SEGMENTATION OF CT BONE IMAGES

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Problem Statement:

To perform segmentation of bone CT scan from 3D(.nii format) image into a 3D segmented image.

Motivation:

Segmentation is a common initial step in medical image analysis, often fundamental for computer aided detection and diagnosis systems. The extraction of bone in CT scans is a challenging tasks, which if done manually by experts require a time consuming process and today does not have a broadly recognised automatic solution. The method presented here is based on a K-means clustering that performs a semantic segmentation of data. The dataset is made up of 350 pelvic bone CT Scans. The image are in full resolution, 512 x 512 voxels. This work effectively demonstrates segmented slices of pelvic bone CT image in both 3D and 2D.

Methodology:

1) Image Contrast Enhancement
2) Image Segmentation
3) Erosion and Dilation

Image Contrast Enhancement

Contrast is defined as the difference in intensity between two objects in an image. If the contrast is too low, it is impossible to distinguish between two objects, they are seen as a single object.

Histogram equalisation is widely used contrast enhancement technique in image processing because of its high efficiency and simplicity. It is one of the sophisticated methods for modifying the dynamic range and contrast of an image by altering that image such that its intensity histogram has a desired shape

Image Segmentation

k-means clustering is a partitioning method. The function k-means partitions data into *k* mutually exclusive clusters and returns the index of the cluster to which it assigns each observation. k-means treats each observation in your data as an object that has a location in space. The function finds a partition in which objects within each cluster are as close to each other as possible, and as far from objects in other clusters as possible. You can choose a distance metric to use with kmeans based on attributes of your data. Like many clustering methods, *k*-means clustering requires you to specify the number of clusters *k* before clustering.

Unlike hierarchical clustering, *k*-means clustering operates on actual observations rather than the dissimilarity between every pair of observations in the data. Also, *k*-means clustering creates a single level of clusters, rather than a multilevel hierarchy of clusters. Therefore, *k*-means clustering is often more suitable than hierarchical clustering for large amounts of data.

Each cluster in a *k*-means partition consists of member objects and a centroid (or center). In each cluster, kmeans minimizes the sum of the distances between the centroid and all member objects of the cluster. kmeans computes centroid clusters differently for the supported distance metrics

Dilation and Erosion

The most basic morphological operations are dilation and erosion. Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries. The number of pixels added or removed from the objects in an image depends on the size and shape of the *structuring element* used to process the image. In the morphological dilation and erosion operations, the state of any given pixel in the output image is determined by applying a rule to the corresponding pixel and its neighbors in the input image. The rule used to process the pixels defines the operation as a dilation or an erosion.

