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“On the exact solution for a linear stochastic delay differential equation”

A general scheme is proposed to calculate the probability density function (PDF) for a linear stochastic delay differential equation (SDDE), using the path-integral techniques. In particular, we present here an explicit calculation for a stochastic system with a fixed, discrete time-delay although the method can be extended in a natural way to stochastic systems with distributed time-delays. In the most common example of stochastic systems driven with Gaussian noise, the PDF is found to be Gaussian. This result has also been derived earlier by Küchler and Mensch [1] but only for the stationary probability density. We further demonstrate that the method presented here can be easily generalized to a wide variety of stochastic phenomena, known as Lévy processes.

[1] U. Küchler and B. Mensch, *Stochastics and Stochastics Reports* **40**, 23 (1992).

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