Different computational ways of enforcing Love's conditions in inverse source from far field data

J. L. Araque Quijano[1], M. A. Francavilla, G. Giordanengo, M. Righero*[2], and G. Vecchi, F. Vipiana[3]

[1] MUN and EMC-UN Labs, Universidad Nacional de Colombia, Bogotá, Colombia
[2] LACE, Istituto Superiore Mario Boella, Torino, Italy
[3] LACE, Department of Electronics and Telecommunications, Politecnico di Torino, Torino, Italy

The regularizing effect of enforcing the Love's (null-field) condition in equivalent currents reconstruction problems is well known in literature (see J. L. A. Quijano and G. Vecchi, "Field and source equivalence in source reconstruction on 3D surfaces," *Progress In Electromagnetics Research*, vol. 103, pp. 67–100, 2010). In this formulation, the reconstruction problem is cast as a least squares problem. If the surface current are expressed in a certain basis, calling $[A]$ the matrix having the field samples due to each basis function, $[C]$ the matrix with the null-field test, and $[e]$ the measured field samples, we look for coefficients $[x]$ which minimize $\|[[A];[C]][x] = [[e];[0]]\|$, where a Matlab-style notation for array concatenation is used.

We present some results about different computational ways to enforce the null-field condition and its effects on the resulting currents. The considered cases are real-life antennas in working conditions, simulated with the Method of Moments to perform the test in a controlled scenario.

More specifically, we consider the reconstruction problems as a constrained least squares problem and test different solving strategies, which put more or less emphasis on the constraints and which require a heavier or lighter computational effort. On one extreme of the spectrum, we have algorithms which directly restrict the least squares problem to the null-space of the testing matrix $[C]$; on the other extreme, we have algorithms which simply weight the null-field condition in the appropriate way. Among them we have, for example, algorithms based on Lagrange multipliers.

The currents obtained in the different cases are compared, in terms of similarity with the actual Love's currents, radiated near field and radiated far field.