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SVO for Linear Inverse Scattering

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A much relevant issue of inverse electromagnetic scattering is extracting the maximum amount of information on the investigated scatterers, when some a priori knowledge on the same is available.

Typically, the scattered field is collected at different spatial positions, so that we can formulate the problem as that of determining the minimum number of acquisition points and their "optimal" spatial distribution to reconstruct the scatterer "at the best". Sampling point number and positions will depend on the shape and size of the acquisition domain, on the employed diversities (frequency, positions of transmitters and receivers) and on the a priori information on the scatterers, in terms of extent of the containing region and relative position to the measurement locations.

With reference to the problem of reconstructing sources from their radiated fields, we have proposed an approach to the field sampling problem based on a singular value optimization (SVO) approach [1]. The technique relies on optimizing the singular values (SVs) behaviour of the operator mapping the unknowns, i.e., the source, and the data, namely, the field samples. Such an approach has been extensively applied and validated in the case of near-field/far-field transformations in antenna characterization under different scanning geometries. Recently, the idea underlying the approach in [1] has been fruitfully exploited in inverse scattering applications, provided that a linear mapping between scattered field and scatterers' properties is established [2].

In this communication, the work in [2] is extended and SVO is applied to an inverse scattering problem under the Born and distorted Born approximations. The approach exploits weak a priori information on the scatterers in terms of extent of the region containing the objects and relative position between acquisition and investigation domains.

The attention is focused on a two-dimensional (2-D) geometry with multifrequency illumination, TM polarization, and near-field measurements performed on a circular domain around the investigated area. Mono-static, multi-bistatic and multi-static configurations are addressed with or without measurement domain truncations. Numerical results show the performance of the approach.

References

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[2] A. Capozzoli, C. Curcio, A. Liseno, "Singular Value Optimization in inverse electromagnetic scattering," *IEEE Antennas Wireless Prop. Lett.*, vol. 16, pp. 1094-1097, 2017.