Subject: Re: FFT confusion
Posted by K. Bowman on Thu, 15 May 2003 15:38:52 GMT
View Forum Message <> Reply to Message

In article <7126861e.0305150615.29c97045@posting.google.com>,
jefield@taz.qinetiq.com (Julian Field) wrote:

> Hi,
>
> I'd be enormously grateful if anyone could help me with this.
>
> I'm looking at the power spectra of "chirp" radio signals and am
> having problems getting sensible plots. The following code should
> generate a complex sinusoidal chirp whose frequency runs from 100 to
> 150 Hz and then plot its power spectrum:
>
> However I'm getting a frequency spectrum running from 100 to *200* Hz
> and I'm really confused. This problem has been bugging me for ages and
> I'd be very grateful if anyone could point out my mistake(s).

Your signal is not a linear combination of frequencies between 100 and
150 Hz. If it were you would get something like this.

```
pro spec
  time = (2.0/1000)*findgen(1001)  ; time (s). NB 1001 samples in 2s
                    ; so sampling freq is 500 Hz thus
                                ; Nyquist freq is 250 Hz
  i = complex(0,1)

  freq1 = REPLICATE(100.0, 1001)          ; single frequency #1
  freq2 = REPLICATE(150.0, 1001)          ; single frequency #2

  theta1 = 2*!pi*freq1*time ; chirp phase angle
  theta2 = 2*!pi*freq2*time ; chirp phase angle
  signal = exp(i*theta1) + exp(i*theta2)

  neg_freq_axis = reverse(-((250.0/500)*findgen(501)))
  pos_freq_axis = ((250.0/499)*findgen(500)) + 1.0
  freq_axis = [neg_freq_axis,pos_freq_axis]       ; x-axis for plot

  window,2,xsize=500,ysize=250
  plot,freq_axis,alog10(shift(((abs(fft(signal)))^2),500)),$
  xrange=[0,260],$
  /xstyle,$
  xticklen=1,$
  xgridstyle=1,$
  yticklen=1,$
  ygridstyle=1
```

end

Even in this case you do not get perfect delta-function spikes in the
power spectrum due to finite signal length and sampling.

To construct your frequency-swept chirp, you have to use frequencies
over a larger range than the "pure" frequencies contained in your signal.

Ken Bowman

Subject: Re: FFT confusion
Posted by jefield on Mon, 19 May 2003 15:46:19 GMT
View Forum Message <> Reply to Message

Kenneth Bowman <k-bowman@null.tamu.edu> wrote in message
news:<k-bowman-FF6825.10385215052003@news.tamu.edu>...
> In article <7126861e.0305150615.29c97045@posting.google.com>,
> jefield@taz.qinetiq.com (Julian Field) wrote:
>
>> Hi,
>>
>> I'd be enormously grateful if anyone could help me with this.
>>
>> I'm looking at the power spectra of "chirp" radio signals and am
>> having problems getting sensible plots. The following code should
>> generate a complex sinusoidal chirp whose frequency runs from 100 to
>> 150 Hz and then plot its power spectrum:
>>
>> However I'm getting a frequency spectrum running from 100 to *200* Hz
>> and I'm really confused. This problem has been bugging me for ages and
>> I'd be very grateful if anyone could point out my mistake(s).
>
> Your signal is not a linear combination of frequencies between 100 and
> 150 Hz. If it were you would get something like this.
>
> pro spec
> time = (2.0/1000)*findgen(1001) ; time (s). NB 1001 samples in 2s
> ; so sampling freq is 500 Hz thus
> ; Nyquist freq is 250 Hz
> i = complex(0,1)
>
> freq1 = REPLICATE(100.0, 1001) ; single frequency #1
> freq2 = REPLICATE(150.0, 1001) ; single frequency #2
>
> theta1 = 2*!pi*freq1*time ; chirp phase angle
> theta2 = 2*!pi*freq2*time ; chirp phase angle

