

Crossover between mean-field and short-range percolation

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Abstract:

We investigate the influence of the range of interactions in the two-dimensional bond percolation model, by means of Monte Carlo simulations. We locate the phase transitions for several interaction ranges, as expressed by the number z of equivalent neighbors. We also consider the $z \rightarrow \infty$ limit, i.e., the complete graph case, where percolation bonds are allowed between each pair of sites, and the model becomes mean-field-like. All investigated models with finite z are found to belong to the short-range universality class. There is no evidence of a tricritical point separating the short-range and long-range behavior, such as is known to occur for $q=3$ and $q=4$ Potts models. We determine the renormalization exponent describing a finite-range perturbation at the mean-field limit as $\nu_r \approx 2/3$. Its relevance confirms the continuous crossover from mean-field percolation universality to short-range percolation universality.