

# **Computer Vision**

## **Spring 2017**

### **Problem Set #7**

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# 1a: Template used for tracking



Template image patch image - **ps7-1-a-1.png**

# 1a: Image frame 28 with overlaid visualizations



Image frame 28 with overlaid visualizations - **ps7-1-a-2.png**

# 1a: Image frame 94 with overlaid visualizations



Image frame 94 with overlaid visualizations - **ps7-1-a-3.png**

# 1a: Image frame 171 with overlaid visualizations



Image frame 171 with overlaid visualizations - **ps7-1-a-4.png**



# 1b: Image frame 14 with overlaid visualizations

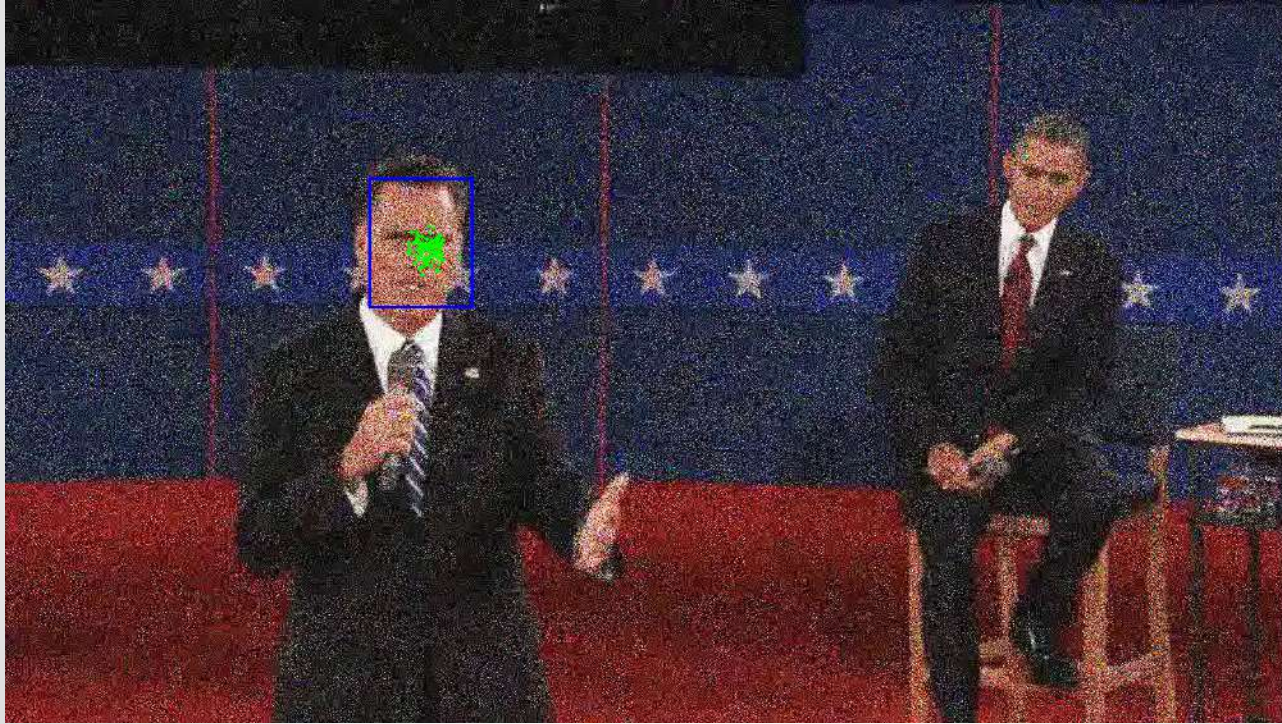


Image frame 14 with overlaid visualizations - **ps7-1-b-1.png**

