CV2015Spring—Assignment #3

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1. Overview

This homework is a segmentation assignment, so I did this through grab cut and meanshift methods as the introduction. And then I evaluated each method by adjusting some parameters in segmentation. The result is followed by each section.

2. Grab Cut

The whole framework of the grab cut method is showed in Figure 1.

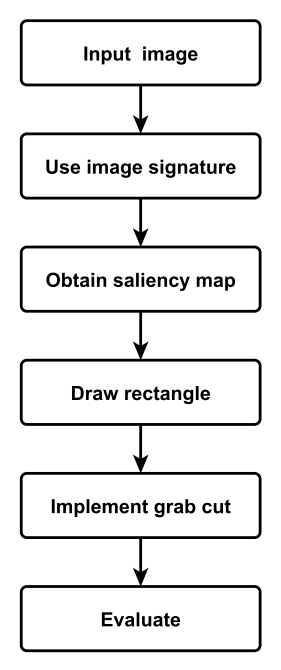

Figure 1: Framework of grab cut method.

2.1 Step 1: Input image

I use the PASCAL dataset download on the assignment webpage[1] and unzip it. The dataset contains raw images and their groundtruth. I use all images (850 images totally) from the dataset for segmentation, and evaluate grab cut by adjusting some different parameters.

2.2 Step 2: Use image signature

Input The input color image ($m \times n \times 3$ matrix).

Output The saliency map ($m \times n$ matrix).

Implementation The saliency map is obtained by image signature and the matlab code can be downloaded from website[2], where the files of SIG_single, signatureSal and default_signature_param are used.

2.3 Step 3: Draw the rectangle

Input The input saliency map image ($m \times n$ matrix).

Output A rectangle that is used to initialize the grab cut.

Implementation

- The rectangle is used to locate the most probable position of object and initialize mask in grab cut.
- I use thresholding to transform saliency map to binary image and draw a rectangle according to the binary image.

2.4 Step 4: Implement grab cut

Input The input image ($m \times n \times 3$ matrix) from step 1, and the rectangle that I computed from step 3.

Output The image after segmentation ($m \times n \times 3$ matrix).

[1] http://vision.ouc.edu.cn/~zhenghaiyong/courses/cv/2015spring/assignments/PASCAL.zip
[2] http://www.eecs.berkeley.edu/Research/Projects/CS/vision/shape/action/

Implementation

- I use grab cut with the rectangle to initialize and iterate k times for segmentation.
- The C++ code for drawing rectangle and implementing grab cut are downloaded from the website[3].

2.5 Step 5: Evaluate segmentation result

Input Segmentation result ($m \times n \times 3$ matrix) and groundtruth ($m \times n$ matrix) from dataset.

Output A figure that indicates evaluation results (The horizontal axis represents the parameter, the vertical axis represents the evaluation results).

Implement

I adjust the threshold , size of rectangle and times of iteration to obtain different segmentation results and draw PRF bar graph to evaluate the grab cut method.

2.6 Notes

- The three parameters to adjust:
  - threshold in step 3.
  - size of rectangle in step 3.
  - times of iteration in step 5.

[3] http://vision.ouc.edu.cn/~zhenghaiyong/courses/cv/2015spring/assignments/GrabcutCode.zip

