A functional limit theorem for stochastic integrals driven by a time-changed symmetric α-stable Lévy process

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Abstract. A continuous time random walk (CTRW) can be formally defined as a random walk subordinated to a counting renewal process. CTRWs became a widely used tool for describing random processes that appear in a large variety of physical models and also in finance.

The main motivation of our work comes from the physical model given by a damped harmonic oscillator subject to a random force (Lévy process) studied in [2] .

We study the convergence of a class of stochastic integrals with respect to the compound fractional Poisson process (see in [1]).

Under proper scaling and distributional hypotheses, we establish a functional limit theorem for the integral of a deterministic function driven by a time-changed symmetric α-stable Lévy process with respect to a properly rescaled continuous time random walk in the Skorokhod space equipped with the Skorokhod M_1-topology. The limiting process is the corresponding integral but with respect to a time-changed α-stable Lévy process where the time-change is given by the functional inverse of a β-stable subordinator.

References

[1] E. Scalas, N. Viles. A functional limit theorem for stochastic integrals driven by a time-changed symmetric α-stable Lévy process. *Submitted*.

[2] I.M. Sokolov, B.Dybiec, W. Ebelling. Harmonic oscillator under Lévy noise: Unexpected properties in the phase space. *Phys. Rev. E. Stat. Nonlin Soft Matter Phys* , **83**, 041118.