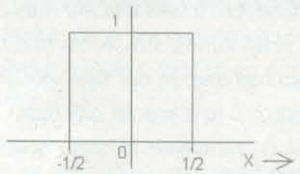
MATHEMATICAL RELATIONSHIPS

AND THE BIG NERDS WHO HAVE RELATIONSHIPS WITH THEM

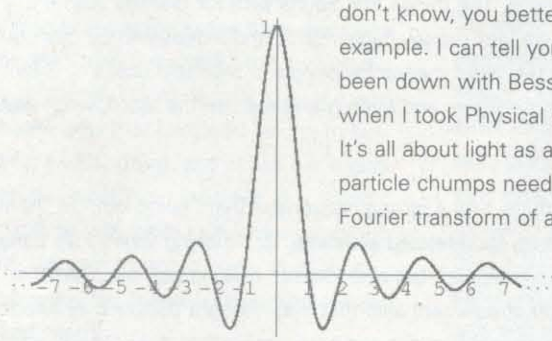
by Seth Baum, Big Nerd



HEY KIDS! DO YOU LIKE ACTION? DO YOU LIKE EXCITEMENT? DO YOU LIKE ... BESSEL FUNCTIONS?

$$\mathrm{sinc}(x) = \frac{\sin(\pi x)}{\pi x}$$

Don't know what a Bessel function is? Well, if you don't know, you better ask somebody! Like me for example. I can tell you all about them. See, I've been down with Bessel functions ever since '01 when I took Physical Optics I. That class was dope! It's all about light as a wave, yo! Those light-as-particle chumps need to step off like the inverse Fourier transform of a sinc function.



But enough about quantum mechanics. We were talking about Bessel functions, and how they describe the relationship between the position of a moving electromagnetic wave (in a cylinder-shaped "waveguide") and its strength. Or, imagine a beating drum. Bessel functions can describe the relationship between the strength of vibratons on the top surface of the drum and a specific position on that surface. Mmm, putting the func back in function, oh yeah.

$$\mathrm{rect}(t) = \sqcap(t) = \begin{cases} 0 & \text{if } |t| > \frac{1}{2} \\ \frac{1}{2} & \text{if } |t| = \frac{1}{2} \\ 1 & \text{if } |t| < \frac{1}{2} \end{cases}$$

Now of course these relationships aren't exact. Just like no man is an island, no cylindrical electromagnetic waveguide cross-section and no drumhead are perfectly circular. In reality, the relationships we're talking about aren't exactly Bessel functions, but some other relationship that's probably unique to that particular waveguide or drum. We couldn't derive the exact relationship analytically, meaning from the underlying geometry, but we could determine an approximate relationship experimentally, meaning by taking measurements of the thing, or numerically, meaning by simulating it with a computer model. We'd find that, sure enough, the relationship looks pretty darn close to a Bessel function. It's like my boy George Box the industrial statistician said, "All models are wrong, some are useful." Modeling waveguides and drums with Bessel functions is wrong because the actual phenomenon is not exactly a Bessel function, but doing so is useful because the reality is approximately a Bessel function, which is much easier to work with than whatever gory relationship is exactly correct. And that, folks, is why I'm down with the Bessel. Plus they look cool. WU

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1 The inverse Fourier transform of a sinc function is a rect function, which looks like a step, if I dare say so myself. Of course, a step function looks even more like a step, but its inverse Fourier transform lacks a catchy name.

Seth Baum wants to know your sine.