# 1b: Image frame 94 with overlaid visualizations



Image frame 94 with overlaid visualizations - **ps7-1-b-2.png**

# 1b: Image frame 530 with overlaid visualizations



Image frame 530 with overlaid visualizations - **ps7-1-b-3.png**



## 2a: Template used for tracking



Template image patch image - **ps7-2-a-1.png**

# 2a: Image frame 22 with overlaid visualizations

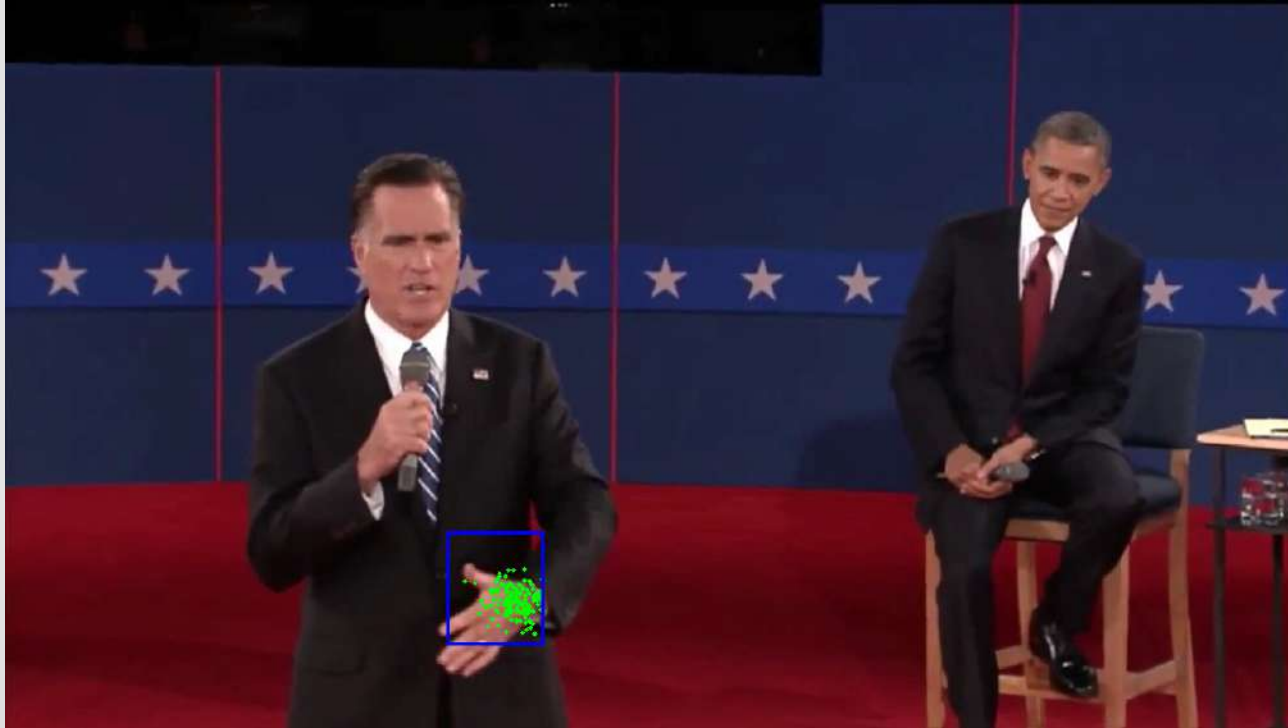


Image frame 22 with overlaid visualizations - **ps7-2-a-2.png**

## 2a: Image frame 50 with overlaid visualizations



Image frame 50 with overlaid visualizations - **ps7-2-a-3.png**

## 2a: Image frame 160 with overlaid visualizations



Image frame 160 with overlaid visualizations - **ps7-2-a-4.png**

## 2b: Template used for tracking



Template image patch image - **ps7-2-b-1.png**



