Computer Vision (Spring 2019) Problem Set #5

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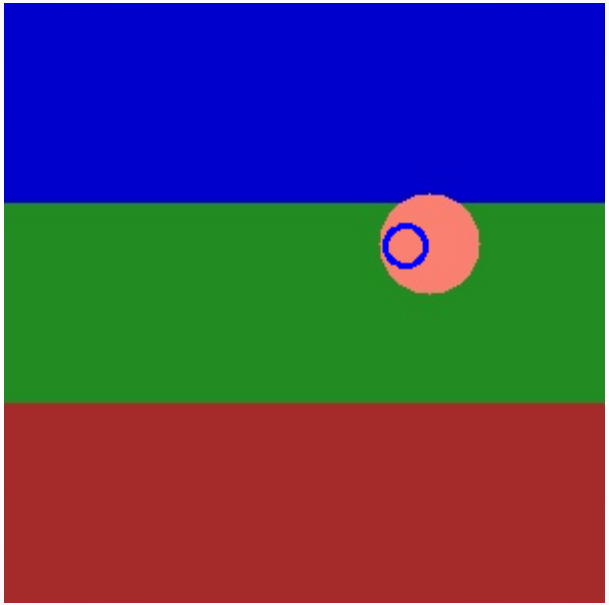
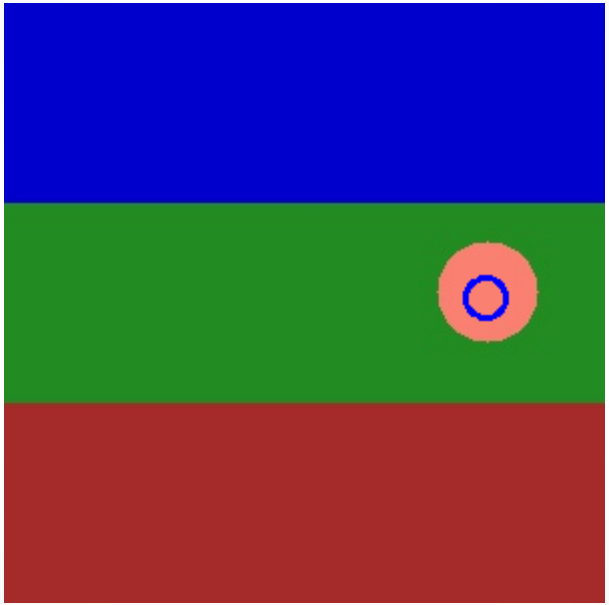
1b: KF Tracking a circle



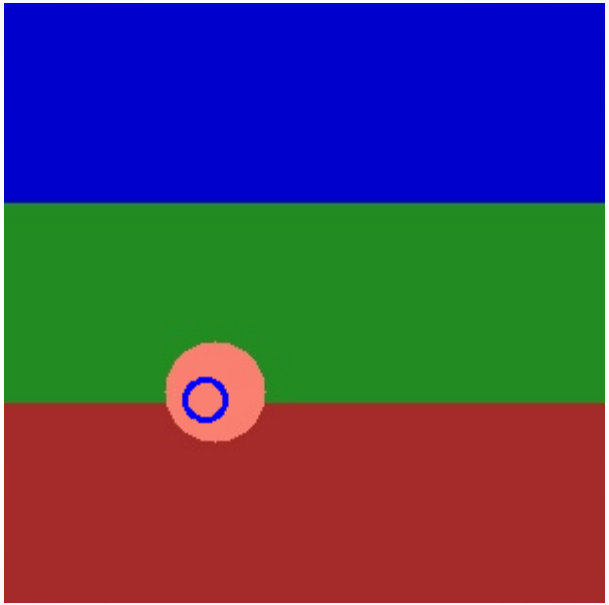
ps5-1-b-1

1b: KF Tracking a circle (cont.)



