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*Fractal Structure in Random Walk on n-Dimensional Hypersurface*

Discrete random walk on n-dimensional hypersurface has been carried out by computer simulation and its fractal structure has also discussed. As an example in a 3-dimensional hypersurface, when coordinates (x, y, z) are given, the tracks of the random walk based on random variables x, y, and z can be interpreted as a kind of discrete orbit. In this work, we newly define and calculate the local fractal dimension (LFD) in a finite short processing window with a duration consisting of 30 epochs placed on the orbit of the 3-dimensional hypersurface. And then the moving LFD can easily be obtained by sliding the said processing window along the orbit one epoch at a time. It is evident that the same procedure can easily be expanded to general random walk on n-dimensional hypersurface. Specifically, a mathematical method has been proposed for the said discrete orbit on the n-dimensional hypersurface using LFD to evaluate the fractal structure of the random walk system. Normal and uniform random walk have been investigated in detail by computer simulation with results showing that the probability distribution of the moving LFD becomes almost a normal distribution in both cases. The proposed method can also be applied to the analysis of general random processes or statistical quality control in factories or plants using similar procedures.

Keywords: random walk, n-dimensional hypersurface, local fractal dimension, discrete orbit, statistical quality control, fractal structure