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The Parallel Computational Complexity of the Percolation Model

D.W. BLAIR, JON MACHTA, University of Massachusetts at Amherst — The parallel computational complexity of identifying cluster in the two-dimensional site percolation model is investigated. For a square lattice with sides of length L and site occupation probability p, the running time of the parallel percolation algorithm we study scales as $log(D_f(L,p))$, where D_f is the average value of the largest, finite cluster diameter in the lattice. We find that D_f exhibits a continuous phase transition as p approaches the critical percolation probability p_c – indicating that the parallel percolation simulation has a "complexity critical point," corresponding to the structural percolation critical point. Our simulations also suggest that $D_f(L,p_c) \sim L^{d_{min}}$, and thus that the parallel percolation simulation runs in $O(log(L))$ time at p_c.

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