Computer Vision
Lab Report 5
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Image Segmentation

8.1 Image Preprocessing

a) Below is the image before and after applying the 5*5 Gaussian filter with sigma = 5

Figure 1(a): original image　　Figure 1(b): smoothed image　　Figure 1(c): image in L*a*b space

b) L*a*b space consists of a brightness layer. Therefore, areas with same colour but slightly different luminosity condition could have closer values than the case in the RGB space. In this case, for instance, the value of grass seems to become closer in the l*a*b space.

8.2 Mean-shift Segmentation

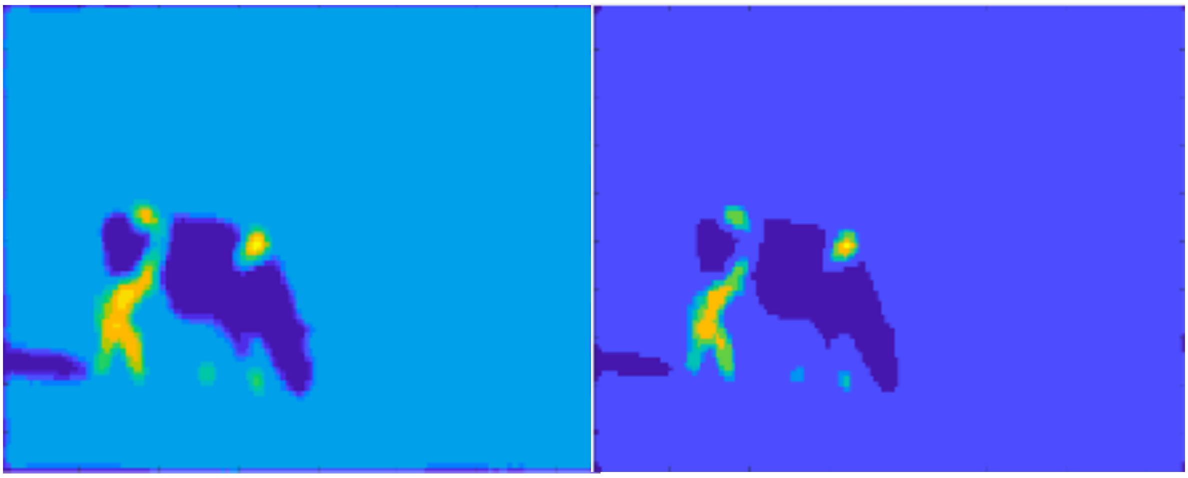

Figure 2(a): mean-shift segmentation with window size 3

Figure 2(b): mean-shift segmentation with window size 5

As we can see, as the window size increases, it appears that there are less classes and the edge of the segmentation becomes clearer. The reason is that when the window size increases, more peaks will be merged together so there would be less clusters.

8.3 EM Segmentation

Case 2: K = 4

```
mu_e =

    0.6305   -0.1895    0.2389
   -3.9542    0.5735   -0.8294
    3.5785    0.8811   -0.6123


var_e(:,:,1) =

    0.5745   -0.0853    0.0079
   -0.0053    0.0889   -0.0813
    0.0079   -0.0813    0.0192


var_e(:,:,2) =

    8.4283   -1.7621    2.4934
   -1.7621    0.4545   -0.5906
    2.4934   -0.5906    0.8735


var_e(:,:,3) =

   20.9575    0.9277    0.0557
    0.9277    0.2662   -0.2688
    0.0557   -0.2688    0.4469


alpha_e =

    0.7642    0.1760    0.0598
```

Case 2: K = 4

```
mu_e =

   -3.8555    0.4588   -0.7751
    0.6346   -0.1896    0.2391
   -2.7214    1.6280   -1.8342
    3.7614    0.6843   -0.3427


var_e(:,:,1) =

    8.1662   -1.6556    2.3974
   -1.6556    0.3987   -0.5422
    2.3974   -0.5422    0.7886


var_e(:,:,2) =

    0.5688   -0.0852    0.0079
   -0.0052    0.0889   -0.0813
    0.0078   -0.0813    0.0192


var_e(:,:,3) =

   24.0471   -0.5836    1.0482
   -0.5036    0.0285   -0.0422
    1.0482   -0.0422    0.1867


var_e(:,:,4) =

   28.3428    1.7822   -0.8686
    1.7022    0.2277   -0.1562
   -0.8686   -0.1562    0.2484


alpha_e =

    0.1636    0.7625    0.0282    0.0537
```

Case 3: K = 5

```
mu_e =

   -4.8975    0.6228   -1.0290
    6.7165   -0.2037    0.2341
   -2.8962    1.6210   -1.8393
   -6.5598   -0.0166    0.1583
    4.0025    0.7880   -0.4754


var_e(:,:,1) =

    7.0787   -1.6319    2.2978
   -1.6319    0.4307   -0.5752
    2.2978   -0.5752    0.8086


var_e(:,:,2) =

    6.5014    0.0075    0.6098
    6.0075    0.0075   -0.6018
    6.0098   -0.0018    0.6179


var_e(:,:,3) =

   21.5974   -0.4304    0.8384
   -6.4304    0.0288   -0.6386
    6.8384   -0.0386    0.6933


var_e(:,:,4) =

    6.6577   -0.0181    0.1374
   -6.0181    0.0129   -0.6168
    6.1374   -0.0168    0.6778


var_e(:,:,5) =

   22.2964    1.4501   -0.3647
    1.4501    0.1867   -0.1132
   -0.3647   -0.1132    0.2096


alpha_e =

    0.1189    0.7008    0.0194    0.1113    0.0495
```

Figure 3(a): EM Segmentation with 3 clusters

Figure 3(b): EM Segmentation with 4 clusters

Figure 3(c): EM Segmentation with 5 clusters

Different from the Mean-Shift method, where only the window size could be chosen, the number of clusters is allowed to be selected with the EM segmentation. As shown in the above figures, the estimated parameters change with different number of clusters. In our case, K = 3 is a clearly better choice than the other 2, since K = 3 would cluster the figure into the grass, the black part, and the white part of the cow. (Though some darker places of the grass is mistakenly clustered in the same cluster as the black part of the cow). With K = 4 or 5, the cow/grass are cluster in more groups and more noises are introduced.