Fractional SPDEs driven by spatially correlated noise: existence of the solution and smoothness of its density

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Abstract

In this paper we study a class of stochastic partial differential equations in the whole space $\mathbb{R}^d$, with arbitrary dimension $d \geq 1$, driven by a Gaussian noise white in time and correlated in space. The differential operator is a fractional derivative operator. We show the existence, uniqueness and Hölder's regularity of the solution. Then by means of Malliavin calculus, we prove that the law of the solution has a smooth density with respect to the Lebesgue measure.

Keywords: Fractional derivative operator; stochastic partial differential equation; correlated Gaussian noise; Fourier transform; Malliavin calculus.

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