

Engineering Physics Seminar

Wednesday 10/10/2007, 4:30 pm
Science & Engineering Building Auditorium

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The Fast Fourier Transform. Use of Excel to Demonstrate its Power and Idiosyncrasies

The Fast version of the Fourier Transform allows “technology to fly”¹. It made possible the medical miracle of MRI. It provides unparalleled insight into many problems in applied physics and engineering; yet its versatility is cause for great confusion.

For example, the frequency dependence of spectral densities specified in a plot per Hz must be modified when working with an octave or decade specification that is more natural for a log-scale of frequency – but which is rarely employed. Absolute specifications can be easily erroneous, so many choose to simply view relative magnitudes in a plot of power versus either frequency or period. In this seminar, Excel will be used interactively to illustrate some of the many subtle sources of error. The talk will begin with a discussion of the six different forms of the purely-mathematical Fourier transform plus inverse, all of which are mathematically acceptable, but which are not equally useful in applied numerical computation. Differences between two common noise types will be discussed; i.e., white ($1/f^0$) and pink ($1/f^1$). There will also be a discussion of earth vibrations, where it is found that low-frequency seismic noise of the earth is not of the ubiquitous $1/f$ form, but is closer to ‘brown’ ($1/f^2$). Finally, a novel simple algorithm will be described that generates nearly-pink noise using the FFT with a random number generator.



The photo is of High-Falls, not far from Macon. The color-noise of crashing water is ‘pink’, also known by the labels ‘flicker’ and $1/f$.

¹Cipra, Barry, “The FFT: Making Technology Fly”, SIAM News, Vol. 26, No. 3, May 1993 -- online at <http://www.siam.org/siamnews/mtc/mtc593.htm>. See also “Graphical explanation for the speed of the FFT”, <http://arxiv.org/html/math.HO/0302212>.

Please join us for light refreshments at 4:15pm outside SEB 203.