on a square surface S of side 20λ located at a height of 5λ. Considering the geometry of S and S', the far field patterns can be derived accurately from the near field measurements for angles between $\pm 45^\circ$.

The RSVD is applied and the singular values above $\sigma_{\max}/10^3$ are kept to construct the numerical basis that is composed of 358 vectors. The DEIM algorithm is applied to select only 358 measurement points, see Fig. 6(c,d). The number of near field points then drops from 1681 (with a standard 0.5λ step) to 358. Considering a regular distribution over the near field surface, it means that the average distance between the field samples is now of only 1.1λ. With our near field scanner, it takes 1h02min to measure both components of the field with a 0.5λ sampling step (Fig. 7(a,b)) whereas only 24min are necessary to collect the 358 selected measurement points (Fig. 7(c,d)). It means that a reduction of 60% of the field acquisition time is achieved in this case. The computation time of the whole procedure, RSVD and DEIM, takes less than 8s.

To assess the proposed ROM procedure, we reconstruct the near field radiated by the metasurface from selected measurements points and compare it to the measured complex near field. The mappings of the near field, magnitude and phase, are shown in Fig. 6(a,d) and (c,f) respectively. They are in very good agreement. To better estimate the quality of the field reconstruction from the ROM procedure, we derive the far field and, more specifically, right and left hand circular polarizations, denoted RHCP and LHCP respectively. An excellent agreement is obtained between the measured and reconstructed far field as shown in Fig. 7 and 8 despite the coarse near field sampling which validates the proposed ROM procedure.

VI. Conclusion

A reduced order model (ROM) is proposed for antenna characterization problems enabling a significant acceleration of antenna radiation pattern measurements. The AUT is enclosed by equivalent currents and the operator that maps these currents to the radiated field on the measurement surface is built. By computing the RSVD of this operator and keeping only the leading singular vectors, the ROM and specifically the orthormal basis tailored to our antenna characterization problem is constructed numerically. Note that the left and right singular vectors can be seen as the characteristics modes of the AUT and the measurement surface, respectively, whereas the singular values represent the coupling between these modes. The DEIM is then applied to select a small number of field sampling points from which the field radiated by the AUT can be properly interpolated. Two complex radiating structures have been characterized to demonstrate the efficiency and potentialities of the proposed approach. It has been found that the required number of sampling points, both for near and far field measurement configurations, can be significantly reduced as compared to previously proposed antenna characterization strategy. The ROM concept exploits only readily available information about the antenna characterization, the outer dimensions of the AUT and the measurement surface geometry. It is directly applicable to any kind of radiating structures and geometry of measurement scans and works both for near and far field characterization. Our procedure paves the way to a more efficient use of antenna near and far field measurement facilities.

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