

Physics 131 Make-up Lab—Motion in Nature

Introduction

Over the course of this semester, we have examined random and directed motion in a variety of situations. Many of our investigations have been investigating principles with glass beads, while the last lab involved examining motion inside of onion skin cells. Both random and directed motion occur all over nature, from the micro-scale we investigated all the way up to the macro-scale.



Investigation

Examine the video(s) from one of the provided cases (below) in ImageJ, and attempt to characterize the motion shown. It will be beneficial to recall skills you developed in previous labs, as well as to think of new ways of characterizing the motion.

Case 1: Ant Social Organization

(Mersch, et al., *Science*, 2013: <http://www.sciencemag.org/content/340/6136/1090.full>)

In this paper, researchers tracked the motion of the ants to identify and track social interactions. They identified distinct social groups, and tracked interactions within and between different groups. Do the ants move randomly or directedly? Back up your claim with quantitative results! Qualitatively, can you spot any of the social groups the paper identifies?

- Size Scaling: 1mm ~ 6 pixels
- Time Scaling: 1fps (Playback is sped up)

Case 2: Dictyostelium Chemotaxis (videos courtesy of Losert/Devreotes Lab, taken from: <http://www.pnas.org/content/106/16/6667.long> (Sato, et al., *Journal of the American Chemical Society*, 2009))

In these two videos, Dictyostelia (slime molds) are shown moving on a slide while exposed to an electric field. Qualitatively, is there a difference between the motion of the slime molds in the two videos? In the first video (SM1), is the motion of the slime molds random or directed? In the second video (SM3), the Dictyostelia have been exposed to a chemical, LY294002, which is an inhibitor of PI3K (PI3 kinase is an essential signaling molecule for directional cell movement). Does the chemical change the behavior of the Dictyostelia? Support all of your claims with quantitative results!

- Size Scaling: Scale Bar Provided 50 μm (gray bar in lower left corner of video)
- Time Scaling: 5 seconds / frame

Interpretation

After you have observed the motion in your case video(s) both quantitatively and qualitatively, you should be able to draw some conclusions from your measurements.

- Is the displayed motion random or directed? How do you know? Can you think of reasons why the motion would be this way? Does the displayed motion change over the course of the video? If so, on what time scales is the motion random and on what time scales is it directed?
- Are the velocities somewhat uniform or do they vary? Do the velocities change over the course of the video?
- Can you think of other situations where this sort of analysis might be valuable?

In the two hours that you have for this make-up lab, you are expected to:

- 1) Choose and analyze ONE scenario;**
- 2) Present your findings to your classmates (or the TA); and**
- 3) Write a lab report.**

Here is a suggested time-line:

Introduction:	5 minutes
Qualitatively analyze video(s):	5 minutes
Harvest data from video (ImageJ):	20 minutes
Analyze data from video (Excel):	30 minutes
Prepare presentation:	10 minutes
Presentation:	10 minutes
Finalize lab report:	30 minutes