

Optimization Problems: Traveling Salesman

This is an example of a *combinatorial optimization* problem. Unlike the crystallization problem considered above, there is no continuous energy landscape. Rather, there is a very large number of *discrete configurations* and the problem is to choose the optimal one, in this case the shortest route to visit N cities with given positions r_i on a 2-D map.

This is an example of an *NP-complete problem*. The amount of time required to find the optimal solution is $\mathcal{O}\left(e^{\text{const} \times N}\right)$.

Numerical Recipes gives a simulated annealing algorithm for finding an approximate solution to the traveling salesman problem in §10-9 Simulated Annealing Methods.

Several other strategies have been suggested to find approximate solutions. An interesting method which is similar to multigrid methods has been suggested by U. Yoshiyuki and K. Yoshiki, *Phys. Rev. Lett.* **75**, 1683 (1995). An approximate solution is obtained in time of $\mathcal{O}(N \log N)$.