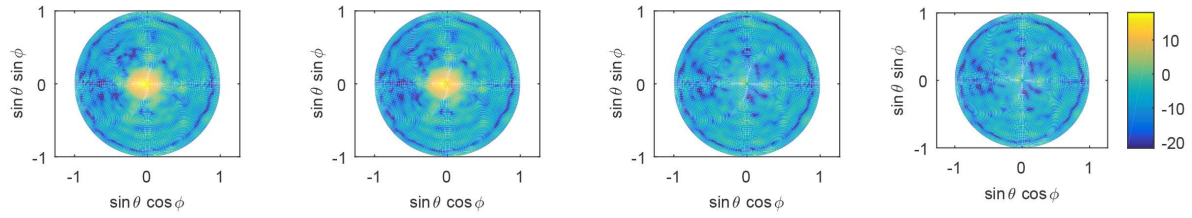
Antenna characterization techniques are facing more and more demanding needs. Measurements of radiation patterns in 3D, over a wide frequency range or for multiple functioning modes are becoming standard requirements. All these features lead to an increase of the antenna testing duration and consequently cost.

A procedure is proposed to reduce the number of measurement points and therefore speed up antenna far field characterization. It relies on the sparse representation of antenna far field pattern when projected onto a vector spherical harmonic basis. Indeed, information about the potential symmetries and the smoothness of current distribution on antennas are encoded into the sparse spherical wave spectrum. The proposed approach is easy to implement and only calls for off-the-shelf routines.

The method is validated experimentally to characterize the far field radiated by a circularly polarized metasurface at 30 GHz. The metasurface is manufactured on a square of side 13 cm. This antenna can excite spherical harmonics whose maximum order is of about $\left[\frac{2\pi}{\lambda}a\right] = 58$, a being the radius of the smallest sphere enclosing the antenna under test. It means that the number of spherical modes to identify is of about 3000. Conventional approaches requires approximately the same number of sampling points whereas our strategy, that exploits the sparsity of the spherical wave spectrum, needs about only 2400 measurement points to provide a good reconstruction as plotted in Fig. 1.

It is important to point out that the proposed approach is an approximation method to interpolate the radiated field. As expected, this approximation improves when the number of sampling points increases. Future work is to assess the quality of the pattern reconstruction and the robustness of the methodology with respect to the inevitable measurement uncertainties.



(a) (b) (c) (d)

Figure 1: Far field patterns of the metasurface at 30 GHz: (a,b) RHCP and (c,d) LHCP. The patterns (a,c) are the reference patterns and (b,d) are the patterns reconstructed from a reduced number of sampling points.