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An Antenna Array Diagnostic Approach Based on a Novel Non-Hilbertian Optimization Technique

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Antenna arrays, thanks to their improved radiation properties and reconfigurability [1], [2], are nowadays crucial components in several applicative areas such as telecommunication, radar and electromagnetic imaging. In these scenarios, some elements may crash or have malfunctioning issues, producing a degradation in the radiated fields, i.e., changes in the sidelobe level and in the array beam direction. The identification of defects may allow the recovery of the faulty antenna under test; the failed elements, once detected, may be repaired to restore the desired radiation pattern. Thus, antenna array diagnostics acts as a key operation in the applicative use of antenna arrays.

The research on this subject is extensive. In the last years, different kinds of antenna arrays and several diagnostic techniques have been developed (e.g., [3]–[5]). Many of them aim at recovering the distribution of the current over the antenna under test starting from measurements of the radiated field. Consequently, array diagnostics is dealt with as an inverse-source problem. However, this problem is demanding since it is needed to face the ill-posedness of the underlying equations. Therefore, the development of proper inversion procedures is required [6].

In this contribution, a novel diagnostic approach, aimed at retrieving an indication about the presence and position of faulty elements from measurements of the radiated field, is presented. The developed technique is based on the use of an effective optimization technique, performing a regularization in the framework of non-Hilbertian spaces. The effectiveness of the approach is evaluated by means of simulations performed in a numerically simulated environment.

1. M. Patriotis, F. N. Ayoub, Y. Tawk, J. Costantine, and C. G. Christodoulou, "A millimeter-wave frequency reconfigurable circularly polarized antenna array," *IEEE Open Journal of Antennas and Propagation*, **2**, 2021, pp. 759–766, doi: 10.1109/OJAP.2021.3090908.

2. S. R. Rengarajan, M. S. Zawadzki, and R. E. Hodges, "Design, analysis, and development of a large Ka-band slot array for digital beam-forming application," *IEEE Transactions on Antennas and Propagation*, **57**, 10, October 2009, pp. 3103–3109, doi: 10.1109/TAP.2009.2028674.

3. A. Zeitler, J. Lanteri, C. Pichot, C. Migliaccio, P. Feil, and W. Menzel, "Folded reflectarrays with shaped beam pattern for foreign object debris detection on runways," *IEEE Transactions on Antennas and Propagation*, **58**, 9, 2010, pp. 3065–3068, doi: 10.1109/TAP.2010.2052564.

4. B. Fuchs, L. L. Coq, and M. D. Migliore, "Fast Antenna Array Diagnosis from a Small Number of Far-Field Measurements," *IEEE Transactions on Antennas and Propagation*, **64**, 6, June 2016, pp. 2227–2235, doi: 10.1109/TAP.2016.2547023.

5. M. Salucci, A. Gelmini, G. Oliveri, and A. Massa, "Planar array diagnosis by means of an advanced Bayesian compressive processing," *IEEE Transactions on Antennas and Propagation*, **66**, 11, November 2018, pp. 5892–5906, doi: 10.1109/TAP.2018.2866534.

6. G. Leone, F. Munno, and R. Pierri, "Inverse source on conformal conic geometries," *IEEE Transactions on Antennas and Propagation*, **69**, 3, March 2021, pp. 1596–1609, doi: 10.1109/TAP.2020.3016375.