GE-INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH
VOLUME -3, ISSUE -3 (March 2015) IF-3.022 ISSN: (2321-1717)

ALTERNATING DIRECTION METHOD-ANALYSIS BASED APPROACH FOR IMAGE INPAINTING

B.H.Deokate[1] **Dr.P.M.Patil[2]** **P. B. Lonkar[3]**

Electronics and Telecommunication

Savtribai Phule Pune University, Maharashtra

ABSTRACT

Image inpainting is the process of filling-in missing or damaged information in visually plausible way. This is the process of "Image Interpolation." Inpainting can be used easily to remove scratches from photographs which often get damage with age as well as for film-restoration. Care should be taken while doing such restoration manually because any sign of scratch should not remain behind. So this manual process is time consuming and prone to errors as human operators have some limits while selecting best suitable patch from surrounding region of damaged area. The patch should be selected correctly so that the restoration of image will give better result. So to overcome this problem a novel method of inpainting is proposed. In this paper an approach for automatic image inpainting system is given using Alternating Direction Method (ADM). Analysis based approach (ADM-A) is presented which handles the inverse problem efficiently. Experimental result shows that ADM-A is efficient for object removal and for restoration of images.

Keywords— Inpainting, Restoration, ADM-A, Region of interest.

I.INTRODUCTION

In computer vision and graphics application image restoration is a crucial issue. Image with a missing regions or a large number of missing pixels, filling of missing elements and restoration of image should be done in visually plausible way. The core problem is how to decide which are the best suitable pixels to fill the damage region or missing region. Traditionally selection of patch is done by manually so it prone to errors and time consuming. Also selection of patch matters a lot for restoration of image. If best matching patch is not selected for filling region then visually we can see the blurring effect at restoration of image. This will lead to failure of restoration algorithm. In this paper, a novel approach is presented for object removal and restoration of image using Alternating Direction Method. Here analysis based approach is presented. Algorithm works well with real photographs taken from camera and also for images database downloaded from internet. An example is shown in fig.1. for applying ADM-A to photograph.

Overall our main contributions are :1)a novel image restoration method is proposed which is very efficient and quite easy to implement using Matlab.2) The algorithm can be use to solve many problems :such as removing unwanted object from images, removing text printed on images, removing scratches on photographs which are due to ageing and for resolving the problem of image deblurring.

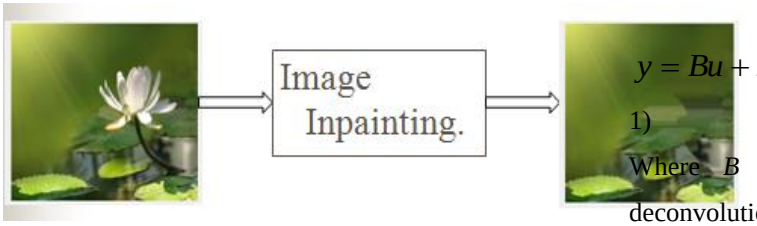

Fig.1.Process of Image Inpainting using ADM-A

II.RELATED WORK

The Alternating direction method was originally proposed in 1970s [1]. The algorithm was studied throughout the 1980s and by the mid-1990s; its convergence was established by Eckstein and Bertsekas [2]. ADMM closely related to or equivalent to many other algorithms such as Douglas-Rachford splitting method [3], proximal methods [4], the splitting Bregman iterative algorithms [5]. ADMM is a simple and powerful algorithm which is well suited to large-scale convex optimization and in particular to problems arising in signal and image processing. The fact ADMM has been re-invented in these research fields over the decade is credited to its simple form and intuitive appeal and effectiveness. In this paper a new idea is presented to use ADM for Image mapping and Object removal .This is totally new approach as in literature we cannot find use for ADM for restoration of large objects. Research is carried out on trail and error basis but experimental results shows effectiveness of this Analysis based approach. Gives better result in terms of PSNR and CPU time and MSE.

III.METHODOLOGY

Image Restoration continues to attracts attention of many researchers and engineers. In image restoration, the aim is to recover an unknown true image $u \in R^n$ from a noisy measurement $y \in R^m$ that is often modeled as

$$y = Bu + n \quad \text{.....(1)}$$

Where B is a convolution operator in image deconvolution or a projection in image inpainting and the identity map in image denoising, n is a white Gaussian noise with variance $\sigma 2$ .For solving this inverse problem many algorithms are known and depends on a variety of signal prior information. Among all this methods, emerging innovative and novel ADM method depends on sparse and redundant representations of signal.