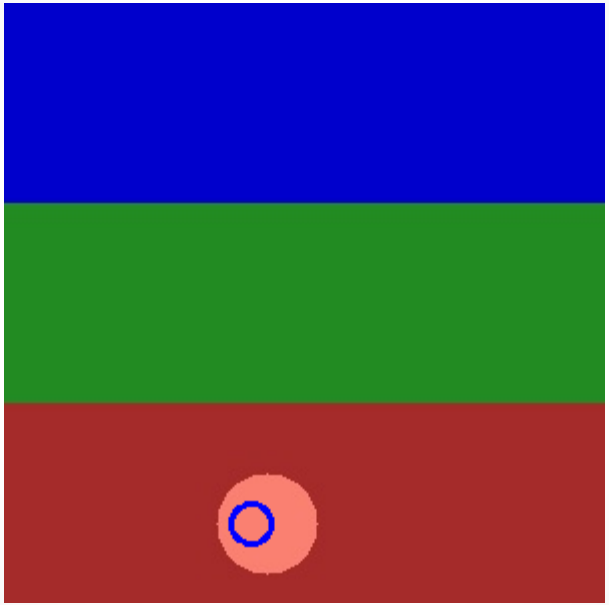
ps5-1-b-2

1b: KF Tracking a circle (cont.)



ps5-1-b-3

1b: KF Tracking a circle (cont.)



