

Math 251: Computational Lab 2

Fall 2019, Sections 1-3

Instructor: Matt Charnley
Recitation Instructor: Some TA
Due Date: September 1, 2019

Introduction

You are encouraged to discuss this assignment with other students and with the instructor/recitation instructor, but the work you hand in should be your own. See the website

<http://math.rutgers.edu>

for more information as well as helpful background information and commands for completing the assignment.

The goal of this assignment is to give a feel for what an arc length parametrization is and why it is useful. Lectures in class can give some of the intuition, but looking at animations and playing with an actual curve can help to improve the intuition about this.

Your Task

For this assignment, you will be given individualized data from your instructor. This will be a curve $\vec{r}_1(t)$ in three-dimensions, given as $\langle x(t), y(t), z(t) \rangle$ and a end time T_{final} . Given this, you will then need to

- Draw and visualize a curve in three-dimensions, compute the length of this curve from $t = 0$ to $t = T_{final}$, and animate a point moving along the curve,
- Find an arc-length parametrization for the curve, and
- Animate the curve with this new parametrization and see how the point moves around the curve.

Deliverable

Your code should consist of the following:

1. Storing the curve $\vec{r}_1(t)$ and the final time T_{final} .
2. Two plots of the curve $\vec{r}_1(t)$ showing the curve from different angles.

3. Code for an animation of a point moving around the curve at evenly spaced t values. You can comment this out when you go to print your final document, as printing an animation won't work out very well.
4. Compute the length of this curve.
5. In words/equations, answer the following questions:
 - If I were to give you two values $t = a$ and $t = b$, what would the length of the curve \vec{r}_1 be between these points?
 - How would you find a **unit** tangent vector to the curve $\vec{r}_1(t)$?
6. Compute the function $g(s)$ that is needed to find an arc-length parametrization of this curve, following all of the standard steps for doing this.
7. Find a formula (using the computer) for an arc-length parametrization $\vec{r}_2(s)$. Define and store this function $r_2(s)$. What are the bounds on s ?
8. Draw a plot of the curve $\vec{r}_2(s)$ (it might look familiar), and write code to animate a point moving around this curve at evenly spaced s values.
9. Find the length of this curve. Hint: This should match your answer from earlier.
10. In words/equations, answer the following questions:
 - If I were to give you two values $s = a$ and $s = b$, how would you compute the length of the curve \vec{r}_2 be between these points?
 - How would you find a **unit** tangent vector to the curve $\vec{r}_2(s)$?
 - What do you notice about the animations for r_1 and r_2 ? What is the difference between them?

Print all of your code (after removing all of the incorrect lines) and the desired images from above and put them into a single stapled packet. This assignment is due on **September 1, 2019** in recitation.