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# A Narrative Methodology towards Normalized Cuts Using Spectral Reduction in Biomedical Image Segmentation

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**ABSTRACT:** An innovative method to incorporate prior domain knowledge into normalized cuts for biomedical image segmentation has started to play one of the most fundamental vital roles in diagnosis and treatment of diseases as the novel medical imaging technologies progress .In this paper; we initiated an innovative method to embody preceding knowledge into normalized cuts. The preceding is incorporated into the cost function by maximizing the similarity of the preceding to one partition and the dissimilarity to the other. This simple formulation can also be extended to multiple proceeding to allow the modeling of the shape variations. A shape model obtained by PCA on a training set can be easily integrated into the new framework. This is in variation to other methods that usually incorporate preceding knowledge by hard constraints during optimization. An Eigen value problem inferred by spectral relaxation is not sparse, but can still be solved efficiently. We engage this method to biomedical data sets as well as natural images of people from a public database and examine it with other normalized cut based segmentation algorithms. We demonstrate that our method gives promising results and can still give a good segmentation even when the prior is not accurate.

**KEYWORDS:** Image segmentation, normalized cuts, normalized cuts with shape prior, shape model, spectral relaxation and medical segmentation.

## I. INTRODUCTION

An image segmentation has started to play one of the most essential roles in diagnosis and treatment of diseases as the innovative medical imaging technologies progress. However, medical segmentation is still challenging due to limited image contrast, presence of noise and variations in anatomy and pathology. To alleviate these issues, prior knowledge is integrated into the segmentation method giving more robust results. In general, due to the specificity of the prior, numerous methods have been developed to solve specific cases. Normalized cuts are an efficient graph theoretic segmentation method robust to noise and outliers, and are thus a good candidate for medical imaging segmentation. Previously, it has been used for segmentation of the spinal vertebrae and clustering of white matter fiber tracts among others. Although normalized cuts has not become as popular in the medical segmentation field as other methods such as level sets or graph cuts. Image segmentation is one of the essential steps of image processing that divides images to separated regions so that each region is a set of connected adjacent pixels. The purpose of segmentation is to decompose an image to significant and convenient regions. Application of image segmentation includes medical images in locating tumors and other injuries, measuring tissue volume and diagnosis, as well as locating objects such as roads, jungles, etc. in satellite pictures, face recognition, finger detection and machine vision. So far, many techniques have been performed for image segmentation, including optimization techniques and graph-based methods. In optimization techniques, image segmentation is performed by evolutionary algorithm e.g. genetic algorithm, ant colony tabu search etc that each method has advantages and disadvantages of its own. Graph-based methods have been used effectively for image segmentation and are so efficient. In this procedure, the image models on a weighted undirected graph. Image pixels form graph nodes, and every adjacent node connect to each other by an edge, then it partitions to several parts according to certain criteria Among this criterion's different graph partitioning methods can be pointed such as minimum cut, normalized cut and isoperimetric cut and also optimization techniques, including genetic algorithm, ant colony, tabu search and simulated annealing. Graph partitioning has various applications in modeling in

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different issues, e.g. transport network, electrical circuit, internet network and Scheduling problem. The most important use of graph partitioning is in image segmentation. Graph partitioning problem is categorized as Np-Hard. Since image segmentation can be reduced to graph partitioning therefore it is also a NP-H problem.

## II. RELATED WORK

A Fast Large Size Image segmentation Algorithm Based on Spectral Clustering: This paper, says that whenever spectral clustering deals with large size image it takes a lot of time and cost .To solve this problem this paper has been developed which separate the large size image into smaller images combine the segmentation results of each smaller image. Then a point is randomly selected in the integrated results to constitute the feature data of the large size image. If the size of image is very large, we face the problem of high computational cost. Therefore, most of the spectral clustering algorithms are applied in the small scale image. Yan etal proposed a general framework for fast approximate spectral clustering which can get minimum distortion rate and reduce the scale of data. In this paper deals with the problem of the large size image segmentation and propose a fast image segmentation algorithm based on spectral clustering. The algorithm FSC in this paper mainly contains block wise segmentation in which image is partitioned into blocks, initial pre-partition in which all gray level of pixels are converted to 8-bit binary code and replace lower m bits by 0, data clustering with representative points in which randomly a pixel is selected from clusters, and the determination of the original image pixel category in which all pixels in cluster have same class labels.

