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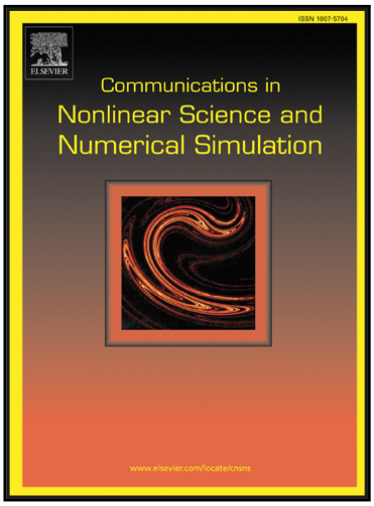

Average weighted trapping time of the node- and edge- weighted fractal networks

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Highlights

- The node- and edge- weighted fractal networks are firstly introduced. When applying network theory to real-world problems, nodes need not all bear the same importance for the network's properties, but there may be nodes having a strong impact on the network's topology that is not reflected by link properties alone. So we take sizes of nodes into account. Based on the edge-weighted fractal networks and node weight, we introduce the node- and edge- weighted fractal networks. The node- and edge- weighted fractal networks have been generalized for applications in the domain of many realistic networks, i.e., the highway network.

- The node-weight-dependent walk and weighted time are proposed. Taking the highway network, for example, nodes represent the highway passenger station and links indicate that there are non-stop vehicle between any two highway passenger stations. Passenger throughput of the highway passenger station is firstly taken into account when a passenger chooses one highway passenger station to the other. So node weight is the passenger throughput of the highway passenger station. A passenger arrives at the next destination station with probability proportional to the passenger throughput of the highway passenger station. So we propose the node-weight-dependent walk. Still taking the highway network, for example, a link is created if a passenger may want to directly reach the destination station from the starting station. A passenger can choose different routes from his origin to the destination according to the consuming traveling cost. So edge weight is the total value of the consuming traveling cost in the highway network. For two adjacency nodes i and j, we introduce the weighted time is the corresponding edge weight r_{ij}.

- The exact analytic formulas of the average weighted trapping time are derived. In the node- and edge-weighted fractal networks, we study the average weighted trapping time (AWTT) and derive the exact analytic formulas of the average weighted trapping time (AWTT), the average of node-to-trap mean weighted first-passage time over the whole networks, in terms of the network size N_g, the number of copies s, the node-weight factor w and the edge-weight factor r. The obtained result displays that in the large network, the AWTT grows as a power-law function of the network size N_g with the exponent, represented by $\theta(s, r, w) = \log_s(srw^2)$ when $srw^2 \neq 1$. Especially when $srw^2 = 1$, AWTT grows with increasing order N_g as $\log N_g$. This also means that the efficiency of the trapping process depend on three main parameters: the number of copies $s > 1$, node-weight factor $0 < w \leq 1$, and edge-weight factor $0 < r \leq 1$. The smaller the value of srw^2 is, the more efficient the trapping process is.

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