Image De-Noising

DSP Project

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Introduction

- These days sparse representation of images or signals is becoming significant. This method is used to remove noise from the received signal and obtain compact and accurate signal.
- Natural signals such as images, admit a sparse decomposition over a unnecessary dictionary leads to efficient algorithms for handling such sources of data. The design of well adapted dictionaries for images has been a major challenge.
- The K-SVD algorithm is the algorithm used for various grey-scaled images. In this project we will be implementing K-SVD algorithm for handling non-homogeneous noises and getting out ways to find missing information. Our goal is to learn the analysis dictionary from a set of examples.

Explanation

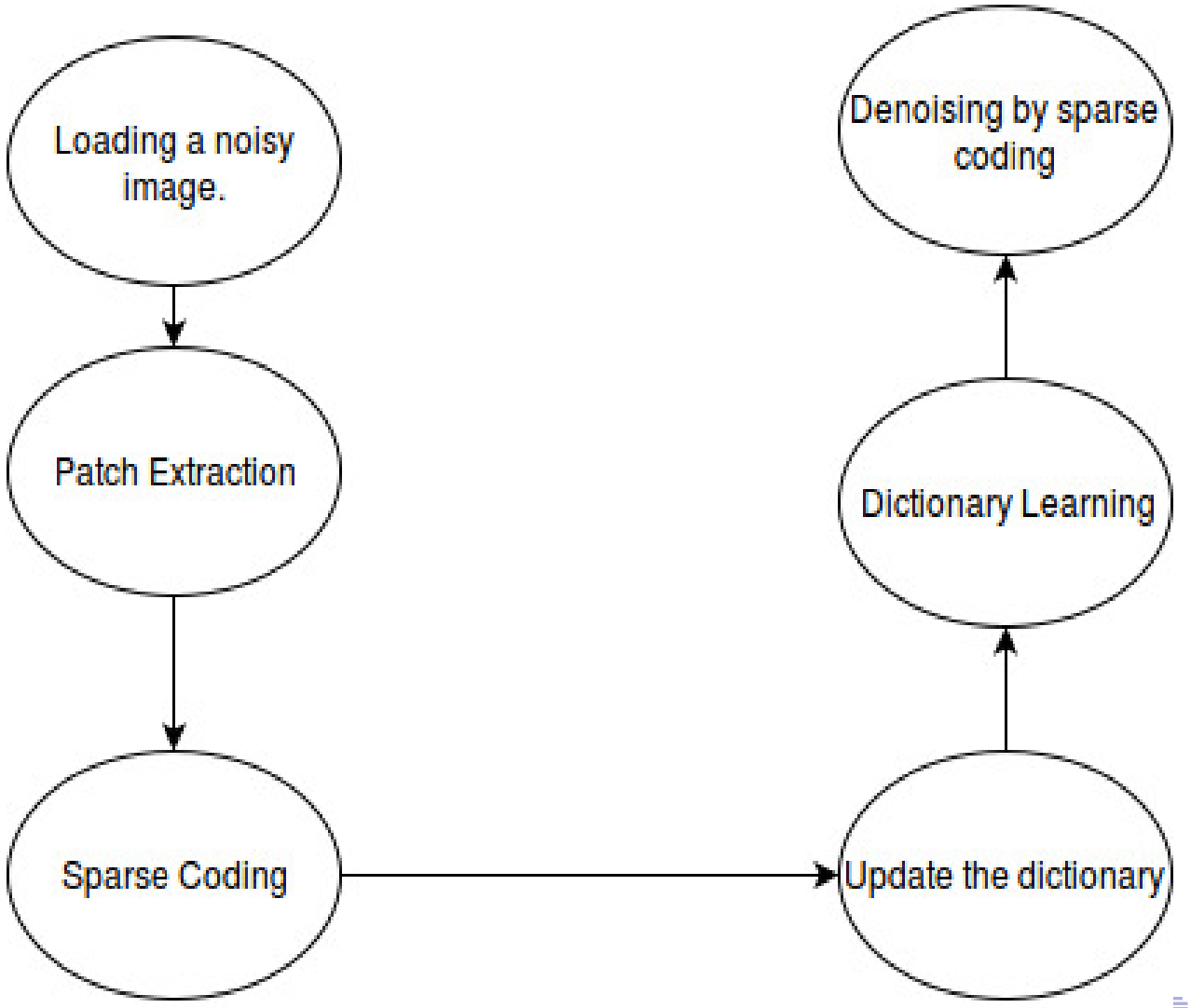
- The system takes an input of a noisy image of gaussian nature.
- Patch extraction - The size of the patches of image and the number of patches can be adjusted. The mean matrix representing the mean of the atoms is removed since the mean of patches is going to be noise free and we want to learn a dictionary of zero mean and unit norm.
- Given a dictionary D, input data set X , we wish to find the representation R such that ——X-DR——^{2} *isminimizedandtherepresentationsaresparseenough.gyandusi*

