Comparions 2

(Benefits of Hexagonal Pixel Structure Over Sqaure Pixel Structure)

**Square Pixel Structure:**

* Less calculation
* Easy to implement
* Less angular resolution
* Less pertinent to vision process of the human eye

**Hexagonal Pixel Structure:**

* Resemblance of the arrangement of photoreceptors in the human eye, resulting in a sharp vision for capturing informations
* Number of Pixels required is less
* Less Storage Space
* Less Computation Time
* Higher Symmetry
* Higher Sampling Efficiency
* Equidistance Property
* Greater Angular Resolution
* Less Aliasing Effect
* Consistent 6-way Connectivity
* Smaller Quantization Error
* Three(3) Dormant Axes which is 60-degrees apart

**Conclusion:**

The use of hexagonal pixel structure has an improved and better visualization. But there is a lack of hardware for capturing hexagonal based images.

**Reference:**

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Segmentation 2

(Image Segmentation)

Introduction to Image Segmentation and The Different Approaches used in Image Segmentation.

The goal of Image Segmentation is to cluster pixels into salient image regions corresponding to individual surfaces, objects or natural parts of objects.

**Different Approaches:**

1. **Clustering in Feature Spaces –** A compact region of the image that has a

grayscale/colour will correspond to a region in the

feature space with a relatively higher density.

1. **Mixture of Gaussians Model –** A natural approach to model the observed feature using

Gaussians(MoG) Model M.

1. **Maximum Ownership Labelling –** The max ownership images are processed using

connected components and small regions were

discarded(gray). The average remaining large regions

are shown(colour).

1. **Mean-Shift Segmentation –** It considers the probability density of feature vectors in

the image. However, a **non-parametric** model of density

is used. (kernel-density estimate)

1. **Mean-Shift Iterations –**  Similar to robust M-estimation, although we are maximizing

The objective function, not minimizing it.

1. **Mean-Shift Iterations –**  Similar to robust M-estimation, although we are maximizing

The objective function, not minimizing it.

**Properties:  
A.Convergence:** The mean-shift iterations converge to a stationary point.

**B.Anti-edge Detection:** The mean-shift iterations are repelled from local maxima

of the norm of the gradient, occurs at strong edges of the image.

**C.Fragmentation of Constrant Gradient Regions:** The density is contant in regions

where the gradient is constant.

1. **Kruskal’s Algorithm –**  A greedy approach guaranteed to give an optimal MST.
2. **Local Variation Method –** Simple but effective modification of the Kruskal’s Algorithm.
3. **Source-Sink Minimum Cut –** An alternative graph-based approach that makes use of efficien solutions of the max-flow/min-cut problem in a directed graph.
4. **Normalized Cut –** We seek a partition of the affinity weighted, undirected graph. In order to avoid partitions where one is a tiny region.
5. **Spectral Approximation –** is a discrete version of a standard eigenvector formulation. This suggests using the tractable approximation obtained by temporarily allowing a real-valued vector.
6. **Berkley Segmentation Database –** provides image segmentations done by humans. The goal is to provide an empirical and scientific basis for research on image segmentation and boundary detection.
7. **Benchmarking Segmentation –** valuated using an efficient algorithm for computing precision and recall with regard to human ground-truth boundaries.

Segmentation 3

(Survey on Image Segmentation Techniques)

Segmentation is the process that subdivides an image into its constituent parts or objects. The level to which this subdivision is carried out depends on the problem being solved.

**Stages in Subdividing Different Categories:**

1. **Reconstruction(Correction)**

**a. Restoration**: Removal or minimization of image degradations. Two types: **Radiometric** and

**Geometric.**

**b. Reconstruction:** Derive an image, two or higher dimensional, of inside view from several one-dim

projections.

**c. Mosaic:** Combining of two or more patches of image. Required to get the view of the entire area.

1. **Tranformation**

**a. Contrast stretching:** Homogeneous images which do not have much change in their levels.

**b. Noise filtering:** to filter the unnecessary information. Filters like low pass, high pass, mean, etc.**..**

**c. Histogram modification:**  Histogram Equalization.

**d. Data compression:** Higher compressed each pixel by JPEG or Wavelet for with minimum loss**.**

**e. Rotation:** In mosaic to match with the second image. 3-pass shear is a common**.**

1. **Classification**

**a. Segmentation:** Subdivides an image into its objects depends on the problem**.**

**b. Classification:** Pixels labeling based on its grey value.

**Image Analyses -** the middle-level, it focuses on measuring.

**Image Understanding -** is high-level operation which is further study on the nature of

each target and the linkage of each other as well explanation of original image.

