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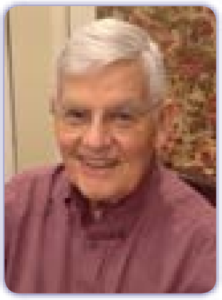

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Generalizing the harmonic oscillator and Fourier analysis: An infinite family of mutually unbiased bases

We consider canonical transformations from the standard coordinate, x, to new coordinates that either stretch or compress the real line. The guide to our choice of transformation comes from consideration of supersymmetric quantum mechanics and the fact that it shows that any 1-D ground state minimizes the Heisenberg uncertainty product of the new coordinate and conjugate momentum. Using the fact that the transformation is a point transformation, it is easy to obtain the conjugate classical momentum. These are quantized, resulting in Heisenberg-Weyl Lie algebra. In parallel to the connection of the harmonic oscillator eigenstates and the Fourier transform, we obtain a generalization of the Fourier transform kernel which is ideally suited to the harmonic analysis of chirps. In addition, the (improper) eigenstates of the new position and momentum operators, as well as their sum are shown to constitute a mutually unbiased set of basis states. The appearance of the Heisenberg-Weyl Lie algebra also leads to a generalized harmonic oscillator (GHO), whose eigenstates are also eigenstates of the generalized Fourier transform kernel. The ground states of these GHOs are simply generalizations of the Gaussian and share many important properties of the Gaussian. In particular, they are attractor solutions of a Fokker-Planck equation who's laplacian is simply the kinetic energy operator of the GHO. The simplest form of these ground states is $N\exp(-x^{2n}/2)$, where N is the normalization factor and the integer, n, ranges from zero on up. The generalized laplacian for the GHO is $-\frac{1}{2}$[illegible], $n \geq 0$. The potential of the GHO is $x^{2n}/2$. However, we show that one may also have polynomials (of a specific structure) as the argument of the exponential ground state. We will discuss various possible applications of our results.

Biography

Donald J Kouri has completed his PhD from University of Wisconsin in the year 1965. He carries research in the fundamental implications of the Heisenberg uncertainty principle and the resulting applications and also generalized coherent states, quantum theory of atomic and molecular collisions.

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