

Correction of Time-Domain Data in Special Cases
Where the Inverse Transfer Functions are
Analytic Time-Domain Operators

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In processing of electromagnetic scattering data associated with an incident broadband pulse, there is the problem of removing the filtering of this data by the radar antenna(s), the characteristics of the incident pulse, and other electronic equipment (such as directional couplers). One approach to this problem is to construct transfer functions (frequency domain) corresponding to these various factors. Then by use of numerical Fourier transforms one transforms the radar data, divides by the transfer functions and numerically inverse Fourier transforms to obtain the delta-function response of the target.

One of the advantages of looking at the delta-function response is the separation of the target response from that of other scatterers (clutter) by looking only at a time window corresponding to the time of return of the target signal. Such time separation is corrupted by the temporal convolution corresponding to the transfer functions mentioned above. There is also the inevitable problem of noise in the data as well. This can affect the accuracy of the deconvolution required by making the above transfer functions correspond as closely as practical to single delta functions in time (i.e., minimum dispersion).

An alternate approach, applicable in some cases, is to use analytic deconvolution directly in the time domain. This applies to the cases where the inverse of the transfer functions mentioned above can be written analytically in the time domain, and where the form that the deconvolution takes is relatively simple. This paper explores a few such cases.

Here we have analytic formulas for deconvolution in the time domain. These have varying degrees of simplicity. The shift-and-add form for the directional coupler is simpler than the recursive integral formulas for the IRAs.

Such analytic procedures will not solve all deconvolution problems. To the degree that they remove some of the dispersion in the data, the corrected data can perhaps be more accurately processed by numerical Fourier transforms since the remaining transfer function to be unfolded then corresponds more closely to a delta function.