Computer Vision cs682 **Due: Mar 27, 2020**
Spring 2020
Dr. Duric

Homework #4 (100p)

In your fourth homework you will analyze silhouettes of a walking person. The goal is too use image features to detected phases of gait. You will first download .png images from the link provided for this homework. The binary images in the .zip file are images of a moving person imaged from a side—i.e. sagittal—view at 30 frames/sec. Your task it to apply a variety of algorithms for feature extraction and image recognition to these images.
There are several stages to this homework:

1. (20p) Apply functions listed in "Structural Analysis and Shape Descriptors" section of OpenCV documentation to compute various features on the silhouettes of the person. Find and display image boundaries/contours. Find polygonal approximation of computed boundaries and compute convex hull and the deficits of convexity for the shapes. Compute area, perimeter, and all first and second order image moments for the original image and for the convex hull. Illustrate the process of feature calculation on two different image and display the contour with marked polygonal approximation and the convex hull. Note that this means that you have to mark and draw the corresponding polygons.

2. (10p) Create a table with computed values for all frames: display the computed features. For deficits of convexity compute the number and their total area.

3. (20p) Given an image boundary implement the method from the book to compute curvature along the boundary. Use color coding to display computed values in an image. The color scheme should be used to display curvature with higher curvature values represented by 'hotter' colors. Mark the local maxima of the curvature. You should experiment with the window size $(-k, +k)$ to determine what works well for curvature estimation. Discuss your choices.

4. (10p) Given a silhouette boundary its distance transform corresponds to distances of non-boundary pixels to nearest boundary point. Compute distance transform for all boundaries. The algorithm is described in the book. Use Euclidean distance transform. Display at least two files showing the computed distance transform results.

5. (25p) *Chamfer matching* is a technique used for matching (possibly noisy) image boundaries. It utilizes distance transform. The method will be described in class and the slides will be posted. Implement chamfer matching and use it to match all pairs of gait images in the provided sequence. Display the results as an image in the manner of Homeworks #2 & #3.

6. (15p) Analyze the results in parts 2 and 5. What can you conclude.

    a. Is there periodicity and how it shows in results (parts 2 & 5)?

    b. Two most distinct phases of gait correspond to the widest and the narrowest profiles. Can you detect them from features displayed in 2.

c. Could you use curvature to detect joints and segment body parts? How?

Submitting your homework

Post the results and your programs/scripts on your webpage; write a report describing your work. Your report must be clear and as brief as possible without compromising comprehension. Your code should be a part of your report, but it also must be downloadable as a *zip* or a *tar* file so that the GTA and I can check it. Post your report with a link to your webpage on blackboard. You *must* use password protection for your web page and put the login and the password into your report.