

## PROJECT III

Today you will work in class on project III in groups. The groups are: Deb, Evan and Brandon // Kerry, Kyle and Mark // Rob and Garrett // John and Steve. Get together with your group partner(s). You will work today on variations and the analysis of the DLA model. Work on the project of your group (see below). In case of any questions please get me to clarify and help with the tasks. Our schedule for today is:

9:30 - 10:15 work on project, 10:15 - 10:25 talk preparation, 10:25 - 10:52 talks.

Each group will give a 5 – 6 min presentation. You may use the transparencies and pens provided in class. **Have fun!**

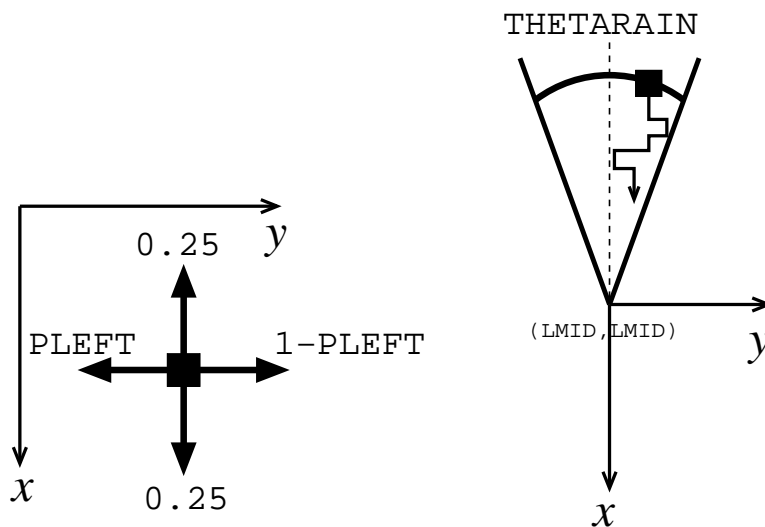


Figure 1

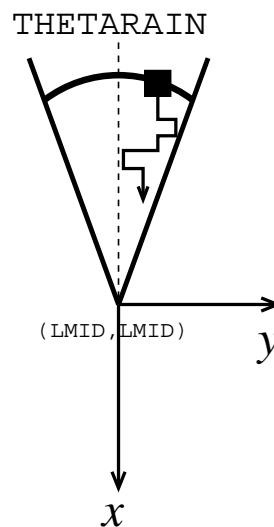


Figure 2

### III1. Wind (Deb, Evan & Brandon)

**III1a.** Our goal in this project is to model fractal growth with wind. One possible implementation is to change your random walk step. As before walk up or down each with probability 0.25. Instead of having a walk to the right and left of equal probability 0.25, introduce a new constant PLEFT which will be set to any number between 0 and 0.5. Let the random walker walk to the left with probability PLEFT and to the right with probability  $(0.5 - \text{PLEFT})$  - see Fig. 1. Use

`~kvollmay/classes.dir/capstone_s2009.dir/fractal.dir/DLA9_sample.cc`

(so  $L=500$ ,  $\text{NPARTMAX} = 10000$  and the lattice is printed only once at the end for a square lattice of length  $L\text{PRINT}=350$ ) or your program from last class. Change the program to build in the wind. Have a look at your final fractal pattern with

`DLAprojIII1a.out | DynamicLattice -nx 350 -ny 350 -matrix`

Explain the resulting pattern.<sup>1</sup>

**III1b.** Vary PLEFT and compare the resulting patterns.

<sup>1</sup>In case you would like to use Fig.1 for your talk, you may copy  
`~kvollmay/classes.dir/capstone_s2009.dir/fractal.dir/DLAprojectIII1.pdf`

### III1c. (Only if time)

To measure the fractal dimension of your resulting DLA cluster, follow the following steps:

- (i) `DLAprojectIII1a.out > cluster.data`
- (ii) `g++ -o measure_df.out ~kvollmay/classes.dir/capstone_s2009.dir/fractal.dir/measure_df.cc`
- (iii) `measure_df.out > lnNoflnb.data` (iii) `gnuplot`
- (iv) `f(x)=a+b*x`
- (v) `fit [1:4.5] f(x) "lnNoflnb.data" via a,b`
- (vi) `plot "lnNoflnb.data",f(x)`
- (vii) to save this gnuplot session save `"df.gnu"` (which you can open again with `load "df.gnu"`)
- (viii) to get postscript version  
`set term postscript`  
`set out "df.ps"`  
`replot`
- (ix) to get out of gnuplot quit

### III2. Rain (Kerry, Kyle & Mark)

**III2a.** Goal of this project is to model fractal growth under the condition that particles are not coming in from all directions. In the original DLA model particles were starting their random walk from a random point on the circle of radius  $R_{max} + 2$  centered about the midpoint of the lattice. Now let the random walk start on only a part of this circle of angle `THETARAIN` as sketched in Fig. 2. You may start with

`~kvollmay/classes.dir/capstone_s2009.dir/fractal.dir/DLA9_sample.cc`

or with your working program from last class. Look at the resulting pictures of the original DLA model and of the rain featured DLA model.

