Understanding Weiner Filter by Optimally Subtracting Seismometer Signal

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The aim of this exercise is to optimally subtract one seismometer signal from another. To do so, a Weiner filter must be computed using one seismometer channel as desired signal and other as observed signal.

Method Adopted

A ten minute signal was taken from 2 seismometer (GUR1 and GUR2) installed at 40m Lab. The start time of the signal was Aug 2 00:00:00 PSD.

For every choice of desired (x) and witness signal(y) a 4000 order Weiner filter (W) was computed using the first 25 seconds of the signal. Witness signal(y) is filtered with the computed Wiener filter (W) to obtained a filtered signal (z). Filtered signal is then subtracted from desired signal (x) to obtain the difference signal (d). We should expect 0 correlation between difference signal and witness signal.

Summary of Results

Desired Signal (x)	GUR1_X	GUR1_Y	GUR1_Z	GUR2_X	GUR2_Y	GUR2_Z
Witness Signal (y)	GUR2_X	GUR2_Y	GUR2_Z	GUR1_X	GUR1_Y	GUR1_Z
Correlation between x and y	-0.0662	-0.2620	0.0565	-0.0662	-0.2620	0.0565
Correlation between d and y	-0.2196	-0.0615	-0.0082	-0.0810	0.0953	-8.21e-4
(Power of D)/(Power of X)	0.3836	0.4547	0.1707	0.2847	0.0941	0.6544

Notes

- The two seismometers were placed far hence the 2 signals were not very correlated.
- Weiner filter is computed with the code written by Keenan Pepper which I obtained from Den.
- Correlation is defined as $\rho_{x,y} = \frac{E[(x-\mu_x)(y-\mu_y)]}{\sigma_x \sigma_y}$.