A signal u is said to have a sparse representation over a known frame $W \in R^{n\times d}$, if there exists a sparse vector $x \in R^d$ such that $u = Wx$. In general, the frame may be redundant. In this paper, the redundant and normalized tight frame (Parseval frame) is used, $WW^T = I$, where I denotes the identity matrix. Thus, $u = W\left(W^T u\right)$ for every vector $u \in R^n$. The components of the vector $W^T u$ are called the canonical coefficients representing u. Hence the frame based image restoration can be described as: the coefficient vector x is estimated from the noisy image under the sparsity assumption first and then the unknown image u can be constructed as a linear combination of a few columns of frame W. Tight wavelet frame systems are redundant so the representation of u in the frame domain is not unique.i.e. the mapping from the image u to its coefficients is not one-to-one. Three formulations utilizing sparseness of the frame coefficients are formed namely analysis-based approach, synthesis based approach and balanced regularization approach. Here we are using analysis based approach which is formulated from balanced

regularization approach as follows, equation (2) shows balanced regularization approach

$$\min_{x} \frac{1}{2}\|BW_x - y\|_2^2 + \frac{\gamma}{2}\|(I - W^T W)_x\|_2^2 + \lambda^T |x|_1 \quad \text{(2)}$$

where $\gamma > 0$ and λ are given nonnegative weight vectors, $\|.\|_2$ denotes the *l*2-norm. The first term denotes penalty on the data fidelity, the last term penalizes the sparsity of coefficient vector, the second term penalizes the distance between the frame coefficients *x* and the range of W^T, i.e., the distance to the canonical frame coefficients of *u*. The larger γ makes the frame coefficients *x* closer to the range of W^T, that is to say, the frame coefficients *x* is closer to the CANONICAL frame coefficients of *u* for the larger γ [6].

On the other hand, when $\gamma = \infty$, if the problem (2) has a finite solution then the term $\|(I - W^T W)_x\|_2^2$ must be 0.This implies that *x* is in the range of W^T, i.e., *x* = W^T *u* for some $u \in R^n$ [6].

Then the problem (2) can be written as

$$\min_{u \in R^n} \frac{1}{2}\|Bu - y\|_2^2 + \lambda^T |W^T u|_1 \quad \text{.....(3)}$$

Here the coefficient is in the range of the analysis operator W^T so This is called analysis-based approach. It is noted that here only the sparsity of the canonical frame coefficients is penalized, which leads to the smoothness of the underlying image.

IV.IMPLIMENTATION

We have implemented this system with Matlab 2012.Database images are collected from photographs taken with a camera. System gives better results for this photographs reconstruction after object removal from them. firstly the resizing of photograph is done with size 256×256 and then RGB image is converted into gray for further processing then the edge detection of the image is done by edge detection algorithm like Sobel, Prewitt or by Robert edge detector. But among all sobel edge detector gives better result so it is preferred for this experiment. Edge detection will give idea about from where we should select the object for segmentation. From this the region of interest is calculated with interested object to be removed. For calculating the region of interest the gray image processing of photograph is done and it is converted into binary with interested object in white and background in black. Then ADM-A algorithm is applied for inpainting of region of interest.

V.RESULTS

(a) (b)

Fig.2.Image inpainting using ADM-A.(a)original image.(b)image with removal of object.

Algorithm is applied on images and result is tested for CPU time, PSNR and MSE. Results shows that ADM-A algorithm for the analysis based approach can effectively suppress the noises but it produced over-smoothed results and eliminated much image

details. For the 3 images (a)(c)(d)the following table shows comparison of CPU time, PSNR and MSE. Algorithm gives better result for text removal also, example is shown in fig(4).and from table we came to know that it will take very less amount of time for restoration of images.

Table.1.Comparison of Inpainted images

Image	PSNR(dB)	MSE	CPU time(sec)
(a)	28.6789	88.1443	0.56263
(c)	20.484	581.6774	0.37859
(e)	21.3417	477.4324	0.42505

(c) **(d)**

Fig.3.Image inpainting using ADM-A.(c)original image.(d)image with removal of object.

(e) (f)

Fig.4.Image inpainting using ADM-A.(e)original image.

(f)image with removal of object.

VI.CONCLUSION

A result shows that ADM-A algorithm for the analysis based approach can effectively useful for reconstruction of images. Gives better result for uniform background. It suppress the noises but it produced over-smoothed results and eliminated much image details.

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