

Assignment 1: First Day Basics

1. Who is your faculty research advisor?

Dr. David Roundy, Department of Physics, Oregon State University

2. If you conducted your research project off campus, you must identify an OSU co-advisor, preferably from Physics and preferably with some expertise in your topic. Who is this person?

Not applicable

3. Give a descriptive working title for your project

Simulating the Brownian Dynamics of a 2-Dimensional Model for the Dynein Motor Protein.

4. What is the goal of your project?

I am seeking to identify a suitable set of parameters for a computational simulation of the dynamics of the dynein motor protein. Such a parameter set would fit our simulation to empirical observations of the protein including various stepping statistics. A successful fit will demonstrate the effectiveness of our simple 2-dimensional stepping model that relies on Brownian dynamics and treating each joint as a hinge with a Hooke's-law restorative force. This will contribute a physical interpretation of the protein's behavior that does not depend solely on the concentrations of the multitude of molecules involved in the protein's chemistry.

5. What will you do during your project?

I will write new computer code to perform simulations, generate data sets, and visualize stepping statistics. I will also be modifying our current simulation code to enable us to study the behavior of multiple dynein on one microtubule as well as how the stepping behavior is altered by the addition of external forces.

6. What is the expected outcome of your project?

A successful project will result in a good set of simulation parameters, a comparison to published empirical results, a well organized and well maintained code base, and (hopefully) new code to extend our simulation to other interesting questions.

7. What materials, equipment or facilities are needed?

I will be using my laptop as well as the Roundy Research Group's computer cluster to run simulations. I will also be taking advantage of Dr. Weihong Qiu's expertise in the analysis of real dynein proteins via fluorescence microscopy.

8. What is the status and timeline of your project?

We currently have a pretty good set of simulation parameters. I need to double check with Elliott (worked on the project last year) to verify what progress we've made over the summer and then verify the parameters by writing some test cases. After, I intend to calculate a wide range of stepping statistics for our model as well as come up with some more ways to visualize our data. Finally, if we are happy with the parameters, I will write some new simulation code to enable us to simulate external forces like a tension (from carrying cargo) to see how the model responds. I intend to have most of this done by the end of this term or the middle of next term.

During this process I will begin writing my thesis (skeleton + outline fall term). I can easily begin the introduction and methods sections as I already have those details ready. Once I am at a stage where I have a good set of parameters, I think I can comfortably begin writing a rough draft of my results. Throughout the process I intend to update my figures as I find new ways to visualize the stepping statistics of our model.