Physics Seminar

Wednesday 1/19/2011, 4:30 pm
Science & Engineering Building Auditorium

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Activities of a physicist and two cardiac practitioners − an example of *interdisciplinary research* rewards

As Professor in the Mercer University Physics Department, the speaker is working with two medical school personnel on a large, two-year NIH grant that was recently awarded to the university. In this capacity, and while developing Mathematica-based seismocardiography (SCG) software, he accidently encountered a remarkably useful numerical algorithm. The math-foundation of this Teager-Kaiser-Energy (TKE) operator is identical to that of a famous physics problem, called the Simple Harmonic Oscillator. Even though the TKE operator is used by a significant number of life-science, computer-science and engineering-science personnel; nevertheless it is virtually unknown to 'physics-science' personnel. Because of its roots in physics, and because of the grant, the speaker was motivated to modify the common form(s) of TKE to create an algorithm that should be acceptable to even the 'pure-hearts' of the physics world. This properly-normalized ('completed') new version, which is called a 'Peak Tracker', is a powerful demodulator/filter that is especially well suited to studies of records in the frequency domain. Historically, the frequency domain has been a place where physicists excel and love to dwell. So, maybe it's not a great surprise that heart understanding is being advanced through the use of this and other components of our novel frequency-domain software collection. Operating synergetically, these software tools were responsible for a recent discovery that shocked us. Like ourselves, most would probably (and erroneously) believe that heartbeat and even respiration should be the most important (dominant) *spectral* feature of either an SCG or the well-known EKG. Because of nonlinear amplitude modulation effects (that remain to be understood from first principles), heartbeat and respiration are actually in most cases invisible--unless the time-domain signal is first demodulated, before doing the Fourier transform that generates spectral lines of the frequency domain. Some examples of these discoveries will be provided during the talk. And for the curiosity of the more technically-minded of the audience; the speaker will provide some detailed discussions of these recently-created software tools.

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