## 2b: Image frame 22 with overlaid visualizations



Image frame 22 with overlaid visualizations - **ps7-2-b-2.png**



## 2b: Image frame 50 with overlaid visualizations

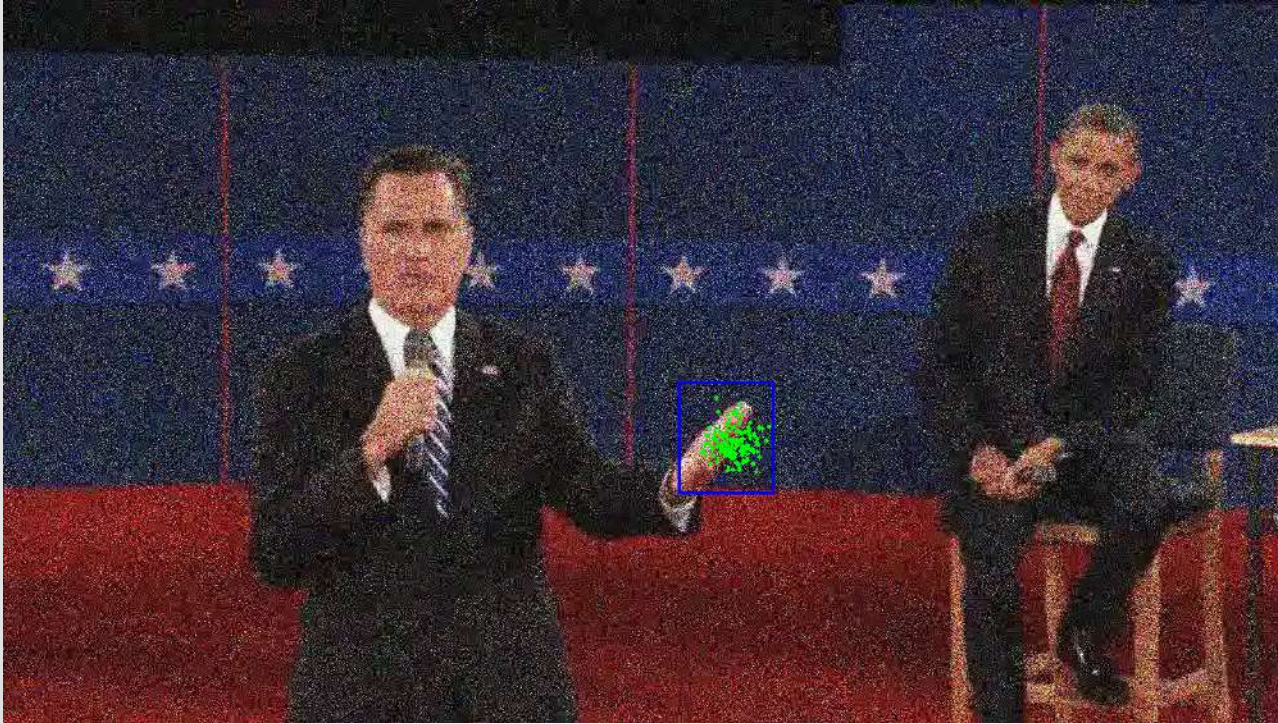


Image frame 50 with overlaid visualizations - **ps7-2-b-3.png**

## 2b: Image frame 160 with overlaid visualizations



Image frame 160 with overlaid visualizations - **ps7-2-b-4.png**

# 3a: Template used for tracking



Template image patch image - **ps7-3-a-1.png**

# 3a: Image frame 28 with overlaid visualizations

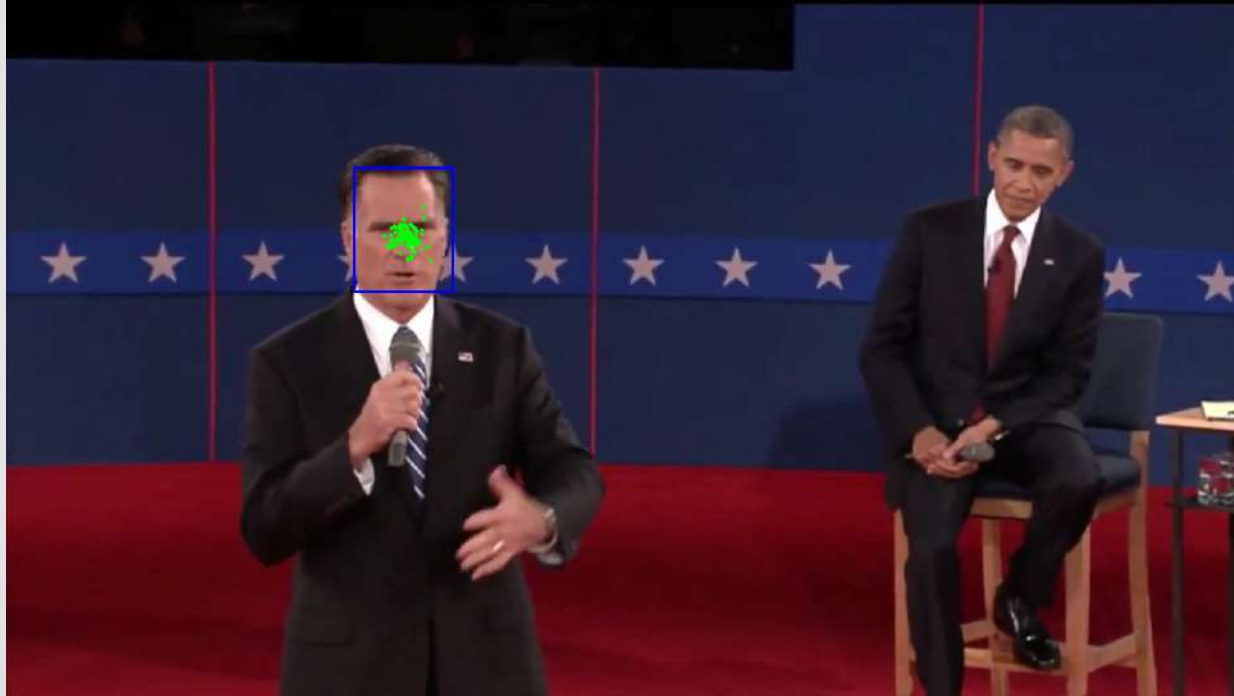


Image frame 28 with overlaid visualizations - **ps7-3-a-2.png**



# 3a: Image frame 94 with overlaid visualizations



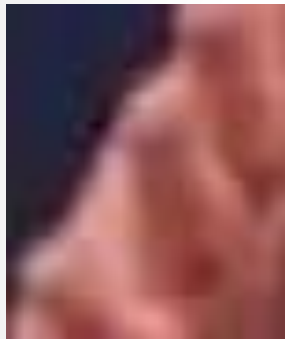
Image frame 94 with overlaid visualizations - **ps7-3-a-3.png**

