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"Imaging thin PEC cylinders via a linear inversion scheme and a spatially varying threshold"

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Abstract – The imaging of thin perfect electric conducting (PEC) objects embedded in a homogeneous and lossless medium for a two-dimensional and scalar geometry is addressed. A multifrequency/multi-static configuration with the scattered field observed over a line of finite extent located in the near zone is considered. The multiple scattering between the objets is neglected in the formulation and their positions (which are the actual unknowns of the problem) are represented as the support of Dirac-δ functions. This allows to cast the problem as the inversion of a linear integral operator we tackle by means of the truncated – singular value decomposition (TSVD) scheme. We show that, due to the considered aspect limited configuration and to the plane-wave spectrum of the source, the unknown function representing the objects' positions undergoes a different filtering through the TSVD reconstruction procedure, depending on the objets' positions. This, on the one side, entails that the inversion scheme is characterized by a spatially varying resolution. On the other side, the spurious artifacts, which arise in the reconstruction due to the unavoidable uncertainties and to the regularization, are spatially varying as well. Such artifacts may give rise to ambiguous interpretations of the reconstruction. In order to filter out such unwanted artifacts a thresholding procedure is introduced. In particular, according to the spatial filtering introduced by the inversion scheme, a spatially varying threshold (SVT) is adopted. Numerical examples are shown to assess the effectiveness of the proposed procedure also for situations where the mutual scattering is not negligible.