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Extending the Wong-Zakai theorem to reversible Markov processes. (English) Zbl 1010.60070

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The motivation for the present paper is to study differential equations of the form $dy_t = f(y_t)dx_t$, which are typical for dynamical systems with exogeneous control, for a large class of paths x_t which are not semimartingales. The approach of this paper is in the spirit of *E. Wong* and *M. Zakai* [Internat. J. Engin. Sci. 3, 213-229 (1965; Zbl 0131.16401) and Ann. Math. Stat. 36, 1560-1564 (1965; Zbl 0138.11201)], who proved that if $x^{(n)}$ is a sequence of bounded variation paths converging uniformly to a Brownian path x, then the solutions of the problem in the classical sense converge to the Stratonovitch solution of the SDE. The seminal paper of *T. J. Lyons* [Rev. Mat. Iberoam. 14, No. 2, 215-310 (1996; Zbl 0923.34056)] shows how the mapping I_f from the control signal x to the solution y can be extended continuously from the class of signals with bounded variation to a bigger space of rough paths. One can regard almost every Brownian path as such a rough signal. The present paper shows that this class is much richer, containing for example diffusions generated by elliptic operators in divergence form, or certain diffusions on fractals. This provides an extension of the Wong-Zakai theorem to rough signals. The main technical achievement of the paper is the definition of a Lévy area, which has finite p-variation for a class of reversible Markov processes satisfying a uniform Hölder condition.

Reviewer: Peter Mörters (Bath)

MSC:

60J60 Diffusion processes
60J25 Continuous-time Markov processes on general state spaces

Cited in **17** Documents

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reversible Markov processes; rough paths; stochastic area; polygonal approximation; stochastic differential equations; finite p-variation

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