IMPLEMENTATION OF DEBLURRING IMAGES USING BLIND DECONVOLUTION TECHNIQUE

In Imaging science, Image processing is any form of signal processing where input is any image and output is an image or set of characteristics or parameters related to that image. Sometimes, the images may be corrupted due to motion blur, noise, camera misfocus. So, in order to restore the original image, a classical research area called Image Restoration came into existence.

Image restoration is a classical research area in the field of image processing.So, in order to restore a degraded image, algorithms related to image restoration are used. Some of the methods involved are usage of inverse filters, weiner filters, iterative filters and blind deconvolution. There are two types of image restoration techniques:

* Non-Blind Deconvolution technique
* Blind Deconvolution technique

# IMAGE BLUR:

The recognition and interpretation of actual information depends entirely on the image quality. Something that is hazy and indistinct to the sight that restrict the sound and clear visual perception have impact on image if captured at that instant. This ill-effect created from the indistinctness of information deteriorating the image quality while image acquisition is known as BLUR.

The basic approach for any deblurring technique is to acquire atleast minimal information about the blur caused. The various existing techniques to revert back the effect and reconstruct the true image depends on the quantitative yet effective knowledge about the cause of degradation. The fundamental method of image restoration is to estimate the parameters of degradation and then apply any classical restoration techniques for image reconstruction. The convergence of many a priori deconvolution techniques also demands for certain parametric assumptions and estimation of image degradation.

The various types of Blur models are:

Motion Blur:

- motion between device and scene

Uniform out of focus blur:

- misfocus of device

Atmospheric turbulence blur:

- due to factors like temperature, wind etc

# CONVOLUTION:

Convolution is a mathematical operation on two functions f and g, producing a third function that is typically viewed as a modified version of one of the original functions. Convolution is similar to cross-correlation. It has applications that include probability, statistics, computer vision, image and signal processing, electrical engineering, and differential equations.

The convolution of *f* and *g* is written *f*∗*g*, using an asterisk or star. It is defined as the integral of the product of the two functions after one is reversed and shifted. As such, it is a particular kind of integral transform:

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| --- | --- |
| (f * g )(t)\ \ \, | \stackrel{\mathrm{def}}{=}\ \int_{-\infty}^\infty f(\tau)\, g(t - \tau)\, d\tau |
|  | = \int_{-\infty}^\infty f(t-\tau)\, g(\tau)\, d\tau. |
|  |  |

# DECONVOLUTION:

It is an algorithm based process which is used to reverse the effects of convolution on recorded data. In general, the object of deconvolution is to find the solution of a convolution equation of the form:

f * g = h \, 

Usually, *h* is some recorded signal, and *ƒ* is some signal that we wish to recover, but has been convolved with some other signal *g* before we recorded it. The function *g* might represent the transfer function of an instrument or a driving force that was applied to a physical system.

Deconvolution is an engineering discipline, which refers to the retrospective improvement of fidelity of the electronic signals such as voice, music, radar and pictures. Image processing utilizes the same concept in restoring the true image from degraded image. The input is the corrupted natural image and one of the many existing deconvolution techniques is used to retrieve the true image. But this restored image is the estimation of the true image and hence the convergence of deconvolution techniques should provide the approximate and closest estimate of the true image. The blind image deconvolution on similar concept estimate the true image but there are almost no or partial information about the cause of degradation function. The partial information can be in the form of some finite support or nonnegativity of the image, coined as physical properties of the image. Similarly, this partial information can also be in the form of any stastical data such as entropy or probability distribution function of the signal. The different optimality criteria along with this partial information form the strong ground in image estimation.

# NON-BLIND DECONVOLUTION:

It refers to the deconvolution with explicit knowledge of the impulse response function used in the convolution. That is, the point spread function is known in advance in this technique.

# BLIND DECONVOLUTION:

It refers to the deconvolution without explicit knowledge of the impulse response function used in the convolution. Blind deconvolution is a deconvolution technique that permits recovery of the target scene from a single or set of "blurred" images in the presence of a poorly determined or unknown point spread function (PSF).

