Near-Field to Far-Field transformation using data acquired with an Unmanned Aerial Vehicle

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We address the problem of using Unmanned Aerial Vehicle (UAV)-mounted radio sources to measure the far-field (FF) radiation pattern of antennas (see Virone et al., IEEE Antennas and Wireless Propagation Letters, 13, 169-172 and C. Chang et al. Publications of the Astronomical Society of the Pacific 127, 957). In particular, we study how to obtain the FF pattern from near-field (NF) measurements, where we have to handle several issues related to the use of UAV to acquire the samples: data are available on a set of scattered points; due to the limited accuracy of the on-board GPS, the position of each measurement point is known with an error margin; the orientation of the UAV, namely the polarization measured, is not constant and is known with limited accuracy. We use numerical methods to build two set of basis functions—one for the NF, one for the FF—which account for the geometry of the considered Device Under Test (DUT) and the environment surrounding the DUT, as for example the presence of a ground plane. The elements in the two sets are in a one-to-one correspondence, so once the expansion coefficients are determined from NF data, the FF pattern can be reconstructed. As a test case, we consider an array of 5 dipoles, oriented along the x direction and displaced along the y direction, on an infinite ground plane. Synthetic data are generated both on a NF cloud representing the flight trajectory of the UAV (obtained with a mixture of slow fluctuations and random displacements around a square with an edge of 10 wavelenght at 5 wavelength above the antenna) and on some FF cuts. The NF samples, currupted with synthetic noise, are used to determine the expansion coefficients. At the end, these coefficients are used to evaluate the FF, which is compared to the reference one in Figure 1. Inside the visibility region dictated by the NF samples locations (namely for $|\theta| < 45°$), the method allows a good reconstruction of the FF pattern.

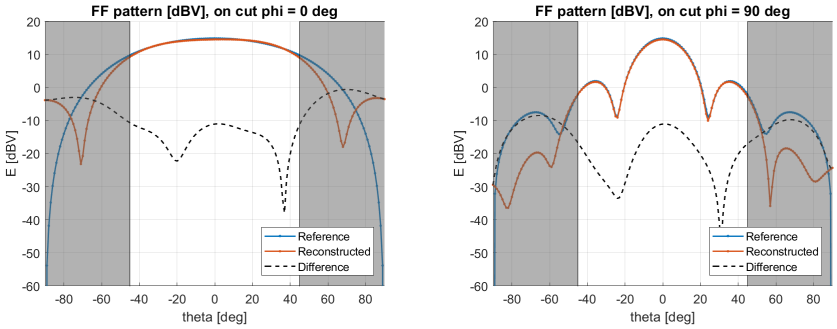

Figure 1: FF pattern on the two cuts $\phi = 0°$ and $\phi = 90°$. Grey panels cover the directions outside the visibility region due to the position of the NF samples.