> signal = exp(i*theta1) + exp(i*theta2)
>
> neg_freq_axis = reverse(-((250.0/500)*findgen(501)))
> pos_freq_axis = ((250.0/499)*findgen(500)) + 1.0
> freq_axis = [neg_freq_axis,pos_freq_axis] ; x-axis for plot
>
> window,2,xsize=500,ysize=250
> plot,freq_axis,alog10(shift(((abs(fft(signal)))^2),500)),$
> xrange=[0,260],$
> /xstyle,$
> xticklen=1,$
> xgridstyle=1,$
> yticklen=1,$
> ygridstyle=1
>
> end
>
> Even in this case you do not get perfect delta-function spikes in the
> power spectrum due to finite signal length and sampling.
>
> To construct your frequency-swept chirp, you have to use frequencies
> over a larger range than the "pure" frequencies contained in your signal.
>
> Ken Bowman

Thank you very much for your help.

Best wishes,

Julian

Subject: Re: FFT confusion
Posted by kapoorconsciousness on Sat, 05 Aug 2017 22:13:01 GMT
View Forum Message <> Reply to Message

Same issue, this chirp peaks at omega0 and omega0 + 2 * chirprate rather then just omega0 + chirprate, have you figured it out why yet?

On Monday, May 19, 2003 at 5:46:19 PM UTC+2, Julian Field wrote:
> Kenneth Bowman <k-bowman@null.tamu.edu> wrote in message
news:<k-bowman-FF6825.10385215052003@news.tamu.edu>...
>> In article <7126861e.0305150615.29c97045@posting.google.com>,
>> jefield@taz.qinetiq.com (Julian Field) wrote:
>>
>>> Hi,
>>>
>>> I'd be enormously grateful if anyone could help me with this.

```
>>>
>>>  I'm looking at the power spectra of "chirp" radio signals and am
>>>  having problems getting sensible plots. The following code should
>>>  generate a complex sinusoidal chirp whose frequency runs from 100 to
>>>  150 Hz and then plot its power spectrum:
>>>
>>>  However I'm getting a frequency spectrum running from 100 to *200* Hz
>>>  and I'm really confused. This problem has been bugging me for ages and
>>>  I'd be very grateful if anyone could point out my mistake(s).
>>
>>  Your signal is not a linear combination of frequencies between 100 and
>>  150 Hz.  If it were you would get something like this.
>>
>>  pro spec
>>    time = (2.0/1000)*findgen(1001)  ; time (s). NB 1001 samples in 2s
>>                       ; so sampling freq is 500 Hz thus
>>                                  ; Nyquist freq is 250 Hz
>>    i = complex(0,1)
>>
>>    freq1 = REPLICATE(100.0, 1001)          ; single frequency #1
>>    freq2 = REPLICATE(150.0, 1001)          ; single frequency #2
>>
>>    theta1 = 2*!pi*freq1*time ; chirp phase angle
>>    theta2 = 2*!pi*freq2*time ; chirp phase angle
>>    signal = exp(i*theta1) + exp(i*theta2)
>>
>>    neg_freq_axis = reverse(-((250.0/500)*findgen(501)))
>>    pos_freq_axis = ((250.0/499)*findgen(500)) + 1.0
>>    freq_axis = [neg_freq_axis,pos_freq_axis]       ; x-axis for plot
>>
>>    window,2,xsize=500,ysize=250
>>    plot,freq_axis,alog10(shift(((abs(fft(signal)))^2),500)),$
>>    xrange=[0,260],$
>>    /xstyle,$
>>    xticklen=1,$
>>    xgridstyle=1,$
>>    yticklen=1,$
>>    ygridstyle=1
>>
>>  end
>>
>>  Even in this case you do not get perfect delta-function spikes in the
>>  power spectrum due to finite signal length and sampling.
>>
>>  To construct your frequency-swept chirp, you have to use frequencies
>>  over a larger range than the "pure" frequencies contained in your signal.
>>
>>  Ken Bowman
```

>
> Thank you very much for your help.
>
> Best wishes,
>
> Julian

Subject: Re: FFT confusion
Posted by kapoorconsciousness on Sat, 05 Aug 2017 22:59:20 GMT
View Forum Message <> Reply to Message

