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LEVEL CROSSINGS AND LOCAL TIME FOR REGULARIZED GAUSSIAN PROCESSES

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Abstract: Let $\{X_n, t \in [0,1]\}$ be a centred stationary Gaussian process defined on (Ω, A, P) with covariance function satisfying

$$r(t) \sim 1 - C|t|^{2\alpha}, \quad 0 < \alpha < 1, \quad \text{as } t \to 0.$$

Define the regularized process

$$X^\varepsilon = \varphi_\varepsilon * X \quad \text{and} \quad Y^\varepsilon = X^\varepsilon / \sigma_\varepsilon, \quad \text{where } \sigma_\varepsilon^2 = \mathrm{var X_t^\varepsilon},$$

φ_ε is a kernel which approaches the Dirac delta function as $\varepsilon \to 0$ and $*$ denotes the convolution. We study the convergence of

$$Z_\varepsilon(f) = \varepsilon^{-a(\alpha)} \int_{-\infty}^{\infty} \left[\frac{N^{Y^\varepsilon}(x)}{c(\varepsilon)} - L_X(x) \right] f(x) dx \quad \text{as } \varepsilon \to 0,$$

where $N^V(x)$ and $L_V(x)$ denote, respectively, the number of crossings and the local time at level x for the process V in $[0,1]$ and

$$c(\varepsilon) = (2\mathrm{var}(\mathrm{X_t^\varepsilon}) / \pi \mathrm{var}(\mathrm{X_t^\varepsilon}))^{1/2}.$$

The limit depends on the value of α.

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