Zelnik-Manor and Perona proposed a method for automatically determining an appropriate number of clusters (segments) and adaptively selecting an appropriate neighborhood size or scale. The number of clusters is determined by minimizing the cost for a range of possible numbers of clusters, associated with rotating the columns of V in alignment with a canonical coordinate system, such that every row of the rotated V contains at most on non-zero entry. A local neighbor hood scale is determined for each pixel based on the distance to its kth nearest neighbor. Chang and Yeung integrated robust statistics methods in their development of a path-based spectral clustering algorithm for image segmentation estimation is applied to reduce the effect of noise and outliers on the pair wise similarity matrix. Xiang and Gong proposed a method for both estimating an appropriate number of clusters and dealing with noisy data.

## III. IMAGE SEGMENTATION METHODS OVERVIEW:

Image segmentation is the process of dividing an image into parts that have a strong correlation with objects or areas of the real world .Complete and partial segmentation such as follows complete segmentation is divides an image into non overlapping regions that match to the real world objects. Cooperation with higher processing levels which use specific knowledge of the problem domain is necessary. Partial segmentation- in which regions do not correspond directly with image objects. Image is divided into separate regions that are homogeneous with respect to a chosen property such as brightness, color, texture, etc.

## IV. NORMALIZED CUT METHOD:

Propose a new graph-theoretic criterion for measuring the goodness of an image partition The minimization of this criterion can be formulated/approximated as a generalized eigenvalue problem.Graph-based image segmentation methods, show the problem as G (N,E) graph, so that each node in the graph is a representative of a pixel in the image and each edge joints adjacent pixels. Weight corresponding to each edge is based on some properties of primary and terminal pixels of the edges. In the first graph-based methods, a threshold and local measuring was used for calculating the segmentation. Zahn stated segmentation based on graph minimum spanning tree. This method is used both for clustering points and image segmentation. For image segmentation in graphs methods, weight value, is based on intensity difference but in point clustering methods, it is based on distance between points.Based on graph formulation there is two techniques for image segmentation: 1. Area-based methods: in this procedure each node indicates set of connected pixel in image. 2. Pixel-based method: in this system, each node is a representative of a pixel in image. Generally in area-based method e.g. watersheds an input image is got over-segmentation. This image is modeled by region adjacency graph that adjacent regions integrate to reduce the number of districts as long as a significant division is done. This method doesn’t perform appropriately in all cases in image segmentation for complicated image with detached objects .Pixel-based methods perform in very low levels and categorize pixels according to a preset similarity

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criterion. These methods create an undirected weighted graph from input image that each pixel considers as a graph node and each pair of connected pixels as weighted edge. This fact indicates the possible association of two pixels to an object. In the first estimate, the graph was considered as a complete one.

