Computational Physics

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Ex. 1b: True Self Avoiding Random Walk in one dimension

Consider first a RW in one dimension where the walker can go left or right with equal probability and calculate ν as in exercise 1a. Consider now a self-avoiding walk (SAW) in one dimension as defined in Ref. [1] where a walker can go to the left or right site with a probability that depends on the number of times these sites have already been visited. In this case you have to define a lattice of $M \sim 2N$ sites, right and left from the origin. The probability that at time $t+1$ the walker will jump to site $i+1$ is given by:

$$P_{i+1} = \frac{e^{-gn_{i+1}}}{e^{-gn_{i+1}} + e^{-gn_{i-1}}} \tag{1}$$

where $n_{i\pm1}$ is the number of times the site $i \pm 1$ has been visited, $P_{i-1} = 1 - P_{i+1}$, and the parameter $g > 0$ is a measure of the desire of the path to avoid itself. Perform a Monte Carlo simulation of a SAW. Store the values of n. At each step calculate the probability P_{i+1}, draw a random number r and perform the move to site $i+1$ if $r \leq P_{i+1}$ or to the left otherwise. Calculate the mean square displacement $< \Delta x^2(N) >$ (where x is the distance from the origin) as a function of N and estimate ν. Consider for instance $g = 0.1$ and $N = 10^3$ and average over $\sim 10^3$ trials. Compare, comment ....

References

[1] J. Bernasconi, L. Pietronero Phys. Rev. **B 29**, 5196 (1994)