Some results for fractional stochastic modeling in biomathematics

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Abstract
Recently the fractional calculus approach in the construction of non-Markov processes for models with memory revealed a powerful mathematical tool. Time-changed processes and fractionally integrated process have been proposed for modelling the interaction between the myosin head and the actin filament, the physio-chemical mechanism triggering the muscle contraction and now not completely understood. Each of these two models includes memory effects in different way. We describe such features from a theoretical point of view and with simulations of sample paths. Mean functions and covariances are provided considering constant and time-dependent tilting forces by which effects of external loads are included. The investigation of the dwell time of such phenomenon is carried out by means of density estimations of the first exit time (FET) of the processes from a strip: this mimics the times of the steps of the myosin head during the sliding movement outside a potential well due to the interaction with the actin. For the case of the time changed diffusion process we specify an equation for the probability density function of the FET from a strip. The schemes of two simulation algorithms are provided and performed. Some numerical and simulation results are given and discussed.
These results are based on a joint work with Nikolai Leonenko and they can be found in [1].

References

1. Leonenko, N., Pirozzi, E. (2025) The time-changed stochastic approach and fractionally integrated processes to model the actin-myosin interaction and dwell times. *Mathematical Biosciences and Engineering* **22(4)**, 1019–1054.