**ABSTRACT:**

# Percolation with Distance-Dependent Site Occupational Probabilities

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Abstract:
We introduce a new method for preparing a percolation system by employing an inverse percolation model. Unlike standard percolation, where the site occupancy is uniform, the new model imposes a distance-dependent probability of site removal, where sites closer to the lattice center have higher probability of being removed and are more

prone to damage, as compared to those at the periphery of the system. The variation of this removal probability is a function of the distance (d) from the central point. Thus, the central point plays a key role. This stems in our effort to model the role of a tumor cell and its surroundings (the tumor microenvironment). The tumor causes a decrease in the concentration of key elements, such as O2 (resulting in hypoxia) and Ca, in the region close to it, which in turn is an impediment in the efficiency of radiotherapy and chemotherapy. This decrease is the largest in sites adjacent to the tumor, and smaller away from the tumor. Such change in the concentrations of these elements is vital in the mechanism of cancer therapies. Starting from a fully occupied lattice, we introduce a distance-dependent removal probability q(d), The values of q(d) is 1 at and next to the tumor (center) and decreases linearly away from it, to a limiting value qp, which is the value of q at the lattice boundaries. We investigate the system properties as a function of qp and observe a significant decrease in the critical percolation threshold pc as qp decreases, falling from the standard value of pc=0.5927 to approximately pc=0.20. Furthermore, we demonstrate that the size of the spanning cluster and the total number of clusters exhibit a strong dependence on qp as well.