Computer Vision cs682 **Due: Mar. 22, 2011**
Spring 2011
Dr. Duric

Homework #2 (40p)

In your second homework you will build on the results of Homework #1. You will use histograms to compare the gray/color frames of the sequence.
There are several stages to this homework:

1. (10p) Build edge histograms for all images in the sequence. Edge histograms should be 36-bin: you can turn a gradient angle into in index by dividing the orientation angle by 36 and rounding to the nearest integer.

2. (10p) Write two functions for histograms comparison: histogram intersection and chi-squared measure. Test your functions on the image sequence that you have collected.

   a) Histogram intersection. Given two color histograms $H_1(\cdot)$ and $H_2(\cdot)$ their intersection is given by
   $$H_1 \cap H_2 = \sum_i \min\{H_1(i), H_2(i)\} / \max\{H_1(i), H_2(i)\}.$$
   Large values correspond to high similarity.

   b) Chi-squared measure: χ^2. Given two histograms H_1 and H_2 the χ^2 measure of their similarity is given by
   $$\chi^2(H_1, H_2) = \sum_{i:H_1+H_2>0} \frac{(H_1(i) - H_2(i))^2}{H_1(i) + H_2(i)}.$$
   Small values correspond to high similarity

3. (20p) Use your histogram comparison functions to segment your sequence into parts. There are several ways this can be done:

   a) Compare frame 0 (first frame in the sequence) to all other frames in the sequence. If the similary of frames 0 and k is below a threshold (above a threshold for chi-squared function) frames $0, \ldots, k-1$ form the first subsequence. Frame k starts a new subsequence, and so on. For each sequence the prototype frame is the one that is most similar to all other frames in the sequence (the center frame). You can choose similarity values experimentally.

   b) You can use the *k-means* algorithm to find a small number of prototype frames for your sequence. You can find information about k-means in many different places. Note that you have to specify how many segments you want.

   c) You can probably invent your own method or adapt some technique from literature.

   Use experiments to determine which of the histogram types is better for your purpose. Justify your choice. Which of the histogram comparison functions works better? Why?

Submitting your homework

You will hand in your program and a report that will include the following: i. description of all algorithms used in your program, ii. examples of color images used in your homework, and iii. examples of histogram displays produced by your program, iv. discussion of possible applications for your program. In support of your technical report you can post the results on your web page and submit the url.