IMPLEMENTING A BAYESIAN-BASED IMAGE RESTORATION METHOD

Adrienne Stolte, Aneesh Malhotra, Rishi Gupta, Shakib Rashid

October 15, 2018

Proposal Presentation

Introduction

Motivation

- Often Fourier methods fail to reproduce deblurred images in the presence of additional noise. We wish to compare the results of applying a probabilistic method with that of the Fourier method.

Requirements

- The goal is to reconstruct an image that has been blurred using a known blurring function with the addition of noise.
- The original image will be obtained when the blurring function is a Gaussian point spread function (PSF).
- The final product will be code written in Matlab that implements the findings of W. H. Richardson's *Bayesian-based iterative method of image restoration* and can be run on a standard laptop.

System Architecture

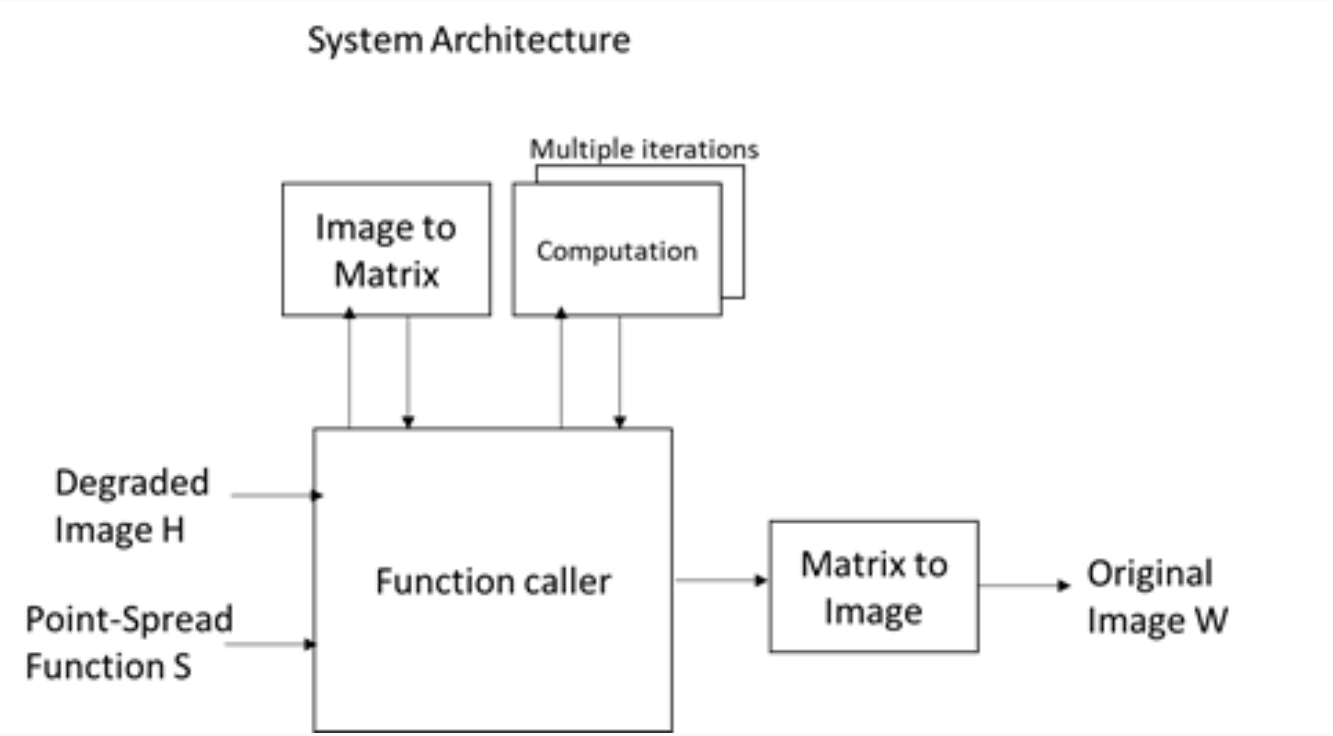

Figure: Diagram of the main components and how they interface

Main Components

- Equation
  - Degraded Image H
  - Point Spread Function S
  - Original Image W
- MATLAB
  - Computation
  - Image Processing

Approach

Alternative Designs

Some examples of other proposed methods of image restoration are:

- Wiener Filter
- Adaptive Filter

Experiment 1

- Simple experiment to reduce factors that would hinder the operation
- Generate simple shapes and figures to be inputted into a blurring point spread function that is known
- Multiple different images will be used at various different noise levels
- Use this as an input to the Bayesian based iterative method of image restoration
- Retrieve the original clear image and compare to the original and repeat for different shapes