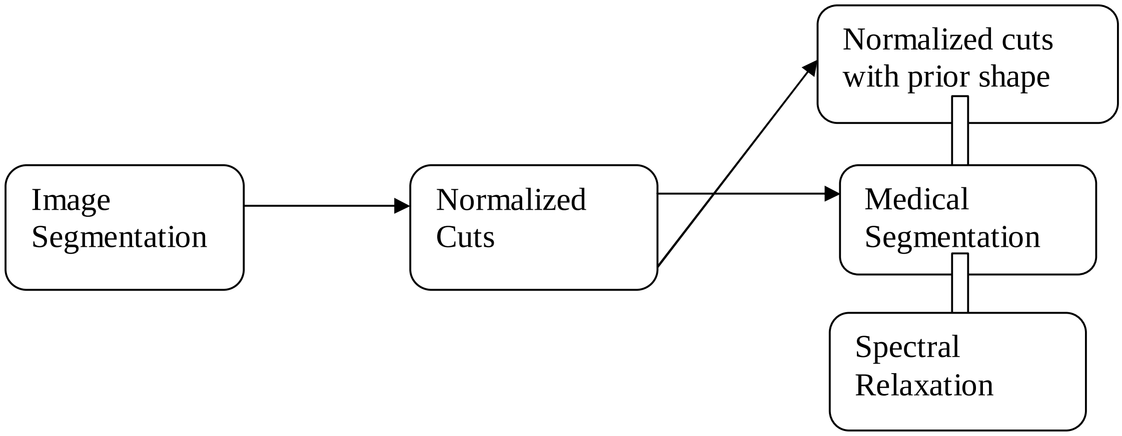


**Figure1. Architecture Normalized Cuts**

## V. EXISTING SYSTEM

The prior can provide valuable information combined with low level cues (e.g., similarity of pixel brightness, color, texture and motion) to guide the segmentation to extract an Object of interest from an image. There are some techniques to incorporate prior knowledge into normalized cuts but they are still limited. Modeling the prior as a linear constraint on a partial grouping solution indicating which pixels should belong to one partition. They also impose a uniformity condition on the constraints by propagating grouping information from labeled nodes to their neighbors to obtain smooth solutions. To reformulate the normalized cut method to seek among the segmentations determined by partial constraints the one that optimizes the goodness of grouping and enforces grouping smoothness for effective propagation .In addition, argue that the main differences with other works of clustering incorporating constraints are that instead of instantiating the labels or the constraints on labeled data points, they use them to regulate the form of the segmentation, and that unlike most of the works, they can guarantee local near-global optima.

**Drawbacks of Existing System:**

1) Depending on the application, the method does not require the inclusion of spatial relationships, because they are already in the prior term.
2) It can be extended easily to deal with multiple priors applying Principal Component Analysis (PCA).
3) The Spectral relaxation of the problem provides an efficient solution, although the resulting Eigen problem is not sparse.

## VI. PROPOSED SYSTEM

The proposed method, it seeks the normalized cut while maximizing the association of the prior within a group and the disassociation with the other. Our main contribution is that the prior is included in the cost function. And without the inclusion of hard constraints avoiding the issues are been depending on the application, the method does not require the inclusion of spatial relationships, because they are already in the prior term and it can be extended easily to deal with multiple priors applying Principal Component Analysis (PCA). The Spectral Relaxation of the problem provides an efficient solution, although the resulting eigen problem is not sparse. We also adapt it on natural images and compare it with the latest methods in normalized cuts with prior.

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**Advantages:**

1) The results of the proposed method are very promising even when the image is noisy with limited contrast.
2) The prior is inaccurate whereas most of the previous methods require a reliable prior.
3) We demonstrate our approach on two biomedical datasets.
4) One dataset consisting of natural images of people as well as standard images in computer vision to make the comparison more objective.

## VII. COMPARATIVE STUDIES IN EXISTING ALGORITHM AND PROPOSED ALGORITHM

- Prior Knowledge is the prior can provide valuable information combined with low level cues to guide the segmentation to extract an Object of interest from an image.
- Principal Component Analysis (PCA) can be extended easily to deal with multiple priors applying Principal Component Analysis.
- Graph Based Segmentation Algorithms based on the representation of an image as an undirected weighted graph where the pixels of the image are the nodes and the edges have weights that represent the similarity between nodes.
- Normalized Cut Based Algorithms seeks the normalized cut while maximizing the association of the prior within a group and the disassociation with the other.
- Hard Constraints in Optimization Technique without the inclusion of hard constraints avoiding the issues are been depending on the application, the method does not require the inclusion of spatial relationships, because they are already in the prior term.
- Spectral Relaxation with Eigen Value Problem is the Spectral Relaxation of the problem provides an efficient solution, although the resulting eigen problem is not sparse.

## VII. CONCLUSION

We implemented a normalized cut algorithm and used it for the intensity and image segmentation. Even though the approximate eighen value method and the algorithm construction optimize implementation, computational complexity remains unsolved for the full-scale image. The performance and stability of the partitioning highly depends on the choice of parameters. We have noticed that the choice of parameters is data-dependent in some sense, smallest, non-zero eigen values, for given eigen system with sparse matrices, often have really small magnitude and the choice of splitting point is influenced by computation precision Stability is controlled by many factors: choice of splitting point, eigen value computations and relative segment position.. Otherwise, algorithm becomes unstable and starts partitioning homogeneous regions. The other approach is to choose maximum N cut for every segment but that would be difficult to implement, if not impossible. Consequently, Normalized cut application is highly constrained by the previous facts.

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