# Chapter 1
# Medical Imaging Importance in the Real World

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## ABSTRACT

*In the medical image resolution, automatic segmentation is a challenging task, and it's still an unsolved problem for most medical applications due to the wide variety connected with image modalities, encoding parameters, and organic variability. In this chapter, a review and critique of medical image segmentation using clustering, compression, histogram, edge detection, parametric, variational model. and level set-based methods is presented. Modes of segmentation like manual, semi-automatic, interactive, and automatic are also discussed. To present current challenges, aim and motivation for doing fast, interactive and correct segmentation, the medical image modalities X-ray, CT, MRI, and PET are discussed in this chapter.*

## INTRODUCTION

In the medical image resolution, automatic segmentation is a challenging task, and it's still an unsolved problem for most medical applications due to the wide variety connected with image modalities, encoding parameters and organic variability. Manual segmentation is time-consuming and frequently not applicable in clinical routine. Semi-automatic segmentation methods which required-user interaction can use in instances where automatic algorithms fail. A wide variety of semi-automatic segmentation methods exist that will roughly classify into voxel-based approaches, where the end-user draws seed things to define fore and background voxels and surface-based means, where the shape of a functional object is reconstructed depending on contours or subject models. Image segmentation can smoothly proceed on three other ways, manually, interactive, semi-automatic and automatic.

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Segmentation is the process of partitioning an image into semantically interpretable regions. The purpose of segmentation is to decompose the image into parts that are meaningful concerning a particular application. Image segmentation is typically used to locate objects and boundaries like lines, curves in images. The result of image segmentation is a set of regions that collectively cover the entire image or a set of contours extracted from the image. Each of the pixels in a region is similar concerning any characteristic or computed property, such as colour, intensity, or texture. Adjacent areas are significantly different concerning the same characteristic.

Segmentation subdivides an image into its constituent regions or objects. That is, it partitions an image into distinct areas that are meant to correlate strongly with objects or features of interest in the image. Segmentation can also be regarded as a process of grouping together pixels that have similar attributes. The level to which the subdivision carried depends on the problem solved (Anderson, C. W., 1987). That is, segmentation should stop when the objects of interest in an application have isolated. There is no point in taking segmentation past the level of detail required to identify those elements. It is the process that partitions the image pixels into non-overlapping regions such that: Each region is homogeneous, i.e., uniform in terms of the pixel attributes such as intensity, colour, range, or texture. To understand the concept using mathematical representation here $\{R_i\}$ is a segmentation of an entire image $R$ if:

1. $R = \bigcup_{j=1}^{n} R_j$ the union of all regions covers entire $R$
2. $R_i \cap R_j$ For all $i$ and $j$, $I \neq j$ there is no overlap of the regions
3. $P(R_i)$ for $i = 1, 2... n$, $P$ is the logical uniformity predicate defined over the points in the set $R_i$
4. $P(R_i \cup R_j)$ =false, for $I \neq j$ and $Ri$ and $Rj$ are neighbouring regions.
5. $Ri$ is a connected region, $i = 1, 2...$ n

All pixels must be assigned to regions. Each pixel must belong to a single region only. Each region must be uniform. Any merged pair of adjacent regions must be non-uniform. Each region must be a connected set of pixels.

## Several Predicate Examples

1. P(R) =True, if $|g(x1, y1) - g(x2, y2)| <= \varepsilon$ for all(x1, y1), (x2, y2) in R
2. P(R) =True, if $T1 <= g(x, y) <= T2$ for all (x, y) in R where T1and T2are thresholds that define the region.
3. P(R) = True if $|f(j,k)-f(m,n)| \leq \Delta$ and false otherwise

where (j,k) and (m, n) are the coordinates of neighbouring pixels in region R, This predicate states that a region R is uniform if (and only if) any two neighbouring pixels differ in grey-level of no more than Δ.

4. P(R) = True if $|f(j,k)-\mu_R| \leq \Delta$ and false otherwise

where f (j, k) is the grey-level of a pixel with coordinates (j, k) and $\mu_R$ the mean grey level of all pixels in R.

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