Experiment 1 figures

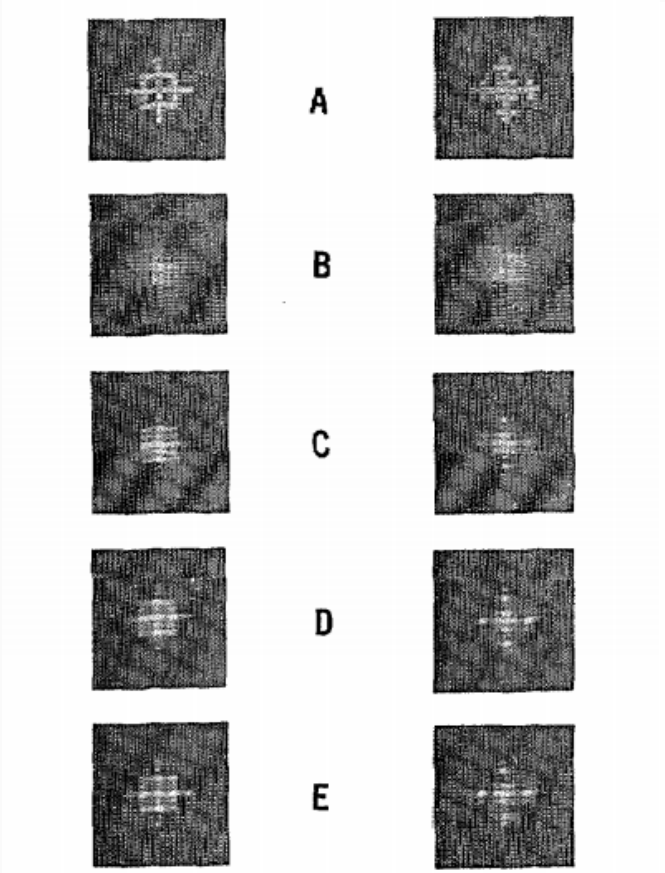

Fig. 3. Restoration with no noise. (A) Original image, (B) degraded image, (C) 10-iteration restoration, (D) 20 iterations, and (E) 30 iterations.

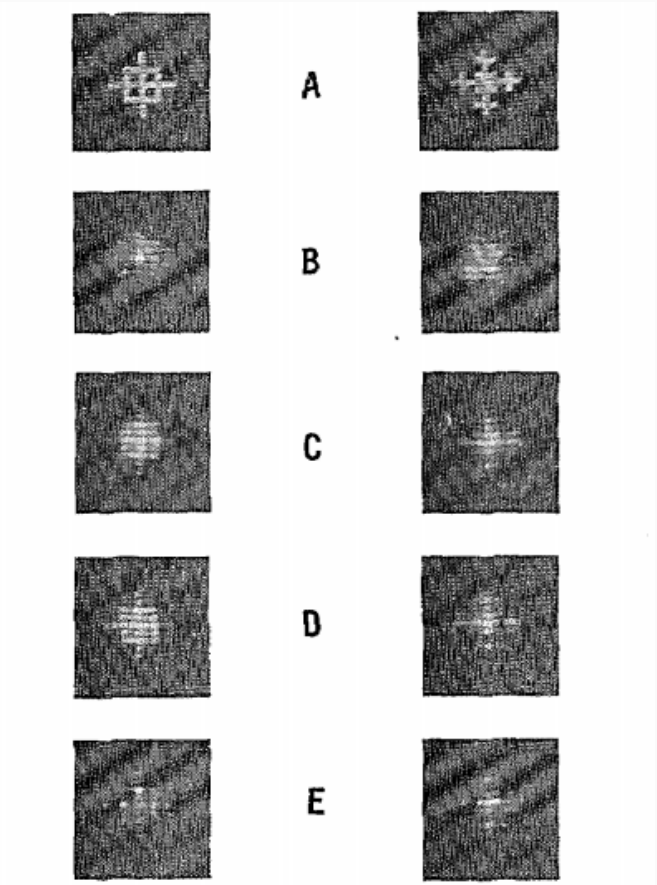

Fig. 4. Restoration with 0.1 noise. (A) Original image, (B) degraded image, (C) 10-iteration restoration, (D) 20 iterations, and (E) 30 iterations.

Figure: Figure 1 (right) no noise and Figure 2 (left) with noise

Experiment 2

- Experiment will be conducted using multiple real images of a simple object such as a box or chair.
- Picture will be taken indoors with artificial light to minimize factors such as sun glare.
- Images will be processed into a blurring point spread function where the function is know
- This will serve as the input to the Bayesian based iterative method that will return a deblurred version of the image
- Compare to original and repeat for multiple images

Challenges

- Learning and understanding the theory behind image processing techniques and Bayes formula as applied to image processing
- Understanding existing methods of blurring point spread functions in order to process our input
- Programming the equation and methods into Matlab
- Latency in the computation as the image becomes more complex
- Deblurring the image until the subject can be reasonably determined (number of iterations)

Tasks

- Track progress; contact faculty - Project Manager
- Program computation - Rishi G., Aneesh M.
- Testing - Adrienne S., Shakib R.
- Prepare in-progress presentation - all members
- Prepare final poster presentation - all members

Knowledge and Skills

- Communications
- Signal processing
- Probability
- Programming in Matlab

Knowledge to be acquired:

- Understanding of image processing theory and applications

Questions?