CMSC427 Fall 2017
Lab 6 – Using Frenet frame for modeling

Due by midnight Thursday, Dec. 7th
Online as combined PDF plus a PDE file

Objectives of lab:

- Calculate the Frenet frame for a parametric 3D curve
- Apply the Frenet frame to a shape
- Construct a rotation matrix by computation of local coordinate system (like camera)

Requirements:

This assignment comes with two initial PDE files:

- HelixFly.pde — This has a helix in 3D as a string of boxes, with correct Frenet frame
- HelixFly2.pde — This has an undulating circle in 3D with boxes, with ***incorrect*** Frenet frame

Your job is to correct the Frenet frame in the second file, imitating the first. The equations used in the second file are, with t in the range $[0,2\pi]$:

$$x(t) = 200 * \cos(t)$$
$$y(t) = 100 * \sin(10 * t)$$
$$x(t) = 200 * \sin(t)$$

You have to compute the Frenet frame for this with parametric tangent, curvature and binormal vectors. The three vectors should be orthronormal when you are done – each of unit length, and perpendicular to each other. The tricky part of this assignment is normalizing the three vectors in the frame. Consider using wolframalpha to do symbolic calculations if needed.

This assignment is a combined lab and homework. You first need to do the math for the frame, and document your work in a Word (or other) document. Then, implement the equations in a new PDE. The basic math for this is in the class handout "CameraMotion.pdf" on the web site.

You're free in this assignment to play with aspects of the program. The color interpolation works for the helix but has glitches for the undulating curve, so feel free to clean that up. Change the shape if you want (but spheres are too rotationally symmetric to make the application of the frame notable.) Change the way the program rotates the 3D shape, change the constants used in the parametric curve, whatever you'd like, as long as the spirit of the assignment is met.

To submit you should create a Word or other document that includes the following:

A. A header with CMSC427 fall 2017 Lab 6 and your name.
B. A short narrative with your computation of the Frenet frame.
C. A copy of the PDE source code from Processing in the PDF
D. Save as PDF and submit, along with a separate copy of your PDE files.

As a lab, the requirements for code are lightweight in that you don't have to validate your program against all possible inputs, or work on the most general solution. Consider your program a working prototype. You're free to extend, play with, revise, and otherwise make the assignment yours.