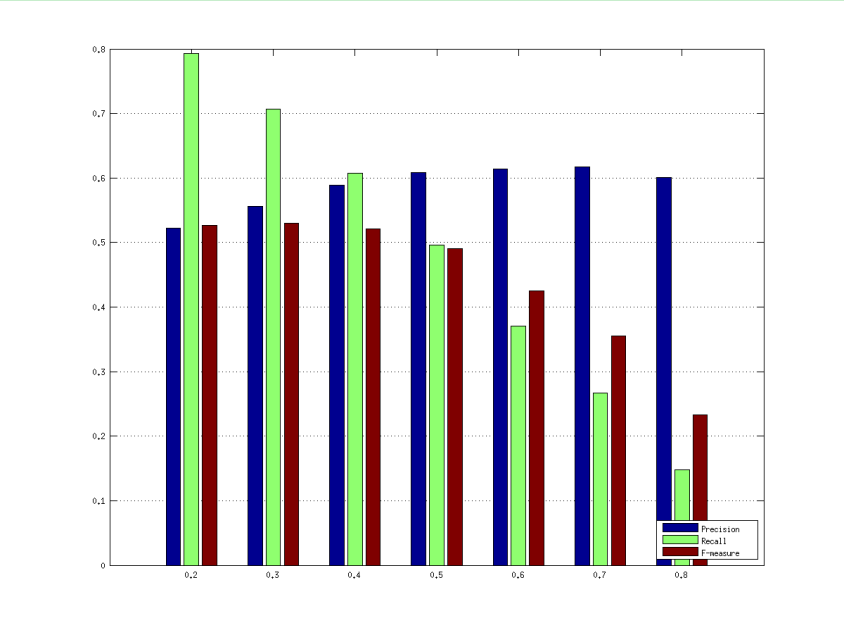

Figure 2: Live chart of PRF by adjusting the threshold value

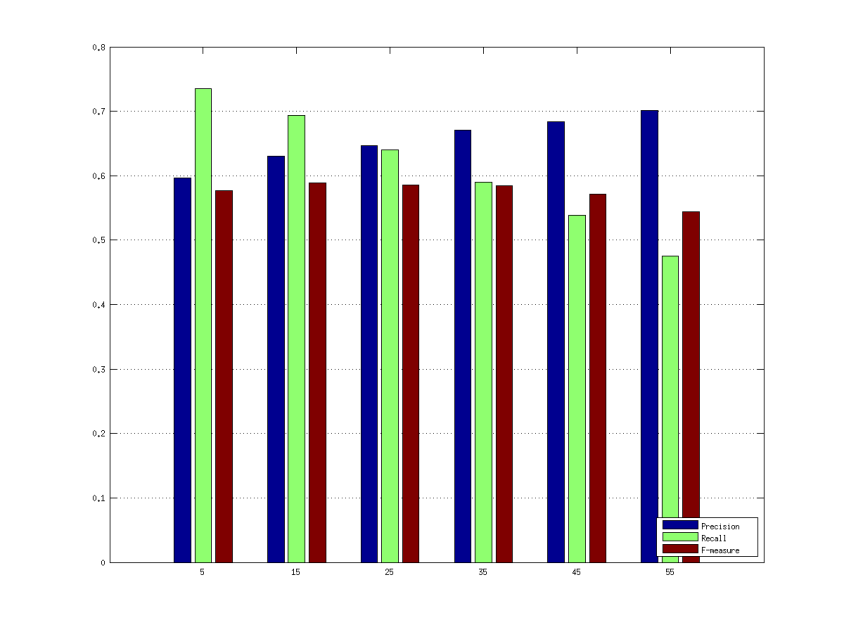

Figure 3: Live chart of PRF by adjusting the iterative size

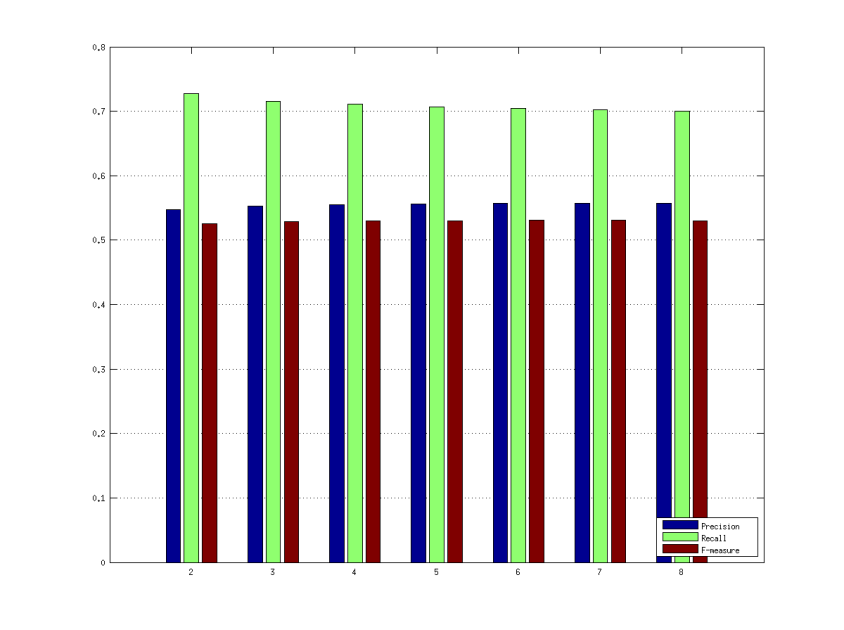

Figure 4: Live chart of PRF by adjusting the iterative times

3. Mean shift (40 points)

The whole framework of the mean shift method is shown in Figure 5.

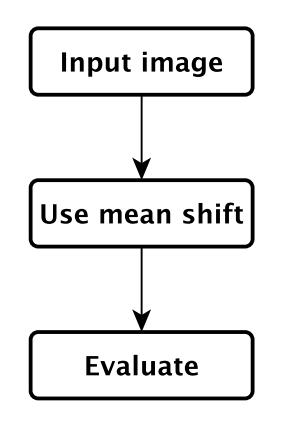

Figure 5: Framework of the implementation for evaluation of mean shift.

3.1 Step 1: Input image

I use the BSDS500 dataset from the website[4] given in the assignment.The dataset contains raw images and groundtruth. I use 200 images of the dataset for segmentation.

[4] http://www.eecs.berkeley.edu/Research/Projects/CS/vision/grouping/segbench/

3.2 Step 2: Segment via mean shift

In this step, I adjust two parameters of mean shift to get different segmentation results.