ps5-1-b-4

1c: KF Tracking pedestrians

ps5-1-c-1

1c: KF Tracking pedestrians

ps5-1-c-2

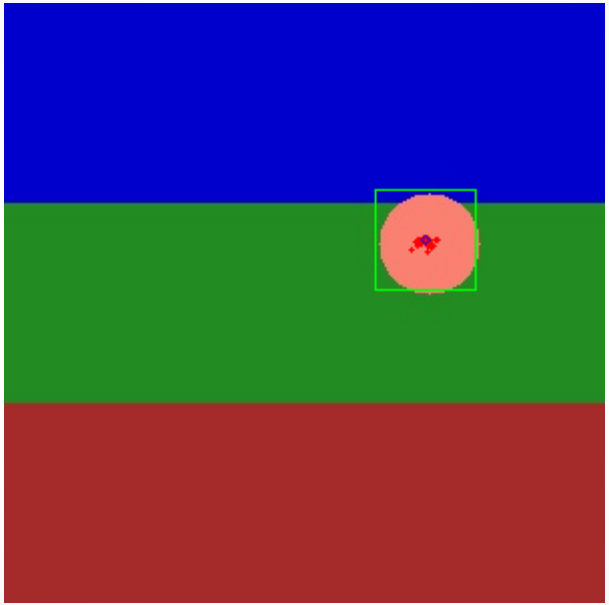
1c: KF Tracking pedestrians

ps5-1-c-3

1c: KF Tracking pedestrians

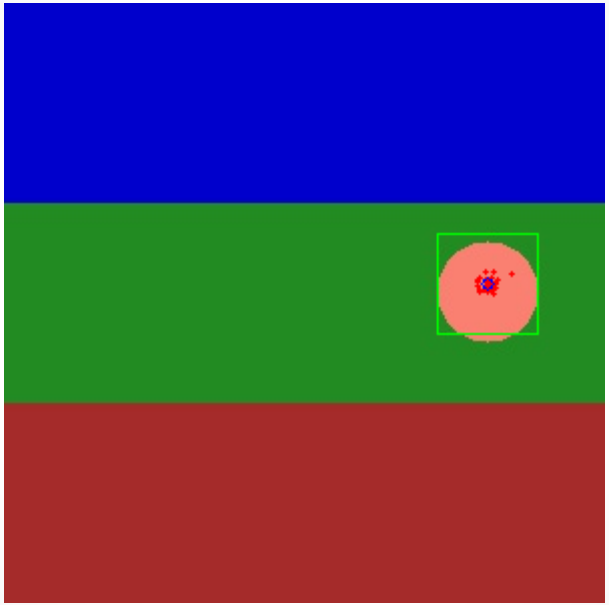
ps5-1-c-4

2a: PF Tracking a circle



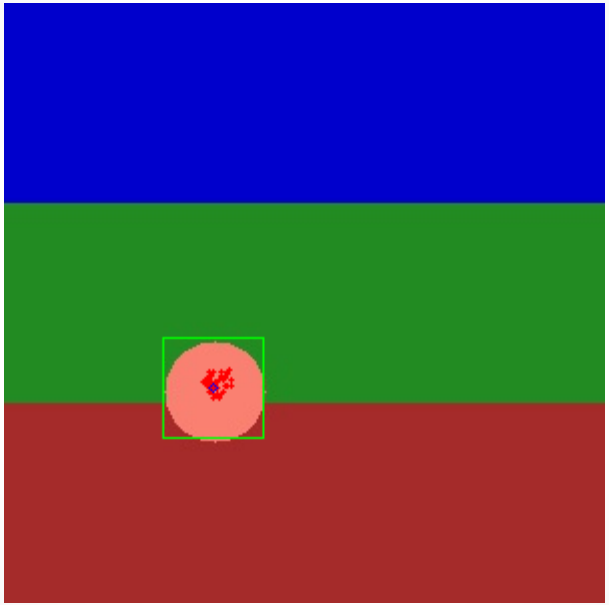
ps5-2-a-1

2a: PF Tracking a circle (cont.)



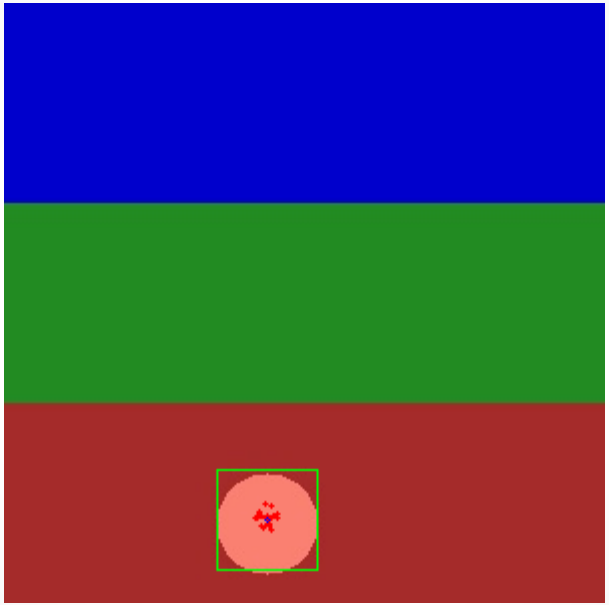
ps5-2-a-2

2a: PF Tracking a circle (cont.)



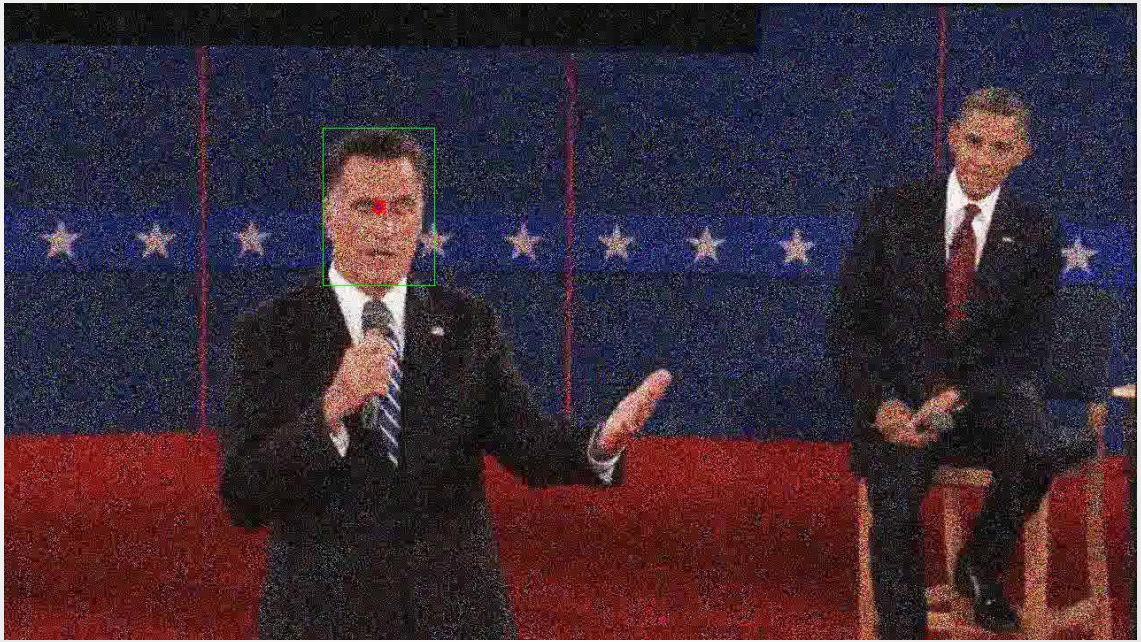
ps5-2-a-3

2a: PF Tracking a circle (cont.)