**Hint:** Be careful with how  $x$  and  $y$  (see Fig. 2) and convert your angle to radians.<sup>2</sup>

**III2b.** Vary `THETARAIN` and compare the resulting patterns.

### III2c. (Only if time)

To measure the fractal dimension  $d_f$  follow the steps of III1c.

### III3. Stickyness (Rob & Garrett)

**III3a.** In this project you do not always stick a particle when it has a cluster particle as neighbor. Instead you stick only with probability `PSTICK`. Use your working program or you may start with

`~kvollmay/classes.dir/capstone_s2009.dir/fractal.dir/DLA9_sample.cc`

(so 500x500 lattice and `NPARTMAX = 10000` and print only once at the end a square lattice of size `LPRINT=350`). To avoid that a non-sticking particle walks on top of already existing cluster particles, do a random walk step only if it would put your random walker onto an empty lattice site. So lines 52-59 are not always done (not for  $x,y$ ) and similarly do line 50 only if your random walk step is allowed.

**III3b.** Now let's compare the **fractal dimension** of the original DLA-model and of the DLA-model with the sticking probability `.` Follow the steps of III1c to determine the fractal dimension.

### III3c. (if time)

Determine the fractal dimension for varying `PSTICK`.

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<sup>2</sup>In case you would like to use Fig.2 for your talk, you may copy  
`~kvollmay/classes.dir/capstone_s2009.dir/fractal.dir/DLAprojectIII2.pdf`

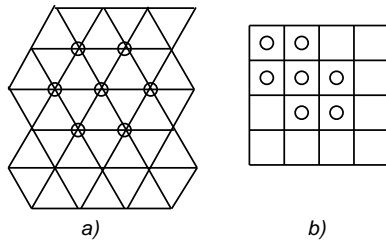


Figure 4

### III4. Neighborhood (Snowflake) (John & Steve)

**Snowflakes** have a pattern similar to the pattern shown in Fig. 4a. We say that the molecules are on the corners of a triangular lattice. Each molecule is surrounded by 6 neighbors. We have so far always used the square lattice. It turns out that if you look at the triangular lattice of Fig. 4a and tilt your head a little bit to the left, then Fig. 4a looks like a square lattice where the neighbors are right, left, up, down, NW and SE as shown in Fig.4b.

**III4a.** Use `~kvollmay/classes.dir/capstone_s2009.dir/fractal.dir/DLA9_sample.cc` or your working program of the inclasswork 9a. (so 500x500 lattice and `NPARTMAX = 10000` and print only once at the end a square lattice of size `LPRINT=350`). Change your program such that the sticking occurs according to the neighborhood of Fig. 4b. Run your program and look at the result with `DynamicLattice`.<sup>3</sup>

**III4b.** To rotate and squish your square lattice back to the triangular lattice, first print out the resulting cluster

```
DLAprojectIII1a.out > cluster.data
```

then copy

```
~kvollmay/classes.dir/capstone_s2009.dir/fractal.dir/snowflake_rotate.cc
```

into your working directory and compile it. Then run it

```
snowflake_rotate.out
```

The program prints x,y coordinates of each clusterparticle into the file "snowflake.data". Look at the resulting snowflake with

```
xgraph -m -nl snowflake.data
```

**III4c.** (if time)

To measure the fractal dimension  $d_f$  follow the steps III1c (ii)-(ix).

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<sup>3</sup>In case you would like to use Fig.4 for your talk, you may copy  
`~kvollmay/classes.dir/capstone_s2009.dir/fractal.dir/DLAprojectIII4.pdf`

**2nd Paper:** The second paper will be the complete scientific paper about your main project. It will include the sections of your first paper. Use my comments on your revised versions to revise your paper further. In addition you will include now all simulation details, the results section, the summary/future section and the abstract. For further instructions see our webpage and hand-outs in class.

**Results:** As preparation for your paper, make the necessary figures and tables for your paper. The more you hand in completed figures, the more feedback I will be able to provide to you.

**Help/Comments:** Please feel free to ask for help any time.

**Upcoming Deadlines:** (see also our webpage)

- April 10: Results (Figures, Tables, etc.)
- April 14: Title & Abstract
- April 17: 2nd Paper First Version
- April 21: Symposium Talks Steve, Mark, Garrett
- April 23: Symposium Talks Rob, Brandon, Kyle, Evan
- April 28: Symposium Talks Kerry, Deb, John
- April 28: 2nd Paper Final Version