1 Introduction

A limited diffusion aggregation (DLA) algorithm was implemented on a 2D lattice. The aggregation behaviour for different simulation parameters was observed.

2 Algorithm Description

The algorithm was implemented in continuous space with wraparound borders and a central aggregation seed. Random walking particles change heading and speed at each step. Their coordinates get projected to the lattice only when checking for coalescence. Particles enter the system at a random location on the lattice border (i.e. on any of the four sides). To limit simulation time, particle lifetime is a simulation parameter; if no contact with the aggregating cluster is made after this set amount of steps, the particle expires and a new one is launched.
The algorithm works along the following principle:

- for n particles do:
  - randomly pick starting site along lattice boundary
  - randomly pick starting heading
  - while not in direct vicinity of aggreggating cluster and while age smaller than lifetime do:
    - randomly change heading
    - randomly change velocity
    - walk one timestep to new position
    - check and record cluster vicinity
    - increase age
- draw final lattice state

3 Results

The program was implemented as described above and submitted with this report. As expected, the cluster grows outward from the seed in random tree-like structures. The occupation probability grows as the cluster grows toward the lattice edges containing the release points (see figure 1 as an example).

Applying 'noise reduction' by requiring m visits to a site before the site gets occupied makes the cluster denser with increasing m (see figure 2).

4 Discussion

In general, the algorithm yields the results expected from theory. As I wanted to go for 'true' randomness and not inject particles near the cluster boundary as suggested by the task statement to improve runtime, rather long lifetimes were necessary for particles to be reasonbly likely to make it to the center seed.

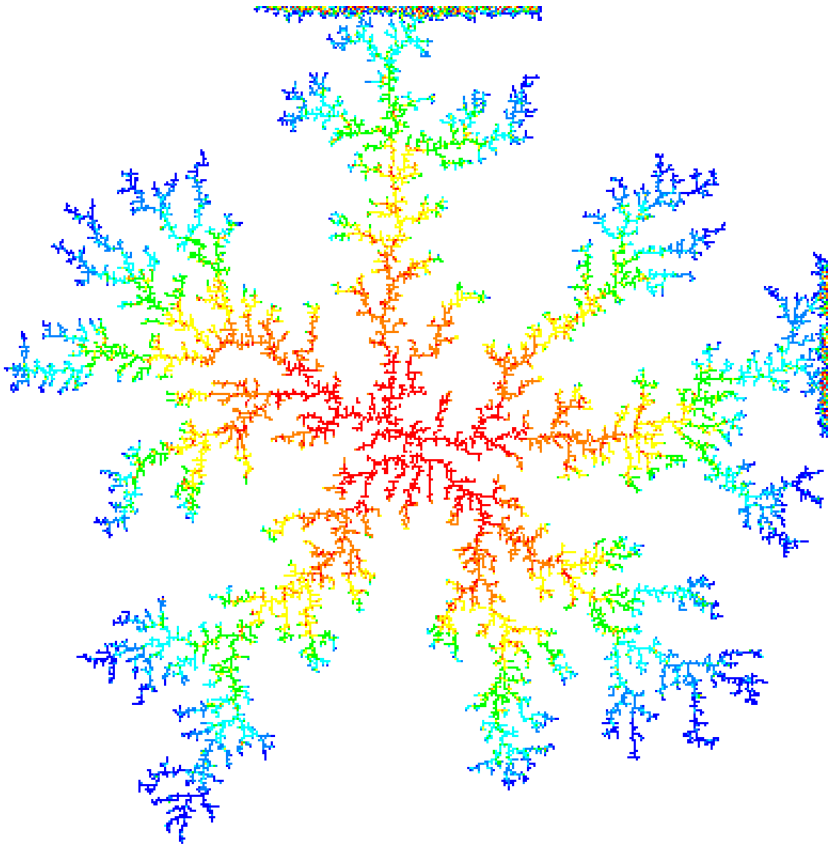
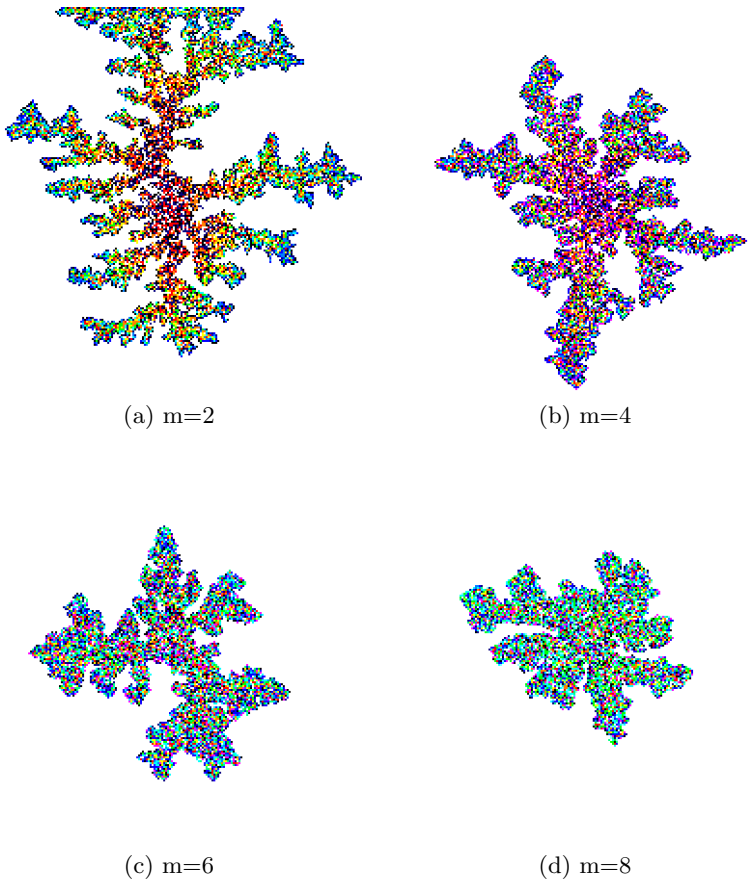


Figure 1: DLA cluster on 2D lattice with side length $L = 400$, particle lifetime 100000 steps, particle count 20000, noise reduction $m = 0$, center seed.



(a) m=2 (b) m=4

(c) m=6 (d) m=8

Figure 2: Different noise reduction parameters m for DLA cluster on 2D lattice with side length $L = 200$, particle lifetime 100000 steps, particle count 10000, center seed.

References

[1] Herrmann, H. J., Singer, H. M., Mueller L., Buchmann, M.-A.,
Introduction to Computational Physics - Lecture Notes,
ETH Zurich,
2017.