An application of Fractional Operators in White Noise Analysis: Bernstein Gaussian Processes

Cristofaro Lorenzo

(Luxembourg)

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The generalization of fractional Brownian motion in infinite-dimensional white and grey noise space has been recently carried over, following the Mandelbrot-Van Ness representation, through Riemann-Liouville type fractional operators, see [1] and [2].

Our aim is to extend this construction in white noise space by means of more general fractional derivatives and integrals, which we define through Bernstein functions. More precisely, we introduce a general class of kernel-driven processes which encompasses, as special cases, a number of models in the literature, including, for example, fractional Brownian motion and tempered fractional Brownian motion. This model allows flexibility and applicability. Indeed, we study the existence of noise, the solution of a Langevin-type integral equation and derive some properties of this class of processes (such as continuity, local times, variance asymptotics and persistence) according to the conditions satisfied by the Bernstein function chosen, see [3].

References:

[1] F. Mainardi, A. Mura, G. Pagnini, The M-Wright Function in Time-Fractional Diffusion Processes: A Tutorial Survey, 2010.

[2] M. Grothaus, F. Jahnert, Mittag-Leffler analysis II: Application to the fractional heat equation, 2016.

[3] L. Beghin, L. Cristofaro, L., Y. Mishura, A class of infinite-dimensional Gaussian processes defined through generalized fractional operators, arXiv preprint arXiv:2309.13283, 2024+.