On Fluctuation with Memory and White Noise Analysis

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ABSTRACT

A fluctuating variable $x(\tau)$ with memory of the past may be modelled by parameterizing its evolution in time t by,

$$x(\tau) = x_0 + \int_0^\tau f(\tau - t)\ \ h(t)\ \ \omega(t)\ \ dt.$$

Here $f(\tau - t)$ is a memory function, $h(t)$ a deterministic factor, and $\omega(t)$ a random white noise variable. The explicit form of $f(\tau - t)$ and $h(t)$ would depend on the natural or social phenomena being modelled. Application of white noise analysis [1, 2], which was originally introduced by T. Hida, facilitates the evaluation of the conditional probability density as a summation-over-all histories [3]. The corresponding diffusion equation and related standard deviation for various forms of $f(\tau - t)$ and $h(t)$ are discussed. The usual fractional Brownian motion appears as a special case. Possible applications of this approach are also given [4].

References

[1] T. Hida, *Analysis of Brownian Functionals,* Carleton Mathematical Lecture NOtes **13** (1975).

[2] T. Hida, H. H. Kuo, J. Potthoff, L. Streit, *White Noise. An Infinite Dimensional Calculus* (Kluwer, Dordrecht, 1993).

[3] R. P. Feynman and A. R. Hibbs, *Quantum Mechanics and Path Integrals* (McGraw-Hill, New York, 1965).

[4] C. C. Bernido and M. V. Carpio-Bernido, *Int. Jour. Mod. Phys.B* **26** (2012) 1230014.