ps5-2-a-4

2b: PF Tracking noisy video



ps5-2-b-1

2b: PF Tracking noisy video (cont.)

ps5-2-b-2

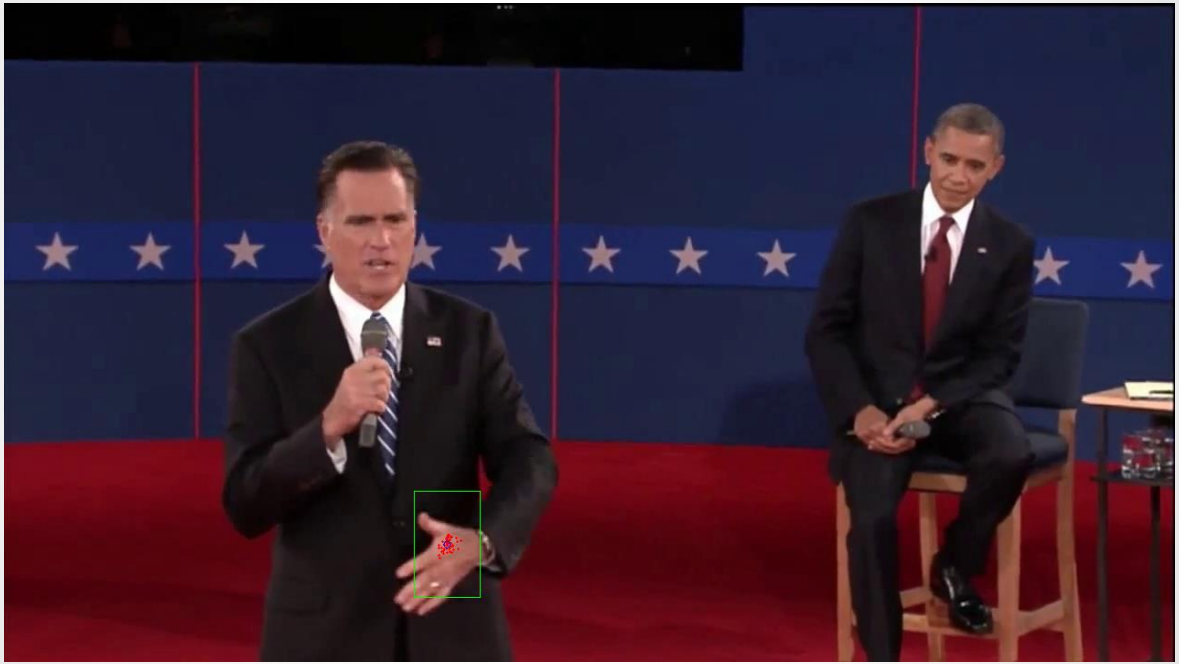
2b: PF Tracking noisy video (cont.)

ps5-2-b-3

2b: PF Tracking noisy video (cont.)

