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STOCHASTIC DIFFERENTIAL EQUATION FOR BROWNIAN MOTION UNDER BOUNDARY CONDITIONS

In $\mathbb{R}^d$, consider an arbitrary star-shaped set C, containing O and Wiener random measure b on the class of Borel subsets $\mathcal{B}(C)$ of C. The values of this measure, $b(A)$, $A \in \mathcal{B}(C)$, are Gaussian random variables with expectation O and covariance

$$\mathbf{E}b(A)b(A') = \mu_{(d)}(A \cap A'), \tag{1}$$

where $\mu_{(d)}$ is Lebesgue measure in $\mathbb{R}^d$. Given the boundary values of b this random measure is not Wiener random measure any more and has more complicated covariance structure than (1).

Using 1-dimensional innovation argument on each ray it is shown that certain filtration with 1-dimensional time parameter allows construction of unique innovation random measure w on $\mathcal{B}(C)$, which is again Wiener random measure and is in one-to-one correspondence with b, given values of b on the boundary.