
Subject: Re: Complications with variance using FFTs
Posted by [olde_english33](#) on Mon, 19 Jul 2004 16:19:03 GMT
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Craig Markwardt <craigmnet@REMOVEcow.physics.wisc.edu> wrote in message news:<oniscn642i.fsf@cow.physics.wisc.edu>...

> olde_english33@hotmail.com (Eric) writes:

>

>> First I computed the FFT of a recorded time series. I then computed
>> the spectrum of this time series to keep the amplitudes of the
>> original data. I then wanted to tie in a random phase because I want
>> to give variables the same kind of shape when I inverse transform.
>> Here is a sample of my code:

> ...

>> My dilemma is that the average sample variances of the generated time
>> series ddd1 and ddd2 are nowhere close to the average sample variance
>> of the original time series xf1 and xf2. A colleague and I have
>> narrowed it down to the fact that we are multiplying the spectrum by a
>> random phase which is throwing off the variance but I don't know how
>> to counteract this problem. Can anyone help???

>

>

> Greetings, it's hard to comment, since your code snippets don't
> actually connect to each other, but I can ask some probing questions.

>

> Have you considered that for a pure real signal, the negative
> frequency components should actually be multiplied by $\exp(-\phi)$?

>

> Did you check that the magnitude of the Fourier components was
> preserved? And the corollary, are you sure that IMAG is purely
> imaginary and doesn't have a real component?

>

> Good luck,

> Craig

Hello. First, I don't understand what you mean by "multiplied by $\exp(-\phi)$? Secondly, consider the following code instead:

```
for i=0,12 do begin
```

```
  Xf1[* ,i]=fft(xf1[* ,i]-mean(xf1[* ,i]))*31.0
```

```
  Xf2[* ,i]=fft(xf2[* ,i]-mean(xf2[* ,i]))*31.0
```

```
  specx1[* ,i]=Xf1[* ,i]*conj(Xf1[* ,i])/31.0
```

```
  specx2[* ,i]=Xf2[* ,i]*conj(Xf2[* ,i])/31.0
```

```
endfor
```

```
for i=0,30 do begin
```

```
  avgspec1=mean(spec1[i,*])
```

```
  avgspec2=mean(spec2[i,*])
```

endfor

```
for j=0,99 do begin
  rp=randomu(5*j,15)
  e[0]=0.0
  e[1:15]=rp
  for k=0,14 do begin
    e[30-k]=rp[k]
  endfor
  Hf1=avgspec1*exp(e)
  Hf2=avgspec2*exp(e)
  whtnoise[* ,j]=(randomu(2*j+3,31)-0.5)*sqrt(12.0)
  wn[* ,j]=fft(whtnoise[* ,j])
  yf1[* ,j]=Hf1*wn[* ,j]
  yf2[* ,j]=Hf2*wn[* ,j]
  ddd1[* ,j]=(fft(yf1[* ,j],1))
  ddd2[* ,j]=(fft(yf2[* ,j],1))
endfor
```

Now I think all the code snippets are related correctly. I checked the the average variance of all the `xf1[* ,i]` was equal to `sum(avgspec1)/31.0` and that the average variance of `xf2[* ,i]` was equal to `sum(avgspec2)/31.0`. This check held. It works if I don't throw in the symmetric random phase `exp(e)`. Does this phase throw off the variance? Is there any way to account for inputting this random phase?
