In this study, the main objective is to reconstruct an image from its projections using some discrete techniques which are applicable to tomography. To do this, Kaczmarz’s and Conjugate Gradient Least Squares methods were used. In order to illustrate the two methods, a software was written in Java language. This software gets an image file as an input and creates projections of it from different directions. Then, it tries to reconstruct the image using Kaczmarz’s and Conjugate Gradient Least Squares methods. The results show that as the number of projection increases the accuracy of reconstruction increases. Conjugate Gradient Least Squares method converges to better results when the number of projections is low. However, as the number of projection increases, the results of Kaczmarz’s method converge to better images in terms of Euclidean distance metric. Also, some other comparisons regarding the number of iterations required for convergence or the costs of the two methods are studied in this project.

The numerical results are given in graphical form for both Kaczmarz’s and CGLS methods in Figures 1-2. The number of iterations required for convergence is incomparably low in CGLS. Several iterations would be enough in CGLS, whereas several thousands of iterations are required to obtain convergence in Kaczmarz’s method, since each CGLS iteration costs too much compared to one iteration of Kaczmarz’s method.

Figure 3 shows that CGLS method converges to better results as the number of projections decreases. However, as the number of projection increases, the results of Kaczmarz’s method converge to better images. In order to generalize this conclusion about the two methods, there should exist some extra effort of comparing the results with respect to some other metrics which might give better understanding of the content of the results. These metrics might be the ones which use information content or entropy of the resultant images.

Conclusion: The two methods are both effective in reconstructing an object from its tomography measures with a small number of projections. In fact, the number of projections done in all the cases do not give a mathematically determined unique solution. However, the reconstruction algorithms create images very similar to the original one, from these small number of projections. It was also seen that as the number of projections increase, better precision is gained in both of the methods as can be seen from the Euclidian distance characteristic in the Figures 1-3. On the other hand, in real applications, increasing the number of projections increases the cost of the operation, so there should be a tradeoff between cost and accuracy.

References: