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The use of the L-curve and NCP parameter-choice methods in electromagnetic inverse scattering problems

It is well-known that the inverse scattering problem is inherently ill-posed: the solution is not unique and does not depend continuously on the data. For solving this ill-posed problem, we use Tikhonov regularization, which can be formulated as a damped least squares problem, in conjunction with a parameter-choice method for finding the optimum regularization parameter. Finding the optimum regularization parameter is very difficult and also computationally expensive because the resulting solution can be very sensitive to the choice of the regularization parameter. Many regularization parameter-choice methods have been proposed in the literature: for example, generalized discrepancy principle, generalized cross validation, the L-curve and Normalized Cumulative Periodogram (NCP) method. The L-curve method tries to balance the (semi) norm of the solution and the corresponding residual by choosing the regularization parameter that puts one on the corner of the L-curve. The NCP method tries to use more available information from the residual as opposed to just the norm of the residual and it is based on the fact that there is similarity between the SVD basis and Fourier basis.

Herein, the application of the L-curve and NCP parameter-choice methods to the Tikhonov-regularized functional arising in the 2-D/TM inverse scattering problem which is formulated via an integral equation and solving using the Born iterative method (BIM) is investigated and adapted for this application.