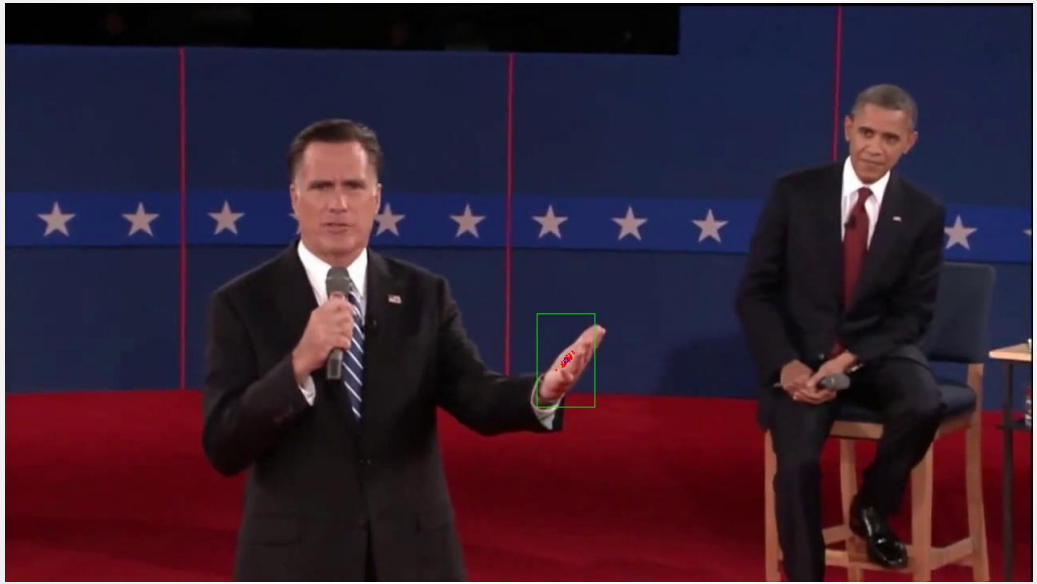
ps5-2-b-4

3a: PF Changes in Appearance



ps5-3-a-1

3a: PF Changes in Appearance (cont.)

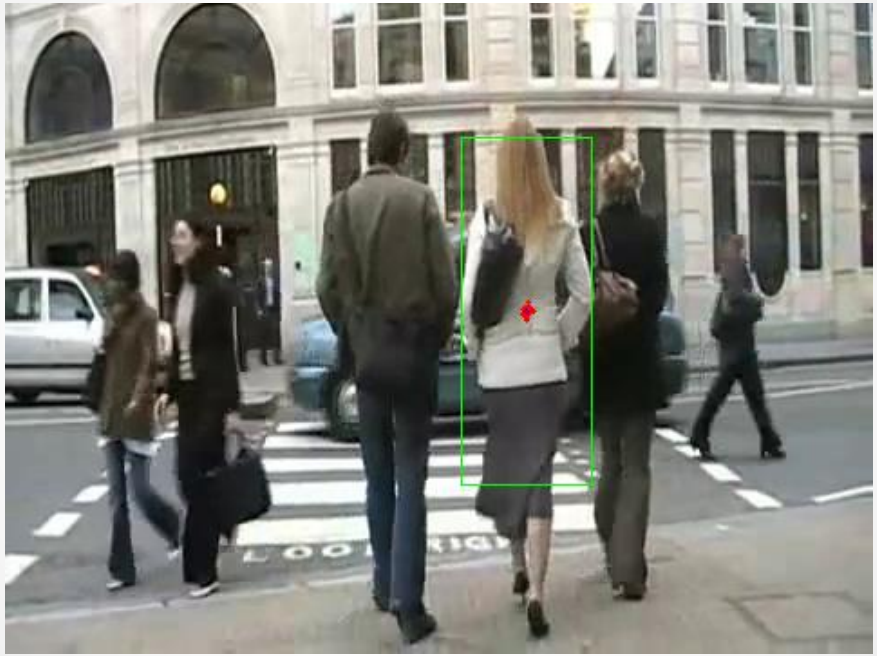


ps5-3-a-2

3a: PF Changes in Appearance (cont.)

ps5-3-a-3

4a: PF Occlusions



ps5-4-a-1

4a: PF Occlusions (cont.)

ps5-4-a-2

4a: PF Occlusions (cont.)

ps5-4-a-3

4a: PF Occlusions (cont.)

ps5-4-a-4

4: Text response

Describe what you did. How did you modify the Particle Filter class to continue tracking after occlusions?

As suggested in the instructions, I added another dimension to my dynamic model. The third dimension is the size/scale factor of our current template. In each iteration, the particles in that dimension are set from a normal distribution with a mean of 1 (the current size of the template) and a small variance I found through tuning. The variance is small based on the assumption that our object do not change in size drastically. The third dimension essentially tells us how much to resize our template. When checking for the similarity measurements, before comparing, I resize the template based on the resize factor. The weights are calculated based on all the 3 dimensions. At the end, I take the weighted mean of the size factor and resize the template according to it.