Input The color image ($m \times n \times 3$ *matrix*).

Output The segmentation results ($m \times n \times 3$ *matrix*) and label matrixes ($m \times n$ *matrix*) of different parameters.

Implementation

I adjusted two parameters of mean shift for this implementation, including:

- Spatial radius
- Color radius

3.3 Step 3: Evaluate segmentation result with groundtruth

In this step, I evaluate the different segmentation results from step 2.

Input The label matrixes ($m \times n$ *matrix*) from step 2, the groundtruth matrixes ($m \times n$ *matrix*) from dataset.

Output Line chart of the evaluation results. (The horizontal axis represents parameters. The vertical axis represents the evaluation results.)

Implementation

I use four evaluation methods, including:

- Probabilistic Rand Index (PRI)
- Variation of Information (VOI)
- Global Consistency Error (GCE)
- Boundary Displacement Error (BDE)

Results : Figures show four kinds of evaluation results (BDE PRI VOI GCE) by adjusting two parameter (Spatial radius and color radius).

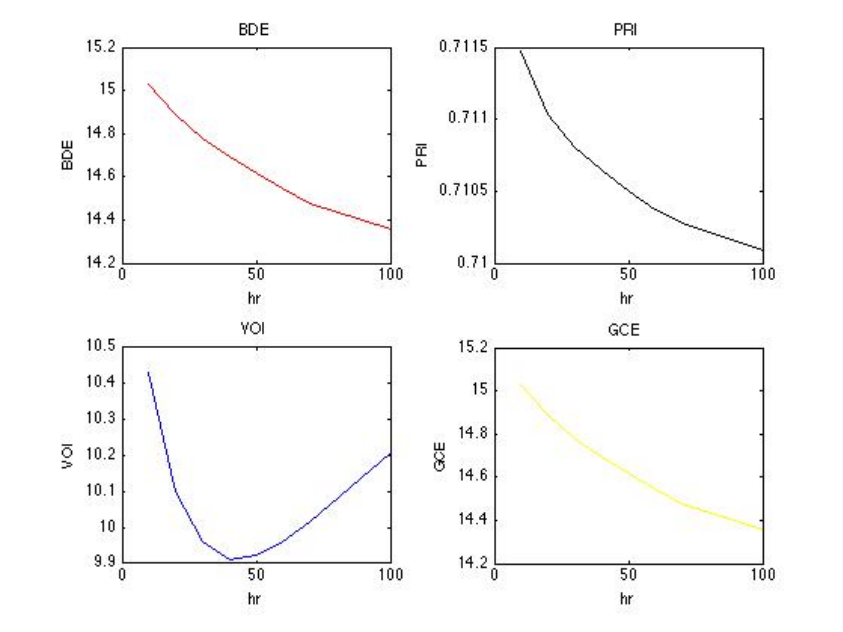

Figure 6: Line chart of BDE PRI VOI GCE by adjusting Spatial radius

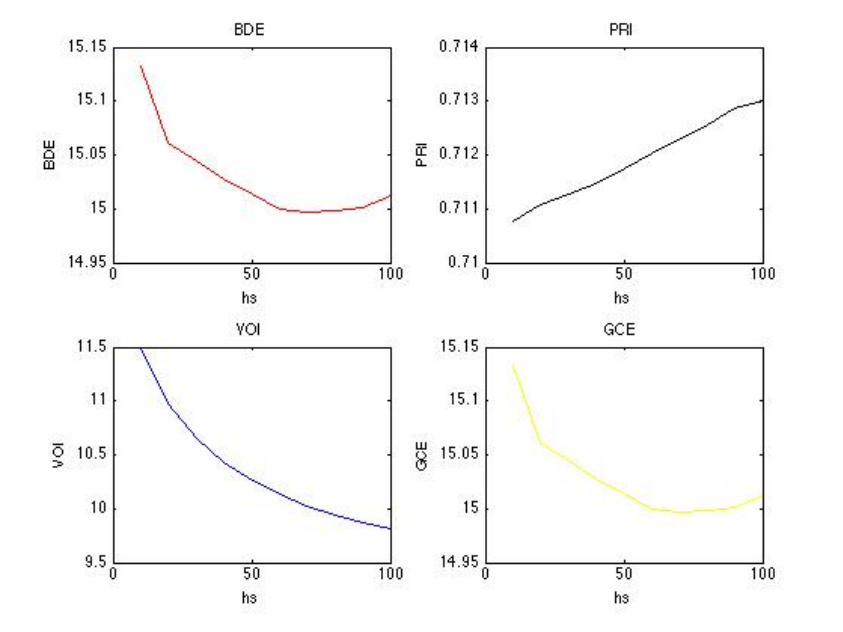

Figure 7: Line chart of BDE PRI VOI GCE by adjusting Color radius

4. Acknowledgement

Thanks to Zhao Haiwei, Wang Ruchen and Dai Jialun's help, without them I can't finish my homework before deadline.