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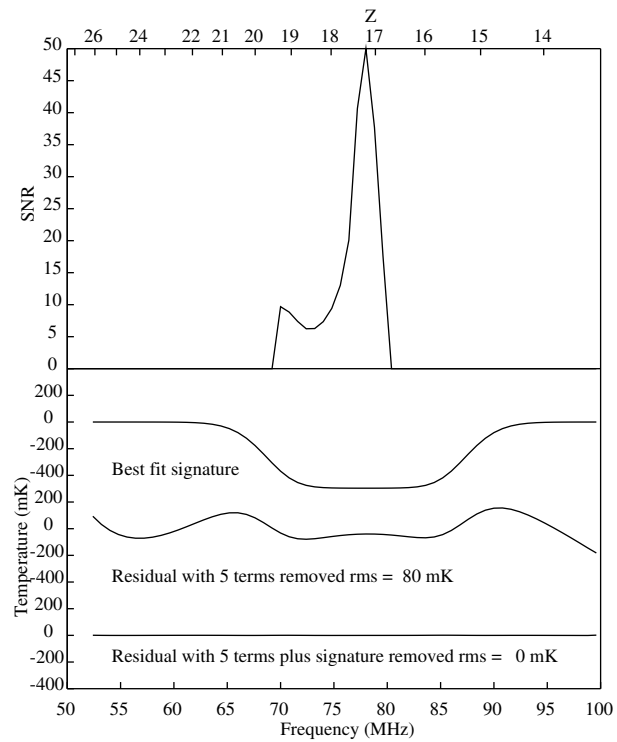
From: Alan E.E. Rogers

Subject: Simulations of the effect of the prior removal of delay to fitting S11 data

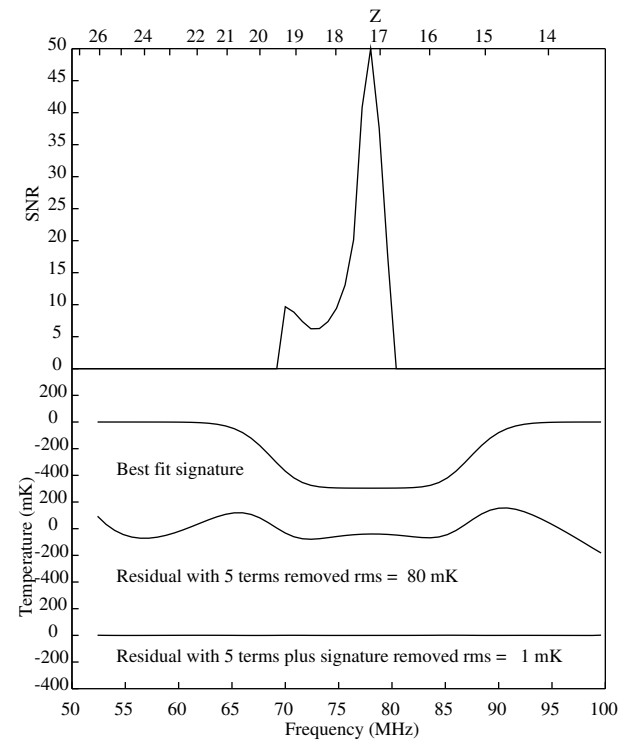
A polynomial or Fourier series fitting of the VNA S11 data is needed to reduce the effects of measurement error and allow accurate “interpolation” of the S11 data which typically has a different frequency spacing than the spectral data. Memo 331 discusses how a delay is taken out before fitting the S11 and put back after the fitting minimizes the structure in the S11 that can be present when fitting a polynomial or Fourier series to the S11. The least squares fit is made in the polyfitr() function using the qrd() function which “long double” precision in the matrix inversion.

In order to provide a test of the performance of the delay removal and reinsertion method the results of using simulated data processed using edges3.c with and without the removal of the S11 delay prior to fitting are compared with the known absorption used in the simulation. Many cases were tested with and without added noise and with and without added systematics derived from applying offsets to S11 parameters. No significant differences were found any larger than the example shown in Figure 1 using simulated data with the absorption parameters of the 2018 result without added noise or systematics shows the almost perfect recovery of the absorption. With added noise and systematics the fractional differences remained at about the same level. In summary with removal and of delay only makes very small differences most of which very slightly favor the use of delay removal and reinsertion so this method is probably only needed in special test cases.

One such case is when the S11 phase is very noisy and fitting the S11 with a polynomial is needed the use of the removal and reinsertion of delay is essential even with 11 terms in case of a large delay like that of the open and shorted cable. However fitting the open and shorted cables with a polynomial has been used very occasionally.



freq 78.0 snr 1313.0 sig 0.50 wid 19.00 tau 7 rmsin 0.0800 rms 0.0005 52 - 100



freq 78.0 snr 1229.5 sig 0.50 wid 19.00 tau 7 rmsin 0.0800 rms 0.0005 52 - 100

Figure 1. Results the processing with removal and reinsertion of S11 delay on the left and without on the right.