
Subject: Re: FFT example. Help!

Posted by [Peter Brooker](#) on Tue, 02 May 2000 07:00:00 GMT

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thanks for taking the time to reply. This helps allot!!

peter brooker

Alan Barnett wrote:

> I think your confusion stems from a misunderstanding of what the FFT
> does. There are at least three related, but not identical, operations
> that are referred to as "Fourier transforms".

>

> 1) Fourier integral.

> A function $f(x)$ that is "well behaved", continuous and not periodic
> has a Fourier transform $F(k)$ that is "well behaved", continuous and not
> periodic. F and f are related by the Fourier transform and Fourier
> inversion formulas:

> $F(k) = \int f(x) \exp(-i kx) dx$

> and

> $f(x) = \int F(k) \exp(i kx) dx$

> The limits of the integral are + and - infinity.

>

> 2) Fourier series.

> If the function $f(x)$ is a periodic function of x with period L , its
> Fourier transform is zero for all k that are not integral multiples of 2
> π / L , and the integral diverges if k is an integral multiple of $2 \pi /$
> L . $F(k)$ can be expressed as a sum of dirac delta functions, but it is
> more convenient to simplify the notation and write $f(x)$ as a Fourier
> series:

> $f(x) = \sum (A_n \sin(n \pi x / L) + B_n \cos(n \pi x / L))$

> where the Fourier coefficients A_n and B_n are

> $A_n = (2/L) \int f(x) \sin(n \pi x / L) dx$

> $B_n = (2/L) \int f(x) \cos(n \pi x / L) dx$

>

> 3) Discrete Fourier transform (DFT)

> If the function $F(x)$ is a periodic function of x with period L and is only
> defined at N equally spaced discrete points $x_n = n L / N$, $n = 0, N-1$, then
> its Fourier transform is a periodic function of $k = 2 \pi / L$ and is
> nonzero only at the discrete values $k_m = 2 m \pi / L$, $m = 0, N-1$. Instead
> of considering the functions $F(x)$ and $f(k)$, which are sums of delta
> function, it is easier to consider F_m and f_n , the coefficients of the
> delta functions. These coefficients are related by the discrete fourier
> transform:

>

> $F_m = \sum (f_n \exp(-i 2 \pi m n / N))$

>

- > and its inverse
 - >
 - > $f_n = (1/N) \sum (F_m \exp(i 2 \text{ Pi } m n / N))$
 - >
 - > The FFT is a fast algorithm for computing the discrete fourier transform.
 - >
 - > If you want an example using the FFT that "makes sense" (I asume that you
 - > mean one that you can compute analytically), you have to remember that the
 - > FFT computes the discrete Fourier transform, not the Fourier integral.
 - > The simplest example is
 - > $f_n = 1$ for all n
 - > $F_m = N$ for $m = 0$; 0 otherwise
 - >
 - > The FFT is frequently applied to the problem of estimating the Fourier
 - > integral of a non-periodic function whose value is only known at a
 - > discrete set of sampled points. One then must cope with errors introduced
 - > by sampling (aliasing) and truncation (Gibbs ringing).
 - >
 - > For a good overview, look in Numerical Recipes by Press et al.
 - >
 - > I hope this helps.
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