Reinforced Fiber Segmenation
Blob Detection

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Summary of the Previous Report

The blob detection method using the ratio of Eigenvalues of Hessian matrix was experimented in the previous report(7_OCT). The method depends solely on 2nd derivative of image apporximated by the LoG filter. Thus, the method is sensitive to σ of LoG filter for detecting blobs and vessels. Small σ results in many false positives for blob detection, especially in vessels which have similar statistical property as blobs. On the contrary, large σ misses small air blobs even though it is obvious in the sense of intensity. Most of vessel-like structure segmentation method set a single σ for an entire image, which is inappropriate for air-voids detection. To solve the variation of the size of air-voids, I suggested methods which aid the 2nd derivative segmentation method by intensity-based segmentation, or clustering, methods. I suggested the method using the maximally stable extremal regions(MSER) feature and K-Means clustering for the blob detection.

Assumptions

There are a few assumptions on air-voids that I made to detect air-voids from a concrete CT image. I do not know this would be always true for every CT image, but I tried to be careful since it restricts the problem.

1. Darker than any other components(blocks and fibers) in CT image

2. Uniformly distributed intensity, which means standard deviation of intensity in air-voids is small
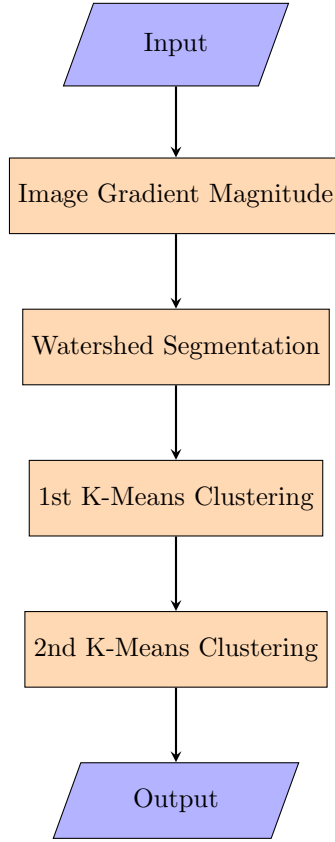
3. Blob-like shapes

Figure 1: Overall work flow of the blob detection algorithm

Watershed segmentation and K-Means clustering method

By the first and the second assumptions, I tried the 1st derivative based watershed segmentation for detecting the blob candidates and intensity based K-means clustering method for grouping candidates by intensity distribution. Figure **??** describes the over all flow of the current implemented algorithm.

First, we calculate the graident magnitude of an input image as a valley map for the watershed segmentation algorithm. The watershed algorithm with "proper" level and threshold generated blobs as shown in Figure 2.

I put the result of watershed algorithm into the K-means clustering method with $K = 4$, K is decided by the observation to the input image. For K-means clustering, the Connected Component Analysis was used to group the adjacent object voxels. Then I extracted mean intensity, mean eigenvalues of Hessian matrix (I will discuss about the effect of σ of LoG filter in the next section) for
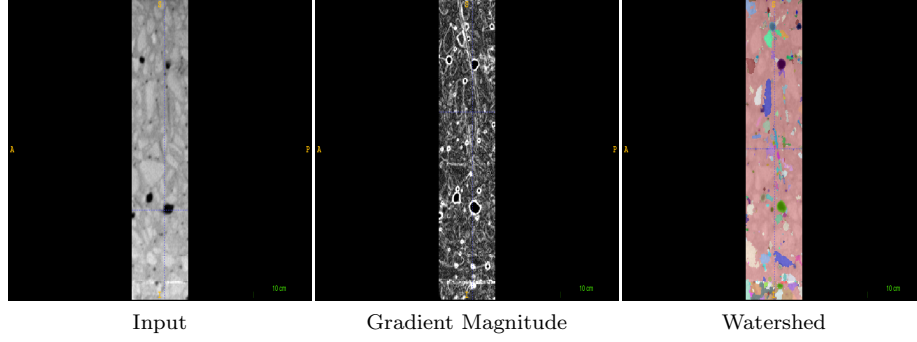
Figure 2: Gradient magnitude image and watershed segmentation results

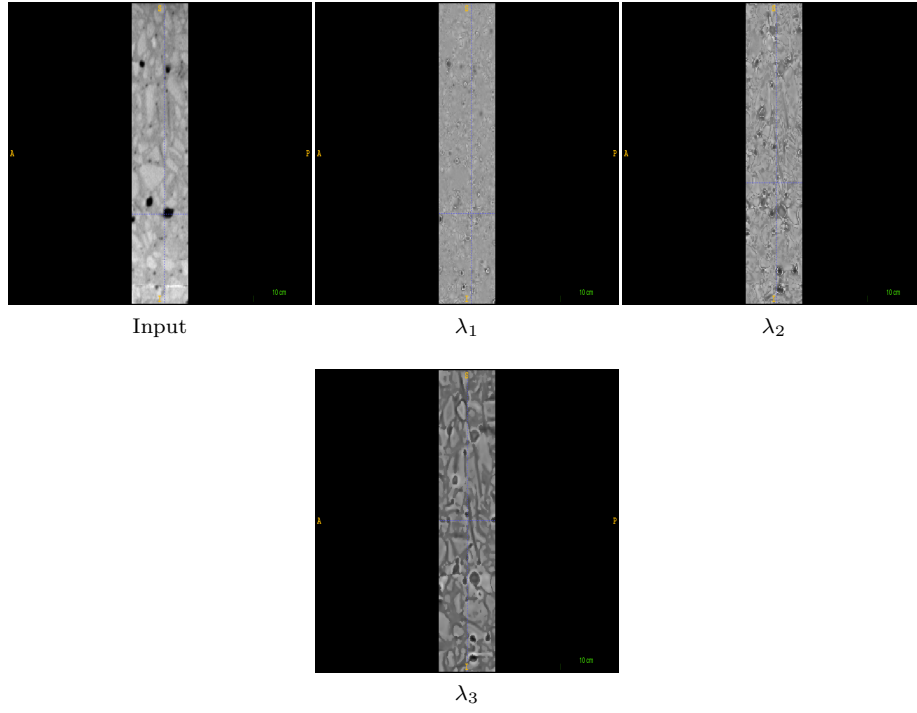each component and put them into the clustering methods.

Figure 3: Eigenvalue maps of Hessian matrix for each voxel $\lambda_1 < \lambda_2 < \lambda_3$

References