Problem Set 4

CMSC 426

Assigned March 5, Due March 12

Background Subtraction 25 points

For this problem, you are given a set of 100 images of background, $I_1, I_2, \ldots I_{100}$. and one test image, *J*. These are on the class web page in BackgroundImages.zip and foreground_image.bmp. The images are in color, but you should convert them to grayscale. Your task is to classify each pixel in the test image as either foreground or background. Suppose pixel *J(x,y)* has intensity *k*. To classify it, you should compute:

$$P(J(x,y)=k)=\sum_{i=1}^{100}\frac{1}{100\sigma\sqrt{2\pi}}\exp\left(-(k-I_i(x,y))^2/2\sigma^2\right)$$

Once you've computed this for each pixel, you'll need to choose a threshold, *T*, so that you classify all pixels as foreground when $P(J(x,y)=k)<T$. Choose values of *T* and σ by hand that seem to produce pleasing results. Our results are in BackgroundSubtractionResults.jpg. Turn in your code, a picture of your result, and indicate which values you used.

Edge Detection –One-Dimensional (25 points)

Implement a 1D edge detector. Recall that to do this, you will need to smooth the image with a Gaussian, compute the first derivative at each point, and then declare that you have an edge if the absolute value of the first derivative at a pixel is larger than this value at its neighbors and is above some threshold, T.

Apply the 1D edge detector to the grayscale image of the swan on the class web site, by applying it to each row of the image separately. We show our results for $\sigma = 1.5$, with a threshold of 10.

Challenge Problem 20 points

Implement the full, 2D Canny edge detector. This is a lot more work (but very fulfilling).