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# Critical Density for Coverage and Connectivity in Two-Dimensional Aligned-Orientation Directional Sensor Networks Using Continuum Percolation

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[Abstract](#)

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Sensing coverage is one of the fundamental design issues in wireless sensor networks. The sensing coverage reflects the surveillance quality provided by them. Moreover, network connectivity is a critical issue for gathering data by sensors to reach to the sink node. Given an initially uncovered area, the sensing coverage is defined as the area covered by the sensors. In this paper, we study the critical density for coverage and connectivity in two-dimensional aligned-orientation directional sensor networks using continuum percolation. We show that the critical density for coverage is lower than the critical density for connectivity. Moreover, we show that the critical density for coverage is lower than the critical density for connectivity in two-dimensional aligned-orientation directional sensor networks using continuum percolation.

and more directional sensors are continuously added to the sensor network, covered areas increases. At some point, the situation abruptly changes from covered areas to a single large covered area. We call this abrupt change the phase transition (SCPT). Likewise, given an originally disconnected sensor network, as more sensors are added, the number of connected components changes suddenly at some point. We call this sudden change the connectivity phase transition (NCPT). The nature of such phase transitions is percolation theory. In this paper, we introduce aligned-orientation directional sensor networks, which nodes are deployed based on Poisson point process and the orientation of nodes is the same. Then, we propose an approach to compute critical density of nodes at critical point of the SCPT and NCPT problems in such networks, for all angles of field-of-view using continuum percolation. Due to percolation theory, the critical density is the same for densities above it SCPT and NCPT almost surely occur. In addition, we propose a unified percolation in directional sensor networks, which provides a basis for solving SCPT and NCPT problems together.

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