Lab 6 Report Shuchen Zhang

<u>Introduction:</u>

In this lab, we learn to use Matlab to display and process video data which is a three-dimensional signal. For part a, we explored the display of video using 21 images as video frames and applied linear interpolation to fill out the intermediate frames. For part b, we examined the difference between subsampled images with the original images. For part c, we write the pyramid decomposition algorithm in Time to reconstruction video frames with zero error.

<u>In part a</u>

we use linear interpolation method to find the intermediate frames so that the resulting video will be a fade effect from image X to Y. We use getframe function in Matlab to display each generated image as a video.

<u>In part b</u>

we first subsampled the original image sequences by factor of 2 and predict the missing frame using linear interpolation in time domain. Then we subsampled the original image sequences by fact of 4 and predict the missing frames using linear interpolation in time domain as well. The Mean Square Error for each subsampling approach is as follow:

MSE for video subsample by 2: 166.9541

MSE for video subsample by 4: 359.4466

Q1:

Comparing the reinterpolated images in the synthesized sequence to the corresponding frames of the real football sequence, only ½ of the original pixels remain in the reinterpolated image for subsampling by 2 method and only ¼ of the original pixels remain in the reinterpolated image for subsampling by 4 method. Other pixels may be different from the original image. So the generated video will be different.

Comparing the two approaches, subsampling by 4 creates larger difference. Since only ¼ of the original pixels remain the same in the reinterpolated images while ½ of the original pixels remain the same in the reinterpolated image for the subsampling by 2 approach.

<u>Part c Method + Answers for Q2,3,4,5</u>

MSE for part c = 0

Q2: Describe how you would implement the pyramid decomposition in the spatial domain (e.g., on a 512x512 image). (Fancier versions of this idea are actually used in many video coding systems. Once pyramid decomposition is carried out in the time domain, one can do it in the spatial domain as well.)

The pyramid decomposition method in this lab is carried in temporal domain. The pyramid decomposition method in spatial domain is similar to the approach in this lab. In the compression procedure, first we downsample the image by factor of 2. Then we interpolate this downsampled image and store the difference between the interpolated pixels with the original pixels as a difference image. Second, we further downsample the downsampled image in step 1 by factor of 2 and interpolate this image and store the difference between the interpolated pixel with the original pixel as a difference image. In the decompression (reconstruction) procedure, we first interpolate the downsampled image by factor of 4 and add the difference pixels from the difference image in step 2. Then we interpolate this image by factor of 2 and add the difference pixels from difference image in step 1.

Pyramid decomposition method in time for video sequence and Q3,4:

For first step, decimating the image sequence by 2 and reinterpolating 4 missing frames using linear interpolation and calculating difference requires 8x486x486 addition, and 4x486x486 multiplication with ½. For second step, decimating the remaining original images by 2 and reinterpolate the 2 missing frames using linear interpolation and calculating difference requires 4x486x486 addition and 2x486x486 multiplication. For third step when we reconstruct the image, interpolating by 2 with the original three images and adding difference frames to reinterpolated frames requires 4x486x486 addition and 2x486x486 multiplication. For fourth step, interpolating by 2 with the 5 images same with the original ones and adding difference frames to reinterpolated frames requires 8x486x486 additions and 4x486x486 multiplication. So the addition/pixel for compression = (8x486x486+ 4x486x486)/(486x486) = 12. The multiplication/pixel for compression = (4x486x486+2x486x486)/(486x486) = 6. The addition/pixel for decompression (reconstruction) = 12. The multiplication/pixel for decompression(reconstruction) = 6.

Q5:

Intensity interpolation is good for recovering only if the missing frames are in the certain position in the image sequences depending on the subsampling and reinterpolation factor. For example in the 9 image sequence in lab c, we could only recover the sequence if we miss the 2,3,4,6,7,8th frame. If we miss the 1,5,9th frame, we cannot reconstruct the image sequence anymore since both subsampling and reconstruction process requires 1,5,9th frame to be the same with the original image to achieve zero error in the image sequence recovery.

Conclusion:

In this lab, we learn the basic video processing procedures and display. We mainly employ intensity linear interpolation method for each par of the lab. We compare the difference between subsampled and reinterpolated video sequences with the original video. Also, we learn the pyramid coding method to decompose the image without error.