Segmentation Task:

For the segmentation task my first thought was to use the thresholding as to isolate the white part which was particularly not use-ful due to the noise in the scan. To tackle the noise next step was to use filter.
First step was to use the

Gaussian Filter:

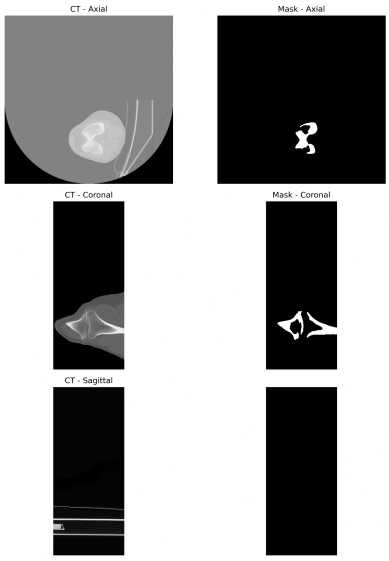

Fig : Gaussian Filter result

Gaussian filter was able to deal with the the noise but the edge are not clearly detected plus it is missing the what looks like some soft part in the second view of the image

Bilateral Filter:

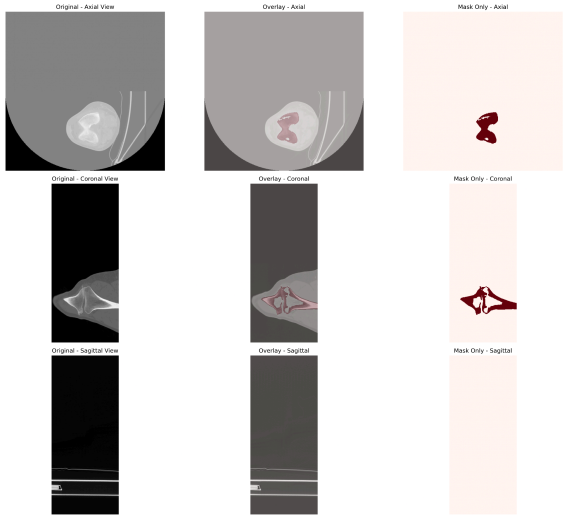

Fig : Bilateral Filter result

We have the better edge detection using the bilateral filter but the segmentation is still missing the soft part in the second view. I tried to smooth the picture noise was also smoothened

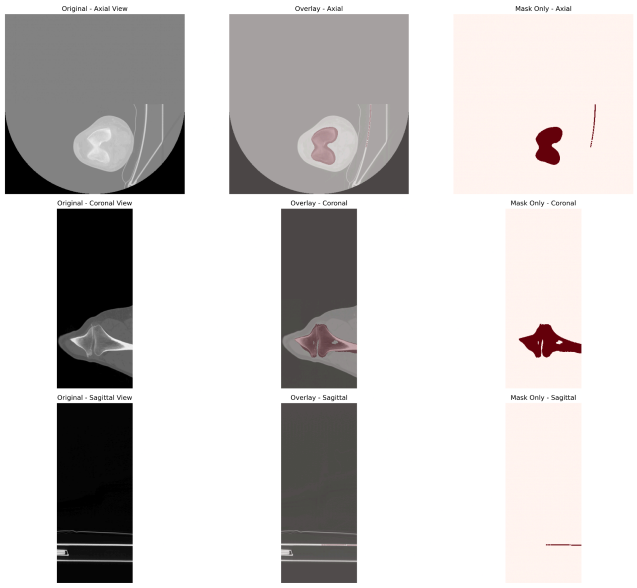

Fig : Bilateral Filter result with increased smoothing

So the final approach was to use two stage filter with the first stage using a gaussian filter to smooth image the gaussian filter with very big kernel and the bilateral filter with small kernel and small value of sigmaColor and sigmaSpace was used for aggressive edge detection. and thresholding is applied to create binary masks: a strong mask for high-density bone and a weak mask for partially dense areas.The weak mask is refined via binary propagation using the strong mask as a guide. Morphological operations like binary opening are applied to clean up the mask. Finally, connected components are labeled, and small objects below a minimum voxel size are removed.

This approach provides better coverage but has slight degradation in the edge detection.

In addition to this The weak mask is refined via binary propagation using the strong mask as a guide. Morphological operations like binary opening are applied to clean up the mask. Finally, connected components are labeled, and small objects below a minimum voxel size are removed

Use of ai:

The code to implement the erosion and binary propagation was done with its help of gpt.

Expand the mask:

The idea was to use the spatial and the volume information to expand the mask. The first step was to to inverse and calculate the distance between the foreground and the background image. In the case of the inverse image, the foreground of the original image becomes the background and vice versa. Using this property spacing information calculation was done between the distance between foreground and background pixel and all the distances less than or 2mm or 4mm were considered.

Landmark detection

The detection of landmark detection determine three steps:

- First isolate the tibia from the rest of the leg
- Then isolate the tibia plateau and isolate the tibia surface.
- Detect the lowest two points in two halves of the tibia surface.

This process assumes lot of assumptions in my part

Detection of tibia

- Find the largest region on the lower half of the image.
- Assumption made that the lower half of the image is tibia

Detection of the surface of tibia plateau

- Get the top most slice of the tibia(Parameter is hand crafted)
- Apply binary erosion to the plateau mask and subtract it from the original to get only the surface.

Detect the lowest two points in two halves of the tibia surface.

- Apply spacing to voxel coordinates.
- Divide points into medial/lateral using x-median; adjust for leg side.
- Select max-y point from each side.

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