# 3a: Image frame 171 with overlaid visualizations



Image frame 171 with overlaid visualizations - **ps7-3-a-4.png**

# 3b: Template used for tracking



Template image patch image - **ps7-3-b-1.png**

# 3b: Image frame 22 with overlaid visualizations



Image frame 22 with overlaid visualizations - **ps7-3-b-2.png**

# 3b: Image frame 50 with overlaid visualizations



Image frame 50 with overlaid visualizations - **ps7-3-b-3.png**



# 3b: Image frame 160 with overlaid visualizations



Image frame 160 with overlaid visualizations - ps7-3-b-4.png

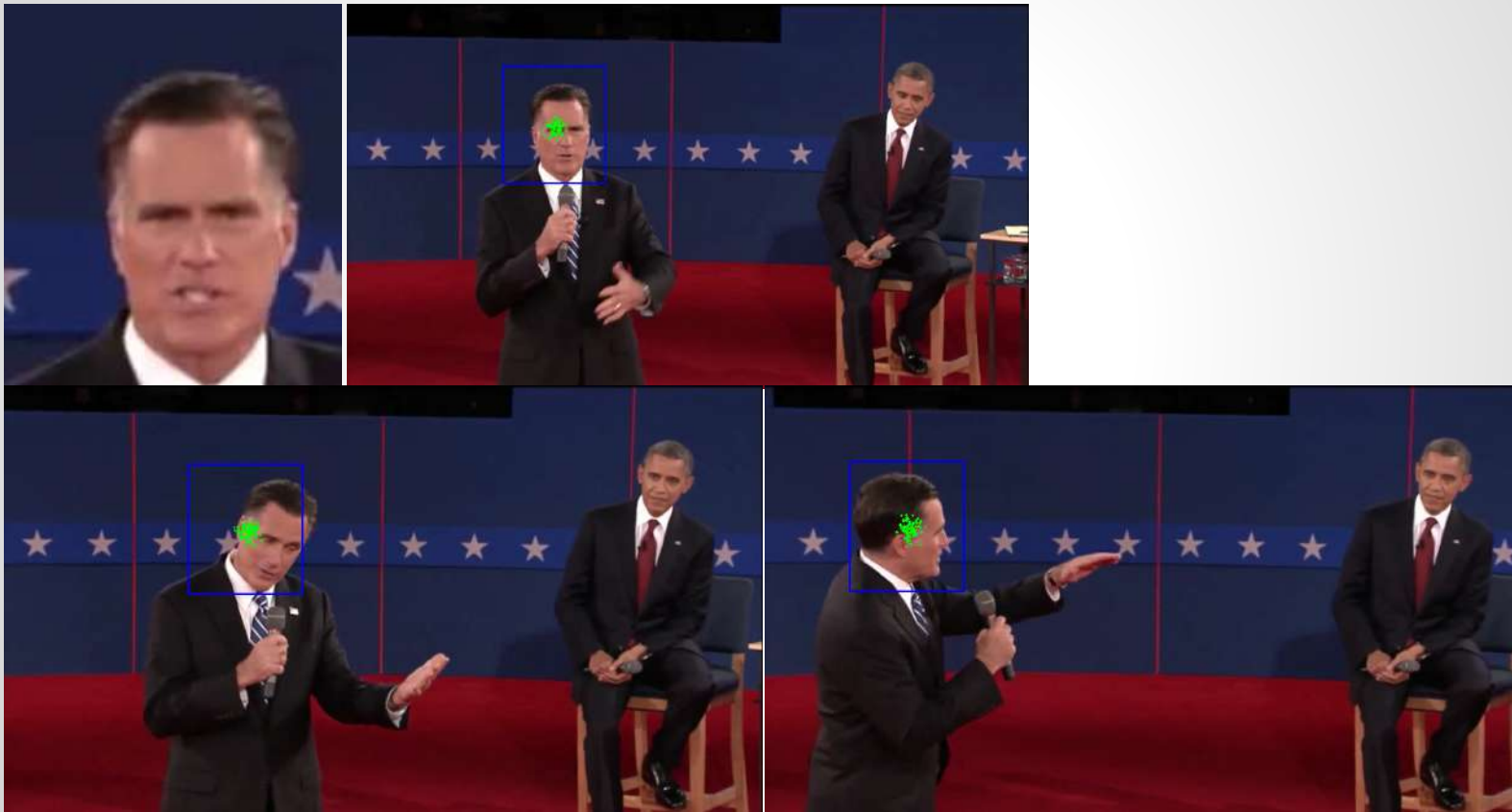
# 4a: Discussion Problems

Using problem 1, experiment with different dimensions for the window image patch you are trying to track. Decrease the window size until the performance of the tracker degrades significantly. Try significantly larger windows than what worked in 1-a. What are the trade-offs of window size and what makes some image patches work better than others for tracking? **Describe 2-3 advantages of larger window size and 2-3 advantages of smaller window size**

Advantages of Large window size:

- (1) Less chances of getting stuck at local maxima. Since there are more pixels in the patch, contribution of each pixel to the mse is pretty less
- (2) More robust in case of noisy images / videos. Since the noise averages over a larger window size and contribution of each pixel to mse is less.

# 4a: Discussion Problems

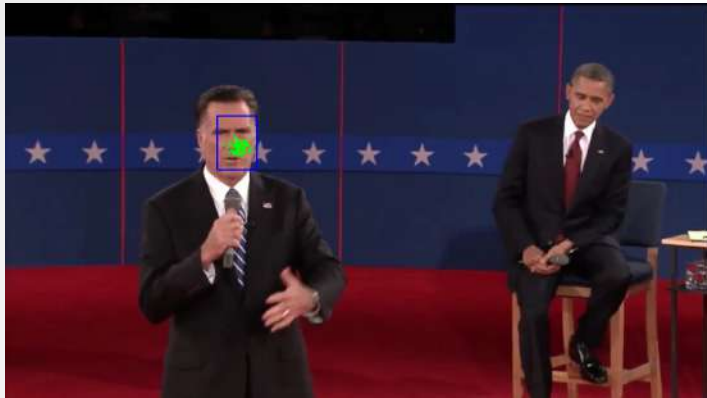


# 4a: Discussion Problems

Advantages of Small window size:

- (1) Each image pixel has high contribution to mse, so small window is suitable for an image with no noise and easily distinguishable tracking object from the background so that small window is good enough
- (2) Since the window size is small, the amount of computation per frame is very less, leading to smaller run times

# 4a: Discussion Problems





## 4b: Discussion Problems

Using problem 1, Adjust the  $\sigma_{\text{MSE}}$  parameter to higher and lower values and run the tracker.

