Mean Shift Segmentation

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DoS : 14th December, 2015

Literature Review

The project is based on the mean-shift algorithm. This concept is applied to images to identify the segments in an image.

The basic technique involves the mean-shift filtering and segmentation of the images discussed in the class.

This general overview of the technique is mathematically formulated and implemented in the references given for the project.

The reference provided helps to undergo critical element for image segmentation as it highlights feature space estimation and mean shift for color components of a color image.

CONTENT

INTRODUCTION

The project as titled Mean-Shift Segmentation, is an image processing technique which uses the mean shift concept to identify segments in an image. The significance of this technique is a lead to semantic analysis of an image.

Segmentation has always been a major technique in image processing. Mean shift technique was introduced in 1975 by Fukunaga and Hostetler and re-introduced in 1995 by Cheng.

The project was carried out in two phases:

1. Phase 1 : Resource Identification and Understanding the concept with Flow
2. Phase 2 : Implementation and Output analysis

Phase 1 :
Main resources were identified from classroom notes of mean shift segmentation and references given for the project suffices the resources for the project.

Phase 2 :
This starts with a flow chart described in the next section and the code implementation to generate desired outputs with their corresponding parameters.

APPROACH

The basic flow of the Mean-shift segmentation is as follows :

1. Input Image (Grayscale or Color)
2. Create a feature space-matrix for the image
3. Select two thresholds H and iter
4. Choose a random row from the feature space and assign it as current mean
5. Calculate the Euclidean distance of all the rows of the feature space and select those which come under a threshold H.
6. Calculate the mean of all the selected points and estimate the meanshift.
7. If the mean shift is within the threshold iter, assign the mean intensity values to all the selected points in the new image and remove them from the feature space.
8. If not, set it as current mean and go to step 5.
9. Continue this until all the points in the feature space are exhausted.

The software use for implementation is Enthought Canopy. The code is written in python language.

OUTCOME

The algorithm is tested using 3 test images : 1 color and 2 grayscale images.

Image 1 : Butterfly Image (iter value = 0.25)

Original Image

H = 30

H = 60

H = 90

The Images obtained here are seen with significant changes in the segmentation when ranged from value 30 to 60. The size of segments increases as we increase the value of H parameter.

Image 2 : Hill House Image (iter value = 0.25)

Original Image

H = 30

H = 60

H = 90

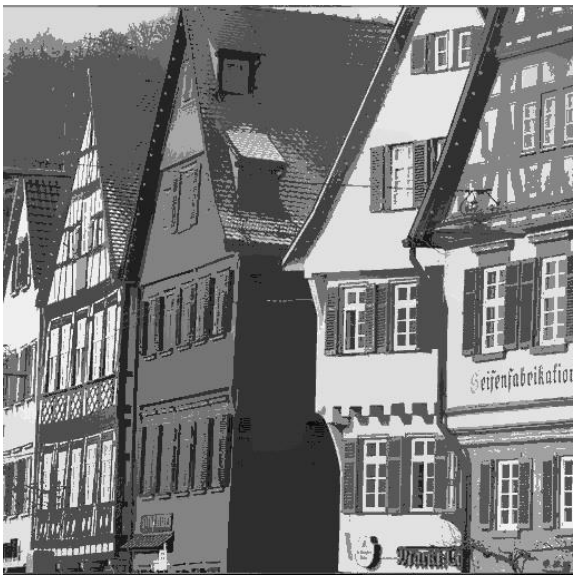
This is a gray-scale Hill House image. It can be seen that the segments are getting bigger in the images obtained from higher H value.

Image 3 : House Image (iter value = 0.25)

Original Image

H = 30

H = 60



H = 90

It can be seen that as we increase the H parameter, the windows are considered as the same segment as the walls.

The most important thing here is the H parameter. It decides how the image will be segmented. It takes into consideration both intensity values and pixel coordinates for mean shift. This parameter can be split into Hr and Hs parameter.[2]

Hr is the range parameter. It estimates the range of intensity values to be considered for mean shift.

Hs is the space parameter. It estimates the space i.e. the distance window to be considered.

Here we also include a weight parameter to assign weights.

It can be assigned using any kernel say Gaussian or Epanechnikov. [1]

CODE DEVELOPMENT

The code id developed in python. The use of image processing lribrary Open CV is used along with Numpy library for python.

This code development involved following elements:

1. Open CV library:
    a. It is an image processing library support for processing images.
    b. It is used in the project to read images, show images.
2. Numpy library:
    a. This is a very fundamental library for mathematical operations.
    b. It is used for creating arrays for processing images.

The rest of the code follows sequential approach using python's basic syntax and programming logic to implement the project.

This is the first time I have done a project on python. It has been a different experience to learn this language.

SUMMARY

This project is a practical implementation of mean shift algorithm for image segmentation. The algorithm has various variations for the decision parameters.

It starts with estimating the current mean of a random window, shift the window based on the decision parameters and hence the term mean-shift.

With the variation of the parameter H, we estimate the segmentation of the image.

This project can be extended for segmentation to real life scenarios like quadcoptor SLAM project.

ACKNOWLEDGEMENT

I would like to thank Professor. Chang Wen Chen for having me take the course CSE 573 and preform this project on mean shift segmentation.

I would also like to thank the TAs, Radhakrishna Dasari and Bhargava Urala Kota to help understand the project concepts.

REFERENCES

[1] .Y. Cheng, “Mean shift, mode seeking, and clustering,” *IEEE Tans. Pattern Analysis and Machine Intelligence*, Vol. 17, No. 8, pp. 790-799, August 1995

[2].http://web.missouri.edu/~hantx/ECE8001/notes/CCV_Lecture_Notes/CCV_Lect13_MeanShift.pdf