In addition, I used a small value of sigma for the particles movement, to able to maintain the state during occlusion (especially that I know the women don't move much to the sides). Furthermore, I also made small changes to the template due to slow changes in appearance.

5: Tracking multiple targets

ps5-5-a-1

5: Tracking multiple targets (cont.)

ps5-5-a-2

5: Tracking multiple targets (cont.)

ps5-5-a-3

5: Text response

Describe what you did. How different it was to use a KF vs PF? Which one worked best and why? Include details about any modifications you had to apply to handle multiple targets.

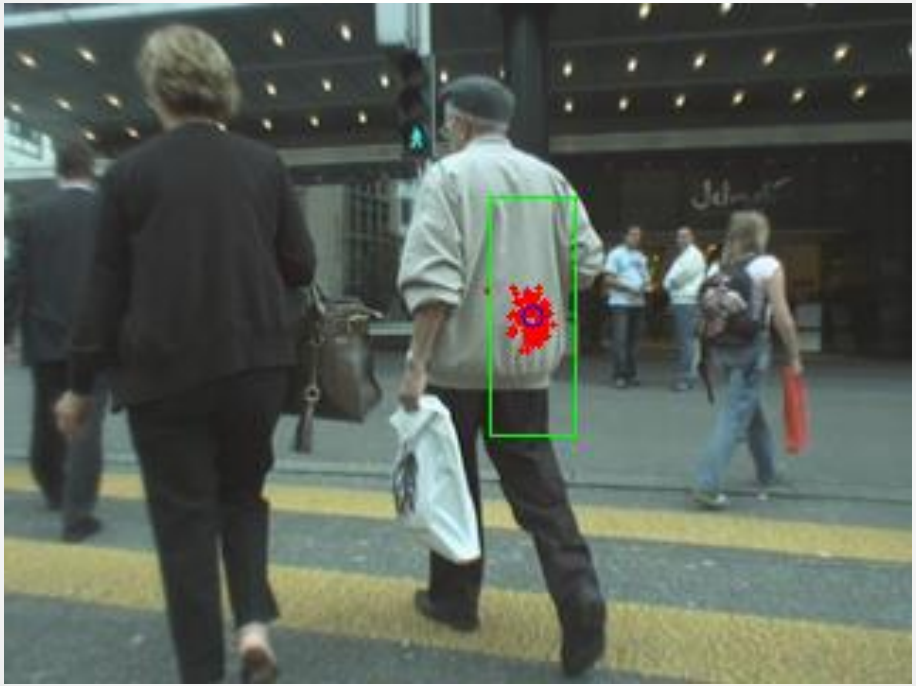
I used the provided method of running our filters, and changed it in order to run multiple filters in parallel. I tuned the parameters for each object based on the object behavior: different alpha based on amount of change and higher sigma for the particles movement in case of occlusion. Since there was no change in size, I didn't utilize the template size change. I provided the initial location manually and I needed to state when each object appear and disappear.

When running PF, we need to account to the right parameters, since they describe our model. PF assume the motion is random, so it does not have any prior beliefs. On the other hand, our KF motion assume movement in one direction, which in this particular case, fits very well. Even in the case of occlusion KF was able to track the object (even if losing it momentarily when occluded). I think that for this case, KF it better, since the world behave as the dynamic model assume, and it is much simpler and efficent. In the case that world wasn't behaving like that, PF is preferable.

6: Challenge Problem

ps5-6-a-1

6: Challenge Problem (cont.)



ps5-6-a-2

6: Challenge Problem (cont.)

ps5-6-a-3

6: Challenge Problem Text response

Describe what you did. Did this task present any additional challenges compared to the previous sections? Include details about any modifications you had to apply.

I used the MDParticleFilter and tuned the parameters so it will be able to track the object. Since the object is moving unpredictably, is occluded, and changes in size, I needed to utilize all the previous parameters. The challenge was to hit the right tuning, as each parameter can throw the filter way off, since we have all this changes. A more sophisticated solution might have include tuning those parameters in each iteration, based on some error metric, but since I was able to get good results I stuck with the simpler one.