Project assignment 2

Computational Analysis of Cooperative Motion of Molecular Motors

September-30-2009

Due: Nov-04-2009

1. Overview

The main goal of this project is to demonstrate the application of computational analysis and modeling in understanding basic biological processes. To achieve this goal, we will reproduce several major results of the work published in (Badoual et al., 2002).

2. General instructions

- Implementation should be undertaken using MATLAB. Upon completion of the project, executable MATLAB programs and animation videos generated for this project should be submitted (by copying to a flash drive provided by the instructor) along with the final report.

- The final report should follow the general format of a project report. For example, it should include a section that states the problem and a section that explains the method applied.

3. Detailed Instructions

The project is divided into multiple steps. Your final grade will be calculated based on the steps completed.

(1) A critical step of any computation analysis and model work is to determine the parameters to be used. Generate a table that lists or explains all the parameters that are used in the computer simulation. You will be assisted by discussion in class. (10/100)

(2) Write a MATLAB function that implements the energy landscape function shown in Fig. 1(a) of (Badoual et al., 2002). The input parameters of the function should at least include U, a, l, q; The output parameter of

Write a short test program to validate your function (use the parameters determined in step 1). In particular, generate a plot of the energy landscape function. (5/100)

(3) Write a MATLAB function that implements the random state transition shown in Fig.1(b) of (Badoual et al., 2002). Again, write a short test program to validate your function. (5/100).

(4) Using the functions developed in (2) and (3), simulate (by generating a computer simulation video of) the movement of one Ncd motor carrying a microtubule that is 2 μm in length. (15/100)

(5) Reproduce the result shown in Fig. 2. (15/100)

(6) Complete a project report. In particular, include a section that summarizes the main results of the Badoual paper and discuss the strength and weakness of its approach, which is the approach we use in our project. (50/100)

(7) Extra credit (10/100): reproduce the result shown in Fig. 3a.

4. Report format

Page size: letter

Line space: single

Page margins: no less than 1 inch

Font size: 12 points for the main text; 10 points for listed references

References

Badoual, M., F. Julicher, and J. Prost. 2002. Bidirectional cooperative motion of molecular motors. *Proceedings of the National Academy of Sciences of the United States of America*. 99:6696-6701.