MATLAB CODE:-

```
%in my data set I have used “3.nii”

I=niftiread(“IMPORT YOUR 3D image in nifty format here");

(x,y,z)=size(I);

J=I*0;

%no of slides in my data set is 350

for i=1:z

c=I(:,:,i);

%Using K- Means Clustering

[L,Centers] = imsegkmeans(k,12);

B = labeloverlay(k,L);

maskn=uint8(L==4);

%Erosion

se1 = offsetstrel('ball',3,3);

erodedI = imerode(maskn*255,se1);

%Dilation

se2 = offsetstrel('ball',4,4);
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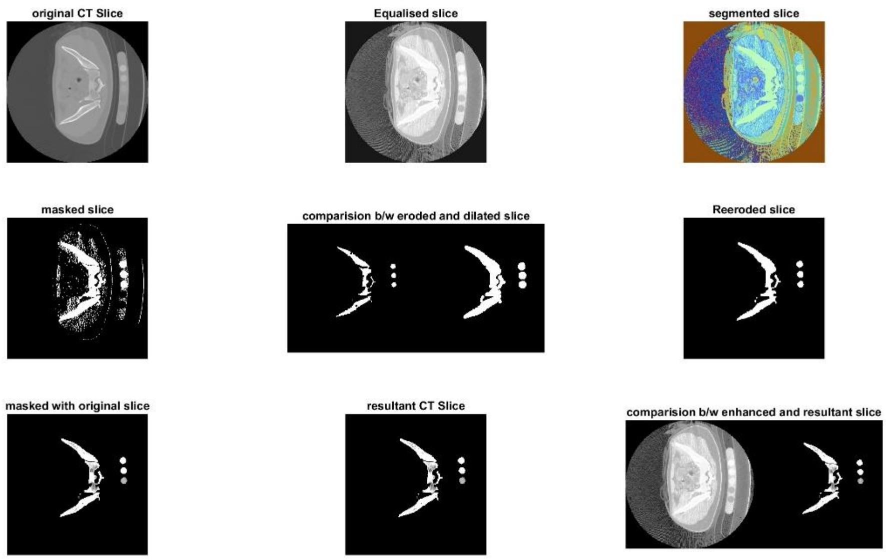
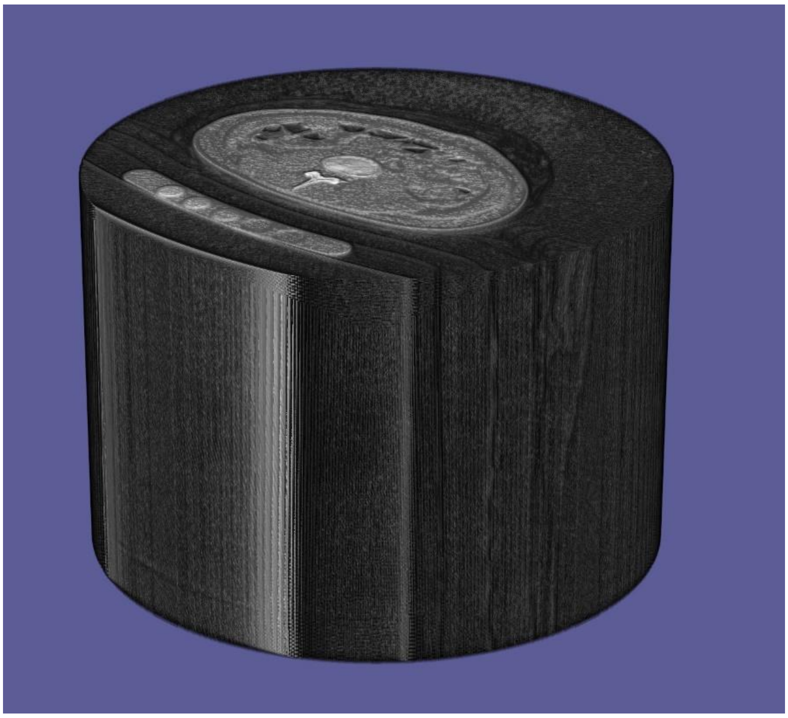
```
dilatedI = imdilate(erodedI,se2);
se = offsetstrel('ball',3,3);
erodedI1 = imerode(dilatedI,se);
%multiply eroded image with respective slice
j=uint16(c).*uint16(erodedI)
J(:,:,i)=j;
End
%3D image viewer
vol=volshow(J)
```

OUTPUT

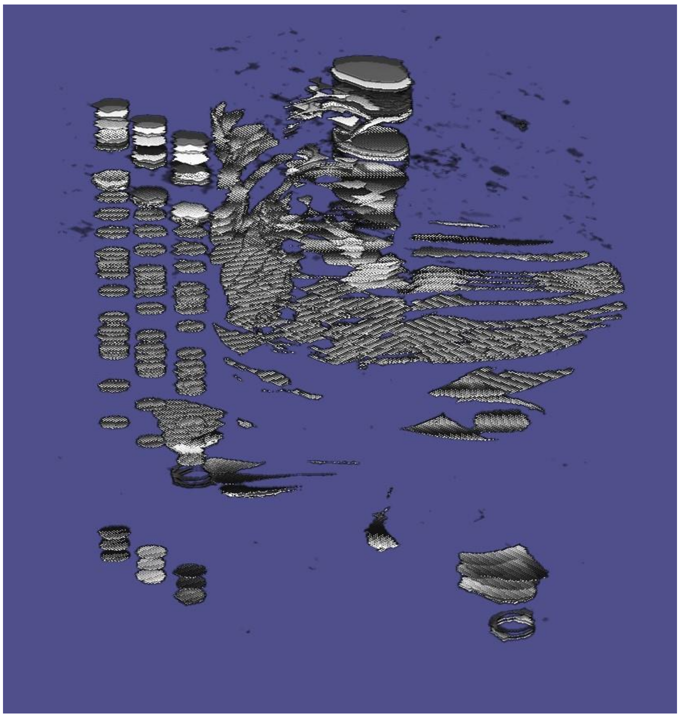
3D Volumetric Image Comparision



Original 3D Image



Segmented 3D Image



Conclusion:

We used an efficient method for segmentation of bone in CT images. The techniques like image enhancement by histogram equalisation, slicing of 3(.nii format) image, erosion and dilation , masking, K-means clustering segmentation, stacking of all slices in to resultant 3D image. Segmentation with k- means clustering is very effective and can be seen in results. This type of process can be used in diagnosis of some abnormalities like cancer(outgrowth), any type of bone infection or degradation of bone can be detected. The morphological changes in any slice of bone can be observed which can help in better diagnosis.