Subject: Re: Wiener filter
Posted by James Kuyper Jr. on Wed, 19 Dec 2001 15:03:21 GMT
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Surendar Jeyadev wrote:

> In article <9vllbg$po7$1@canopus.cc.umanitoba.ca>,
> Richard Tyc <richt@sbrc.umanitoba.ca> wrote:
>
>> Has anyone developed a Wiener filter algorithm for image processing in IDL
>> (and be willing to share it ???)
>> My image processing handbook by John Russ does not have it ??
>> A paper that describes it says it produces a "minimum least-squares error
>> between the "true" uncorrupted image and the noisy, measured version" It
>> makes use of the power spectral density of the image.
>>
>> Any help appreciated.....
>
>
> I am note sure what you mean by 'filter'. The Wiener spectrum is
> defined by precisely what you quote: it is the square of the
> Fourier transform of the (density) fluctuations.
...

Optimal Wiener filtering of a one-dimensional data set is described in section 12.6 of "Numerical Recipes in C", by Preuss et.al. It cites three books on signal processing as references. The basic result is that if you have a corrupted signal with the fourier spectrum S(f), containing noise with a fourier specturm N(f), it can be shown rigorously that the optimal (in the sense of a least-squares fit) frequency filter for removing the noise is:

```
            |S(f)|^2
phi(f) = --------------------
       |S(f)|^2 + |N(f)|^2
```

The procedure is straightforward. Estimate the fourier spectrum of the noise. Calculate the fourier spectrum of the corrupted signal. Calculate the corresponding filter function. Multiply the fourier spectrum of the corrupted signal by the filter function. Do an inverse fourier transform on the resulting function, to get an optimum estimate to the uncorrupted signal.

A seemingly bright idea is to subtract that estimate of the uncorrupted signal from the corrupted signal, to get a better estimate of the noise. Then use that improved noise estimate to re-filter the data. This doesn't work: the process converges to a signal of S(f)=0. Basically, each step in that process treats a portion of the uncorrupted signal as if it were part of the noise.

I've not seen this derived for an image processing context, where you have a two-dimension fourier transform to contend with, but I would expect the results to be basically the same.