**Image Segmentation -** is a key step from the image processing to image analysis.

**Methods for Image Segmentation:**

1. **Layer-Based Segmentation** **­–** Layered model: for object detection and image segmentation that composites the output of a bank of object detectors in order to define shape masks and explain the appearance, depth ordering, and that evaluates both class and instance segmentation.
2. **Block-Based Segmentation** **­–** based on various features found in the image. This might be

colour information that is used to create histograms, or information about the pixels that indicate edges or boundaries or texture information.

**2-Types of Block-Based Segmentaion:**

1. **Region-Base Method:**  Divide the entire image into sub regions or clusters, e.g. all the pixels with same grey level in one region.

**­--Clustering:** shape-based image segmentation algorithm.

**--Split and Merge:** the whole image which is taken as a single region is repeatedly split until no more

splits are possible.

**--Normalized Cuts:** This method is based on graph theory. Each pixel is a vertex in a graph, edges link

adjacent pixels. Weights on the edge are assigned according to similarity, distance,

colour, grey level or extures and so on.

**--Region Growing:** Starts with a pixel and will go on adding the pixels based on similarity, to the

region, repeat until all pixels belong to some region.

**--Threshold:** is separating foreground or object from the background into no overlapping sets.

1. **Edge or Boundary-Base Method:**  transform images to edge images using the changes of grey tones in the images. Edges are the sign of lack of continuity, and ending.

**--Robert’s Detection:** Cross operator performs a simple; quick to compute, Point output pixel

values at each is the magnitude of the spatial gradient of the input point.

**--Prewitt Detection:** Estimate the magnitude and orientation of an edge using the 3x3

neighbourhoods for eight directions which are calculated and the largest convolution mask is then selected.

**--Sobel Detection:** One kernel, 3x3, is the other rotated by 90-degrees.

***Types of Edges***

1. Step Edges **2.** Line Edges **3.** Ramp Edges **4.** Roof Edges

**Edge Detection Computer Approach:**

1. **Fuzzy Logic Based Approach** **­–** Pixels are divided into fuzzy sets, each pixel may belong partly to many sets and regions of image.
2. **Genetic Algorithm Approach** **­–** Derives from the evolution theory, consists of three major operations: selection, crossover, and mutation. GA used in pattern's recognition applications.
3. **Neural Network Approach** **­–** Important differences between neural networks and other AI techniques are their abilities to learn and generalize. The network "learns” by adjusting the interconnection, weights, between layers, and generalizes relevant output for a set of input data. Artificial neural networks (ANN) are applied for pattern recognition.

**PDF Image Segmentation Techniques:**

1. **Text Segmentation ­–** Text segmentation is separating text pixels from the background . The strategies are sensitive to text colour, size, and font and background clutter, since they simply exploit general segmentation method or some prior knowledge.
2. **AC Coeffecient based techniques ­–** AC Coefficients introduced during (Discrete Cosine Transform) DCT to segment the image into three blocks; Background: smooth regions of the image, Text/graphics: high density of sharp edges and Image: the non-smooth part of the PDF image.
3. **Histogram based techniques ­–** The image is segmented using a series of decision rules from the block type with the highest priority to the block type with the lowest priority. The decision for smooth and text blocks is straightforward. The histogram of smooth or text blocks is dominated by one or two intensity values (modes). The intensity value is defined as mode if its frequency satisfies two conditions: It is a local maximum‡‡ and the cumulative probability around it is above a preselected threshold.
4. **Text Extraction ­–** The image is segmented into: Smooth region (Background) and Non Smooth region (Text regions or Image region). In AC Coefficient Based technique while segmenting the PDF image, background is identified as smooth blocks. The foreground (non- smooth block), using K-means algorithm thus text part is extracted from the PDF image.

**Conclusion:**

Block image segmentation methods are two main categories: region based and edge or boundary based method and each of them is divided into several techniques. The image is segmented using a series of decision and there is no universal segmentation method for all kinds of images and also an image can be segmented by using different segmentation methods. Image segmentation is a challenge in image processing and the researchers would evaluate their image segmentation techniques by using one or more of the following evaluation methods.