**Discuss how changing  $\sigma_{\text{MSE}}$  parameter alters the results and attempt to explain why.**

Higher  $\sigma_{\text{MSE}}$  increases variance of weight distribution of the particles which leads them to be little spread out from one another. This can cause tracking to latch on to some other object in the frame which is somewhat similar to the object we are tracking

# 4b: Discussion Problems

Higher  $\sigma_{\text{MSE}}$  used for tracking



## 4b: Discussion Problems

Using problem 1, Adjust the  $\sigma_{\text{MSE}}$  parameter to higher and lower values and run the tracker.

**Discuss how changing  $\sigma_{\text{MSE}}$  parameter alters the results and attempt to explain why.**

Lower  $\sigma_{\text{MSE}}$  decreases variance of weight distribution of the particles which leads them to be concentrated in a small area. This can cause tracking to be stuck at local maxima sometimes and not been able to recover from that because of particles concentrated over a small area and cannot explore the frame much.

# 4b: Discussion Problems

Lower  $\sigma_{\text{MSE}}$  used for tracking



# 4c: Discussion Problems

Using problem 1, optimize the number of particles needed to track the target. The particle filter should still be able to track the object.

Optimized particle number required for problem 1 is 40.

As we increase the number of particles, tracking accuracy increases, but run time increases exponentially. Large number of particles ensures that the algorithm is not stuck at local maxima.

# CHALLENGE PROBLEM:

## 5: Template used for tracking



Template image patch image - **ps7-5-a-1.png**

# 5a: Image frame 40 with overlaid visualizations



Image frame 40 with overlaid visualizations - **ps7-5-a-2.png**



# 5a: Image frame 100 with overlaid visualizations



Image frame 100 with overlaid visualizations - **ps7-5-a-3.png**

# 5a: Image frame 240 with overlaid visualizations



Image frame 240 with overlaid visualizations - **ps7-5-a-4.png**