Homework 3, due January 29th, 11:59pm

January 23, 2020

1. The file `gw.bmp` contains an image of a straightened out guidewire from an X-Ray image. However, as you can see, the wire is not perfectly straight.

a) Load the image and normalize it by subtracting from each column its minimum value. Display the normalized image. On another image show the normalized image and over-impose in red, green or blue the plot of the curve connecting the minimum value locations from each column. The image should be displayed such that the columns of I are on the x axis and the rows are on y, thus the guidewire is almost horizontal. (2 points)

b) Let I be the normalized image from a), where $I(i, j)$ is the value of the pixel intensity at row i column j. A curve approximating the guidewire can be represented as a vector $\mathbf{c} = (c_1, ..., c_n) \in \mathbb{R}^n$, where n is the number of columns of I, and c_i represents the row (y coordinate) through which the curve goes at column i. To obtain a smooth curve, we want to minimize the following cost function:

$$f(\mathbf{c}) = \sum_{i=1}^{n} I(c_i, i) + \alpha \sum_{i=2}^{n} (c_i - c_{i-1})^2$$

over all possible vectors $\mathbf{c} \in \mathbb{R}^n$. Write the recursion equation to solve this minimization using dynamic programming. (3 points).

c) Implement dynamic programming using the recursion equation from b) and report the minimum value of $f(\mathbf{c})$ that you obtained for $\alpha = 2$. (3 points)

d) On two different graphs show the normalized image with the plot of the c over-imposed in color, for $\alpha = 2$ and $\alpha = 15$. (2 points)