ECE 442 H51 LAB 4

Background Subtraction

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Question 1: Find the optimum threshold value to extract the foreground by Mean Frame method for frame 420 using trial-and-error. Observe the result for three different threshold values: one lower than the optimum value, optimum value, and one higher than the optimum value. Based on your observation, describe the effect of changing threshold briefly. Include the mean frame and foreground image obtain by optimum value of threshold in the zip file?

Solution: The optimum threshold value to extract foreground for frame 420 is threshold value = 0.3 using mean frame method. When we change the threshold value one above the optimum value, we observe that background is not subtracted properly, and we are still left with the considerable amount of background elements. Similarly, when the threshold value is less than the optimum value, we subtract too much information and some of the foreground information is also subtracted alongside the background. Images are attached along the zip file.

Question 2: Fit a Mixture of Gaussians with K=6 to pixel (360,640) of the first 240 frames. Choose an iteration number to make sure that EM algorithm has converged?

Solution: Done on MATLAB code line 40 – 58 of the .mlx file, iteration number where the model converges is 700, it is chosen because we also need EM algorithm to work later in Question 5.

Question 3: Test the performance of the MoG background model for pixel (360,640) considering 420th frame as the testing frame. Using K=6, find the minimum value of threshold?

Solution: Done on MATLAB code line 60 – 64 of the .mlx file Performance of the MOG background model can be indicated using the probability of pixel and the minimum value of threshold is probability which we get for the pixel as probability = 0.0061.

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Gaussian mixture distribution with 6 components in 1 dim
Component 1:
Mixing proportion: 0.131873
Mean:  111.9858

Component 2:
Mixing proportion: 0.272593
Mean:  152.0855

Component 3:
Mixing proportion: 0.250937
Mean:  156.3075

Component 4:
Mixing proportion: 0.250937
Mean:  156.3075

Component 5:
Mixing proportion: 0.068576
Mean:  137.5644

Component 6:
Mixing proportion: 0.025085
Mean:  128.8424

EM Alogrithm converged
pixel_420 = 141
probability = 0.0061
Probability_Q4 is
    0.0232    0.0102    0.0063
```

Figure 1: Showing the MOGmodel values and minimum threshold value for pixel(360,640) in 420th frame and Probability values for different K values in order of K = 1, 3, 6

Question 4: Using the minimum value of threshold, compare the results for K=1, K=3, and K=6?

Solution: Done on the MATLAB Code Line 66 – 78 of the .mlx file, See the above Figure 1 for results of probability for K =1, 3, 6. The values are 0.0232, 0.0102 and 0.0063 respectively.

Question 5: Compute the MoG background model with K=6 for each pixel of training frames located at a 250*300 box centered at the center of the frames. Extract the foreground and background pixels of the box for testing frame using three different thresholds (0.0001,0.001,0.01), and attach the result to the zip file?

Solution: Done on the MATLAB code line from 80-135 of the .mlx file the required results are attached in the zip file.