CS3570 Introduction to Multimedia Technology

Homework #4

Due: 11:59pm, 6/1/2015

Write a program for motion estimation using the block matching methods on the caltrain sequence which includes 11 successive images. Three example images are shown below. You should implement two motion estimation (ME) algorithms, the **full search** and **2D logarithmic** motion estimation in this problem. Suppose that caltrain007.bmp and caltrain008.bmp are used as the reference frame R and target frame T, respectively. You should try two different sizes of the **macroblock 8x8 and 16x16** for ME. For each marcoblock T(x,y) in the target frame T, a search is performed to find the block within the search region of R(x,y) in the reference image R such that it best matches the macroblock T(x,y). The search region is defined to be a rectangle that is within +/- d pixels along horizontal and vertical directions. The block matching measure is defined as sum of absolute differences (SAD) given as follows:

$$SAD(i,j) = \sum_{a=0}^{N-1}\sum_{b=0}^{N-1}\left|T(x+a,y+b) - R(x+i+a,y+j+b)\right|$$

where the macroblock is of size N-by-N.

Implement the two motion estimation methods, and apply them to all non-overlapping macroblocks to compute the motion vectors for the **search range with d=8 and d=16**. Assume caltrain007.bmp is the reference frame, the rest are target frames. Then, calculate the prediction errors (SAD) between the target image and the motion compensated prediction image by using the two ME methods.

(a) (40%) Compare the total SAD values for the two search ranges (d=8, 16) and two macroblock sizes (8x8 and 16x16) by using the two ME methods. Show the residual images (caltrain008.bmp & caltrain017.bmp) for all the above combinations.

(b) (30%) Compute the PSNR values (in dB) for all the frames by plotting the curves of the PSNR value vs. frame # and discuss the result for all above combinations.

(c) (30%) Analyze the time complexity for the two motion estimation algorithms for this problem. Measure the execution time required for the two ME algorithms with the two different search range sizes. Compare and discuss the execution time with the theoretical time complexity.

caltrain007.bmp (reference)

caltrain008.bmp (target)

caltrain017.bmp (target)