Re: Fourier transform and the like

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- *From*: israel@xxxxxxxxxxx (Robert Israel)
- *Date*: 11 Oct 2005 23:18:45 GMT

In article <1129058622.804690.94460@xxxxxxxxxxxxxxxxxxxxxxxxxxxx>,
S. Gammelmark <gammelmark@xxxxxxxxx> wrote:
>I'm well aware, that e^(kx) does not form an orthonormal/orthogornal
>basis with respect to the same inner product as is used in the fourier
>transform/series, but it can, however, be constructed using the
>Gram−Schmidt process.

I'm not sure what "it" is here, but if you're talking about the real line here in the context of Fourier transform, e^{kx} is not square−integrable, so Gram−Schmidt can't even get started.

Another way of thinking of Fourier transform is as the application of the Spectral Theorem to the self−adjoint operator −i d/dx on L^2(R). This operator is rather special because it generates translations. Other self−adjoint operators with continuous spectrum would produce other transforms. Self−adjoint operators with discrete spectrum lead to orthonormal bases, analogous to Fourier series. If you want a nice orthogonal basis for L^2(R), you might try Hermite functions
u_n(x) = pi^(−1/4) 2^(−n/2) (n!)^(−1/2) exp(−x^2/2) H_n(x)
(H_n the Hermite polynomials), which are eigenfunctions for the harmonic oscillator.

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