Homework 1

Ryan Nguyen

September 24, 2018

1 Polarization

1. Refer to Fig1.png, Fig2.png, and Fig3.png for DM, PZ, and PSM polarization, respectively.
2. Generally, I would say none of these systems are in steady state because of the amount of fluctuation of the polarization values over time. For all samples, polarization values fluctuate to various extremes which indicates disorder. Higher polarization values indicate more order in the system. I see that the DM polarization values for Fish 3 are generally higher indicating more order.
3. Sorry I didn't really know how to store cells into csv's without distorting the structure of the data. It is saved under polarizations.mat.

2 Mean Square Displacement

1. Refer to Fig4.png, Fig5.png, and Fig6,png for MSD plots of DM, PZ, and PSM, respectively.
2. Refer to alpha.csv and D.csv
3. (a) For the values of alpha, all of the values are pretty much the same. However, values of D are distinct across different domains.
   (b) This does make sense since these boundaries can be defined by a notable shift in diffusion coefficients which would lead to distinct developmental compartments.
4. The polarization data implicates Fish 3 to be mutated since its polarization in the DM domain is notably higher than those of any other fish. Fish 3 also seems to have a higher MSD in the PSM and DM domains than any other fish. In addition, across fish in the same domains, fish 3 and fish 4 seem to have significantly higher diffusion coefficients than the rest of the samples. Thus, I believe fish 4 is also a mutant.

3 Calculate the Polarization

1. When the cells are close together, they aggregate together and move in generally the same direction. This system is significantly ordered as All of the cells are moving to the upper right quadrant.
2. The mean polarization of this system is about 0.93, which makes sense given the high order of these cells.
3. Refer to PolBeta0.png and PolBeta30.png
4. When $\beta = 0$, noise decreases polarization sharply causing more disorder in the system. When $\beta = 30$, increasing noise causes a significantly more gradual decrease in polarization.

5. Contrary to my intuition, it seems that increasing amounts of repulsive forces actually causes the system to maintain its order while decreasing amount of repulsive forces causes the system to become more disordered. However, only two values of β were tested, so more data should be collected. When $\eta = 0.55$ and $\beta = 0$, polarization decreases sharply causing an order to disorder transition. When $\eta = 0.65$ and $\beta = 30$, polarization decreases causing an order to disorder transition.

6. We see more disorder at these regions as cells move in various directions causing disorder and, in turn, symmetric growth.