Explanation

- We are using stochastic gradient descent to achieve the sparse coding.The value of lambda is automatically updated to minimize the error. Ideally if norm(X-D*R) is too large then lambda should be made smaller.
- Once the sparse coefficients are calculated we update the dictionary.
- The full dictionary learning is achieved by iteratively computing the coefficients X and then updating the dictionary D.
- The denoising of the image is obtained by sparse coding a large collection of patches (ideally all the patches).

Flowchart

- Flowchart of the Process:



Results

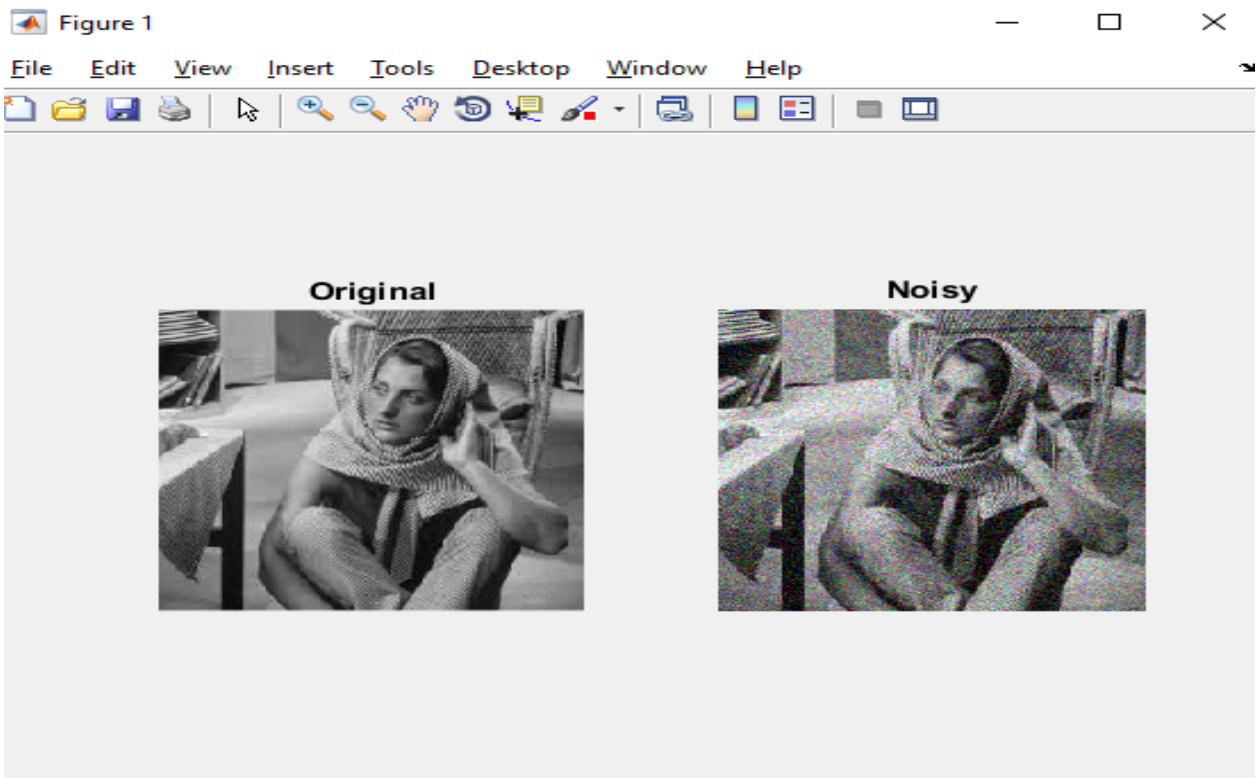
- We have implemented image de-noising through an adaptive filtering mechanism called Wiener Filtering. The results are shown in last slide.
- Secondly, we have implemented some part of dictionary-based approach. We have done patch-extraction and initialized the dictionary. Then, we have applied gradient descent algorithm for dictionary learning. With increasing multiple iterations, the error goes on decreasing.

