Summary of Monte Carlo Simulation for Cluster Detection

This summary provides an overview of the Monte Carlo simulation that was performed on a 2D grid where particles attach or detach based on the occupation of neighboring sites. The goal was to identify clusters of particles and analyze the distribution of cluster sizes by plotting a histogram of their sizes.

Approach:

1. A 2D grid was initialized with all sites empty (0 for empty, 1 for occupied).

2. Particles were attached to empty sites based on the number of occupied neighboring sites (up, down, left, right). The attachment rate was given by the equation below.

3. Particles were detached from occupied sites with a fixed probability.

4. Clusters of occupied particles were detected using connected component labeling.

5. The sizes of the clusters were calculated, and a histogram of the cluster size distribution was generated.

Attachment Rate Equation:

Attachment Probability = alpha * beta ^ (sum of occupied neighbors)
Where alpha and beta are parameters between 0 and 1.

Issues and Solution:

During the simulation, initial issues with cluster detection were identified, as the clusters were not correctly recognized. This was addressed by utilizing connected component labeling to correctly label and identify clusters. The cluster sizes were computed manually, excluding background cells, and a histogram was plotted to visualize the distribution of cluster sizes.

Conclusion:

The simulation successfully detected clusters of particles and provided a correct histogram of their sizes. By adjusting the attachment rate, detachment rate, and the Monte Carlo steps, different

cluster formation patterns can be observed.