Blind deconvolution can be performed iteratively, whereby each iteration improves the estimation of the PSF and the scene.

Blind deconvolution techniques have always been a challenging and critical problem. But, since the techniques are more useful for the practical scenario compared to classical ones, the methods cannot be ignored. Different blind image deconvolution techniques assume various parameter to solve the problem. The literature review on different techniques reveal that some strong underlying concept has to be used as a key to crack the problem. Though the convergence is not well-defined as well as not sure. This motivates to search for the parameters responsible for degradation. The parameter once estimated is used to reverse the ill-effect.

# POINT SPREAD FUNCTION:

The degradation producing ill-effect of blur is termed as the point spread function, psf. Any type of blur is characterized by the psf. The electromagnetic radiation or other imaging waves propagated from a point source or point object is known as the psf.

The quality of any imaging system depends on the degree of spreading of the point object.

g(n1,n2) = d(n1,n2) \* f(n1,n2) + w(n1,n2)

where, g(n1,n2) is the degraded image

d(n1,n2) is the original image

f(n1,n2) is the point spread function

w(n1,n2) is the noise

# ALGORITHM FOR PSF GENERATION:

* Find the psf size n\*n, n should be odd number.
* Randomly generate (n+1)/2 values in the range (0,1).
* Sort the values generated in the ascending order.
* Produce a vector d, of n elements, by flipping the values left to right provided the middle element is untouched.
* Create d=d1\*d1t.
* Normalize the d.

# GAUSSIAN BLUR:

The image degradation due to atmospheric condition is modelled by the Gaussian effect. It is the result of blurring an image by a Gaussian function. The Gaussian blur is a type of image blurring filter that uses normal distribution for calculating the transformation to apply to each pixel in the image. The visual effect of this blurring is a smooth blur resembling that of viewing the image through the translucent screen.

The deconvolution techniques are required for proper analysis in the scientific study. The research on various deblurring technique has been done in the literature to overcome this problem. The thesis presents the approach for restoring the image degraded due to Gaussian effect by an Evolutionary algorithm.

# EVOLUTIONARY ALGORITHM:

The recent development and the growing popularity of genetic algorithm in the various field, motivated the researchers to utilize the same in the field of image processing also. The evolutionary algorithm is the generic name for the genetic algorithm. The evolutionary alogorithm (EA), in artificial intelligence, is a subset of evolutionary computation. It is generic population based metaheuristic optimization algorithm. An EA utilizes the concept of biological evolution. Evolutionary algorithms are search techniques based on the concept of natural selection and survival of the fittest in the natural world.

It is an algorithm used in Blind deconvolution technique. Evolutionary algorithm involves a search from set of possible solutions known as “population”. Each iteration ends with a set of possible and feasible solutions based on some “fitness” criteria. The solutions with high fitness are then recombined with other solutions by interchanging parts of solution with one another. These solutions are then mutated generating new solution optimal to the given problem.

# APPLICATIONS OF EVOLUTIONARY ALGORITHM:

Evolutionary algorithm is considered as global optimization technique. The most important factor about EA is its robust performance in “noisy” functions where there is multiple local optima. EA can find global optimal solutions discarding the local minima. There exists wide variety of application domains of EA for finding optimization problems such as wire routing, scheduling, travelling salesperson, image processing, engineering design, parameter fitting, knapsack problem, game playing and transportation problem. EA are well suited for wide range of combinatorial and continuos problems, but the different variations are tailored depending upon specific applications. The concept of EA has been utilized in the field of image processing. Different image processing area such as edge detection, segmentation, shape detection, feature slection, clustering, classification, object recognition use EA to get the optimal solution.

# EA FOR BLIND DECONVOLUTION:

The development and successful application of EA in different complex problem motivates to utilize the concept in the field of blind image deconvolution. The blind deconvolution is the practical method of image reconstruction, when it is not possible to reconstruct the image with all psf. The EA provides large solution space for the deconvolution and then the optimized solution is selected.

# MUTATION:

A set of random PSF’s is generated in every generation. These PSF’s are then used along with all individual images, obtained from the previous generation.