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In- and Out-Degree Distributions of Nodes and Coverage in Random Sector Graphs

Abstract:

In a random sector graph, the presence of an edge between two nodes depends on their distance and spatial orientation. This kind of graph is widely used for modeling wireless sensor networks wherecommunication among nodes is directional. In particular, it is applied to describe both the radio frequency transmission among nodes equipped with directional antennas and the line-of-sight transmission in optical sensor networks. Important properties of a wireless sensor network, such as connectivity and coverage, can be investigated by studying the degree of the nodes of the corresponding random sector graph. In detail, the in-degree value represents the number of incoming edges, whereas the out-degree considers the outgoing edges. This paper mathematically characterizes the average degree of a random sector graph and the probability distributions of the in-degree and out-degree of the nodes. Furthermore, it derives the coverage probability of the network. All the formulas are validated through extensive simulations, showing an excellent match between theoretical results and experimental data.