Solved, you we missing taking into account the deltat of your data into making the chirp signal. The code below would work:

```
  time = (2.0/1000)*findgen(1001)        ; time (s). NB 1001 samples in 2s
  ; so sampling freq is 500 Hz thus
  ; Nyquist freq is 250 Hz

  ;;; so your deltat = 2, aha!
  deltat = 2;

  freq = 100.0 + (50.0/1000)*findgen(1001)/deltat ; chirp frequency array

  theta = 2*!pi*freq*time ; chirp phase angle

  i = complex(0,1)

  signal = exp(i*theta)

  neg_freq_axis = reverse(-((250.0/500)*findgen(501)))
  pos_freq_axis = ((250.0/499)*findgen(500)) + 1.0
  freq_axis = [neg_freq_axis,pos_freq_axis]        ; x-axis for plot

  window,2,xsize=500,ysize=250
  plot,freq_axis,alog10(shift(((abs(fft(signal)))^2),500)),$
    xrange=[0,260],$
    /xstyle,$
    xticklen=1,$
    xgridstyle=1,$
    yticklen=1,$
    ygridstyle=1

set_plot, "x";
end
```

On Monday, May 19, 2003 at 5:46:19 PM UTC+2, Julian Field wrote:

> Kenneth Bowman <k-bowman@null.tamu.edu> wrote in message
news:<k-bowman-FF6825.10385215052003@news.tamu.edu>...
>> In article <7126861e.0305150615.29c97045@posting.google.com>,
>>   jefield@taz.qinetiq.com (Julian Field) wrote:
>>
>>> Hi,
>>>
>>> I'd be enormously grateful if anyone could help me with this.
>>>
>>> I'm looking at the power spectra of "chirp" radio signals and am
>>> having problems getting sensible plots. The following code should
>>> generate a complex sinusoidal chirp whose frequency runs from 100 to
>>> 150 Hz and then plot its power spectrum:
>>>
>>> However I'm getting a frequency spectrum running from 100 to *200* Hz
>>> and I'm really confused. This problem has been bugging me for ages and
>>> I'd be very grateful if anyone could point out my mistake(s).
>>
>> Your signal is not a linear combination of frequencies between 100 and
>> 150 Hz. If it were you would get something like this.
>>
>> pro spec
>>   time = (2.0/1000)*findgen(1001) ; time (s). NB 1001 samples in 2s
>>   ; so sampling freq is 500 Hz thus
>>   ; Nyquist freq is 250 Hz
>>   i = complex(0,1)
>>
>>   freq1 = REPLICATE(100.0, 1001)   ; single frequency #1
>>   freq2 = REPLICATE(150.0, 1001)   ; single frequency #2
>>
>>   theta1 = 2*!pi*freq1*time ; chirp phase angle
>>   theta2 = 2*!pi*freq2*time ; chirp phase angle
>>   signal = exp(i*theta1) + exp(i*theta2)
>>
>>   neg_freq_axis = reverse(-((250.0/500)*findgen(501)))
>>   pos_freq_axis = ((250.0/499)*findgen(500)) + 1.0
>>   freq_axis = [neg_freq_axis,pos_freq_axis]   ; x-axis for plot
>>
>>   window,2,xsize=500,ysize=250
>>   plot,freq_axis,alog10(shift(((abs(fft(signal)))^2),500)),$
>>   xrange=[0,260],$
>>   /xstyle,$
>>   xticklen=1,$
>>   xgridstyle=1,$
>>   yticklen=1,$
>>   ygridstyle=1
>>
>> end

>>
>> Even in this case you do not get perfect delta-function spikes in the
>> power spectrum due to finite signal length and sampling.
>>
>> To construct your frequency-swept chirp, you have to use frequencies
>> over a larger range than the "pure" frequencies contained in your signal.
>>
>> Ken Bowman
>
> Thank you very much for your help.
>
> Best wishes,
>
> Julian
