

Professor Mariel Vazquez
April 10, 2008

Math 414-1 / 714-1

Homework 6: Supercoiling (part II)

The homework set is due on Thursday, April 24th

I. Review questions:

1. (10pt) Lk is a topological invariant; Tw and Wr are not. What does this mean?
2. (10 pt) Double-stranded DNA can be modeled as a ribbon. Explain the difference between twist crossings and writhe crossings, and their contribution to the linking number (state White's Theorem and explain).

II. Computations:

3. (50 pt) In class you went over a method to compute the writhe of a polygonal chain in 3-space, call this method 0. Two other similar methods, method 1a and 1b, are described in the paper *Computation of writhe in modeling supercoiled DNA* by K. Klenin and J. Langowski. Assignment:
 - a. Group 2: Rysavy, Holcomb and Wees will implement method 0
 - b. Group 3: Demiglio, Dewoskin and Chu will implement method 1a
 - c. Group 1: Brascher and Lopez will implement method 1b

This assignment requires you to write pseudocode and code for the algorithm that you were assigned. You can use any programming language of your choice. We have functions written in C for the vector product, the dot product and the norm of a vector which you can get from us. These are also easy to compute in Matlab if that is your language of choice. We will send you some coordinates of a few polygonal chains and ask you to compute the writhe on them. The assignment will be worked in groups but the report is to be tuned in individually.

III. Enzymatic actions and supercoiling:

4. Enzymatic actions on DNA molecule:
 - a.- (15 pt) Go to the Dolan Learning Center from the Cold-Spring Harbor laboratories and watch the video http://www.dnalc.org/mediashowcase/media_item.html?id=585 (Transcription: DNA codes for messenger RNA (mRNA), 3D animation with basic narration)
Based on how the enzymes move along the DNA, do you think that there should extra supercoiling accumulated in front or behind the enzyme?
Elaborate on this, use words and figures to explain your answer.
 - b.- (15 pt) In figure 2.1 of the book there is a model for DNA replication. Can you explain how the enzyme slides through the DNA to have compensatory supercoiling ahead of it? Can you explain how and why these extra "writhe" turns are formed? Can you identify if they are positive or negative and why they have the sign they have?