ΣΕΜΙΝΑΡΙΟ ΚΕΝΤΡΟΥ ΚΒΑΝΤΙΚΗΣ ΠΟΛΥΠΛΟΚΟΤΗΤΑΣ & ΝΑΝΟΤΕΧΝΟΛΟΓΙΑΣ/
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Area and perimeter covered by anomalous diffusion processes

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Abstract

Random walks are omnipresent in everyday life. In the often-encountered two-dimensional environment it is desirable to quantify the geometric properties of the area covered by the random walker. A simple and widely employed approach makes use of the convex hull of the trajectory, which is the minimum convex polygon enclosing all points visited during the walk. Nevertheless, convex hulls of Markovian processes such as Brownian motion have only recently been taken into consideration. We go beyond this and examine the geometric properties of Levy walks and continuous time random walks (CTRWs), which are genuinely non-Markovian stochastic processes.
Using the concept of subordination we derive exact analytical expressions for the time-dependent average perimeter and area of the convex hull of CTRWs, a class of non-Markovian sub-diffusive processes. Such processes are characterized by a sub-linear time dependence of the mean square displacement.
A Levy walk is a specific type of random velocity model where the random travel times between two consecutive turning points are distributed according to an inverse power law. Motivated by the ongoing debate regarding whether or not there exist animals that perform a Levy walk, we propose a new robust method based on convex hull properties for discriminating between random walks and Levy walks.