Graph based Image Segmentation

Pansetty Karthik (15110082)
Mentor – Prof. Shanmuganathan Raman

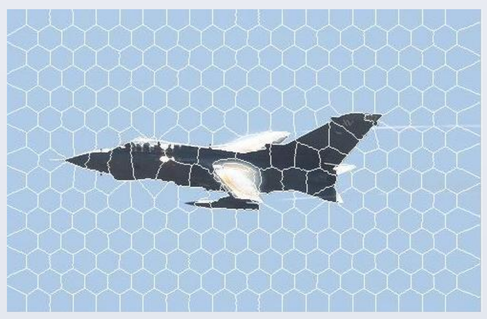
Indian Institute of Technology Gandhinagar

ABSTRACT

- We address the problem of segmenting an image into different regions. We segment the image into two regions by constructing a graph and utilizing it to cluster it into two regions.

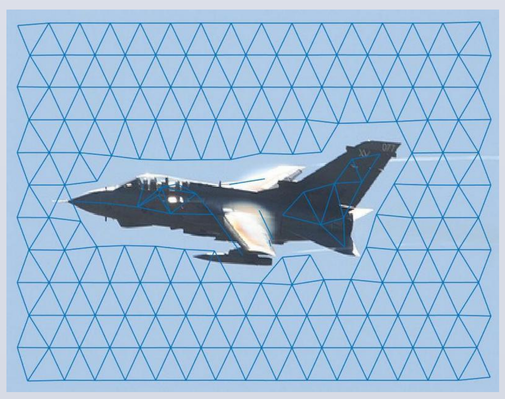
OBJECTIVE

- To construct the superpixels of the image. Superpixels are basically a group of pixels which can be used to replace the rigid structure of the pixels and they are convenient to compute image features. Superpixels fit well to image boundaries based on the edges and the colors and they improve the speed and quality of image segmentation.



- Extract SIFT and L*a*b color values of each the pixels of a superpixel. The SIFT and L*a*b colour values are then encoded using Fisher Vectors. We take local feature descriptors of the pixels and encode them into higher dimensional vector to get a feature descriptor for the superpixel. This is done this by the implementation used by VlFeat.

- A graph is then constructed by using these feature descriptors for computing the edges by using the Gaussian between nodes. There is a threshold value below which there will not be edges between nodes.



- Then we use Normalized Spectral Clustering to separate the image into two clusters. The two different clusters will be the two different regions of the image.
- For this clustering we use the Normalized graph laplacian, defined as

$$L_{rw} = D^{-1}L = I - D^{-1}W$$

where W is the weighted adjacency matrix and D is a diagonal matrix containing the degree of each vertex.

- The computation of this Laplacian, its eigenvectors and eigenvalues are done by using ‘The Graph Signal Processing Toolbox (GSPBox)’.

- To cluster it into k clusters, we take the first k eigenvectors and then use the classical clustering k-means algorithm to cluster in into k clusters. This method is more efficient and faster than the k-means algorithm and the computation is easier as it can be solved by standard linear algebra methods.
- For segmentation, the graph is separated into two clusters (k=2) using Spectral Clustering
- This computation is done by using ‘The Compressive Spectral Clustering Toolbox’.

- In the above results I have represented the nodes of the superpixels which belong the one cluster in blue dots. (i.e. the part which belongs to one segment of the image).

RESULTS

- The images which clearly have only one object have good results whereas the images which have many different objects do not have that good results. (This is because I previously took the centre of the superpixel to computer the feature descriptor, I’m now trying to consider all the pixels in the superpixel to compute the feature descriptor of the superpixel). Below is a result of an image with multiple objects.

- The computation time is not fast but I’m working on the algorithm to make it efficient.

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