Result

- Output for Wiener Filtering:

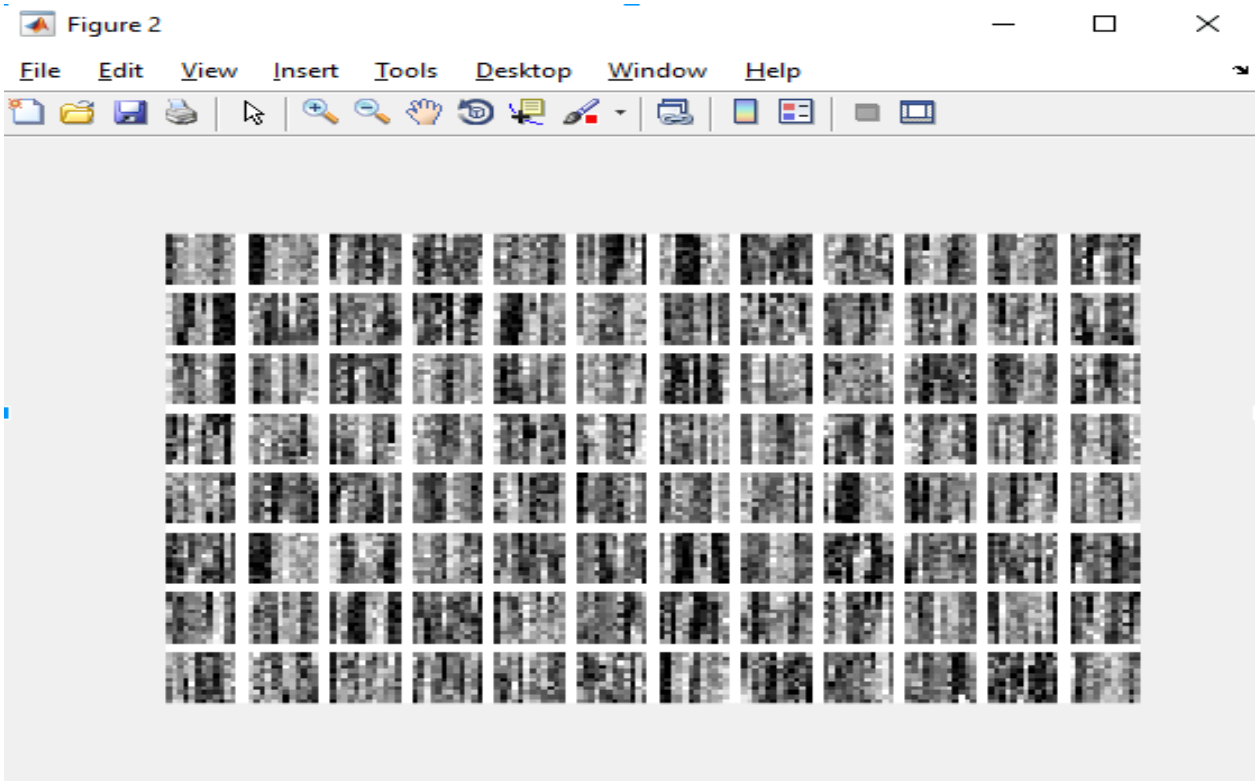
Result

- Adding gaussian noise:



Result

- Initialized Dictionary:



Result

- Graphs for lambda and error: