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Image Restoration using Inpainting

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Abstract: This paper presents comparision between two methods of image inpainting for image restoration. A coarse version of the input image is inpainted using CDD inpainting technique and also by TV inpainting technique. Image is often statistically corrupted with noise; hence removal of the noise is another important objective of this paper. These methods will be applied to gray scale and RGB images. Compared to existing approaches, some improvements have been done .The inpainting of a coarse version of the input image allows to reduce the computational complications, to be less prone to noise and to work with the dominant orientations of image structures. Experimental results on different images will show the effectiveness of the two methods.

Keywords: CDD -curvature driven diffusion, TV -total variation.

I. INTRODUCTION

For inpainting a damaged image or an ancient painting with missing regions is to guess and fill in the lost image information in such a consistent way that the restored image or painting seems as natural as its original version.

Important applications of digital inpainting are

A. Restoration of ancient paintings for conservation purposes
B. Restoring aged or damaged photographs and films
C. Object removal and text removal in images for special effects
D. Digital zooming and edge-based image coding

Mathematically, what makes the inpainting problem so challenging is the complexity of image functions. Unlike many traditional interpolation or boundary value problems, the target image functions to be inpainted typically lie outside the Sobolev category. Multilevel complexities of image functions force researchers to develop inpainting schemes targeted at specific classes of images. As a result, these inpainting models are of low levels. The ultimate goal, of course, as in the blueprint of vision and artificial intelligence, is eventually to be able to combine and integrate all the low-level inpainting components into an ideal program that can well approximate human inpainters.

Image inpainting is the process of filling in missing parts of damaged images based on information gathered from surrounding areas. In addition to problems of image restoration, inpainting can also be used in wireless transmission and image compression applications. In this project, we will developed an automatic digital in painting system that enables the user to choose between two complementary approaches. The first is based on the solution of partial differential equation of isophote intensity to fill-in missing portions in the region under consideration, while the second is based on texture inpainting. The filling-in process is automatically done in regions containing completely different structures, textures, and surrounding backgrounds.

II. RELATED WORK

A. Super resolution based inpainting

By O.Ebdelli, M.Guillemot, Le Meur.

This paper introduces a novel framework for examplar-based inpainting. It consists in performing first the inpainting on a coarse version of the input image. A hierarchical super-resolution algorithm is then used to recover details on the missing areas. The advantage of this approach is that it is easier to inpaint low-resolution pictures than high-resolution ones.

B. Image inpainting.

By Bertalmio, M., Sapiro, G., Caselles, V., Ballester, C

Inpainting, the technique of modifying an image in an undetectable form, is as ancient as art itself. The goals and applications of inpainting are numerous, from the restoration of damaged paintings and photographs to the removal/replacement of selected objects. This paper, introduces a novel algorithm for digital inpainting of still images that attempts to replicate the basic techniques used by professional restorators. After the user selects the regions to be restored, the algorithm automatically fills-in these regions with information surrounding them.

C. Tv-based texture image inpainting

By Minqin Wang

This paper proposes a novel algorithm which simultaneously inpaints structures and textures of damaged images. This paper proposes an algorithm that decomposes the image into two parts. Firstly inpainting the cartoon image part by boundary reconstruction, then texture synthesis to texture image part guided by boundary reconstruction is done. The method aims at inpainting structure and texture simultaneously and produces good results for texture with complex structure.

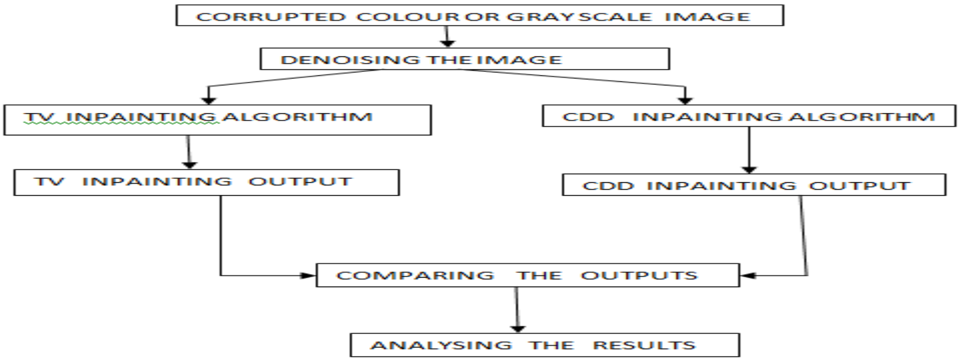
D. Exemplar image inpainting by means of curvature-driven method

By Shenfeng Li

This paper presents a new image inpainting method based on exemplar-based image inpainting idea by Curvature-Driven Diffusion (CDD) model in this paper. This method improves effectiveness and the linear structure propagation by rational confidence and data computing method. Therefore, the method proposed in this paper can effectively prevent the "garbage" from producing during the process of inpainting, which is a common problem faced in other methods.

III. IMPLEMENTATION

A. Block diagram:



- Image with painted data has to be removed with using two algorithm i.e CDD inpainting and TV(Total variation) image inpainting.
- The two inpainting techniques to be employed are:

  1) CDD : Curvature driven diffusion

  It is based on the solution of partial differential equation of isophote intensity to fill-in missing portions in the region under consideration.

  2) TV :Total Variation

  It is based on texture inpainting. The filling-in process is automatically done in regions containing completely different structures, textures, and surrounding backgrounds.

- We have to compare their Signal to noise ratio

B. Inpainting via cdd inpainting

The cdd model refers to,

$$\begin{cases} \frac{\delta u}{\delta t} \text{ (or 0)} = \nabla \cdot \left[\frac{g(|k|)}{|\nabla u|} \nabla u \right], & x \in D \\ u = u^0, & x \in D^c \end{cases}$$

Here the inpainting domain D is mathematically considered as an open set ,ie not including its boundary ;and u is available part of the image .If we solve the time marching equation ,then the initial condition can be any compatible guess, that is any u(x,0)that satisfies $u(x,0) = u^0(x), x \in D^c$

The flux field for the curvature –driven diffusion is

$$j = -D \nabla u = -\left(g(|k|) / |\nabla u|\right) \nabla u,$$

Which is anti gradient and hence stable . Physically we can treat the image function u as density function of certain type of particles. The available part of original image u^0 acts as a constant source or sink of particles. For example ,suppose we are inpainting a broken bar in uniform background , The connecting of two broken parts is realized ,in this particle diffusion picture,by the particle constantly fluxed into the inpainting domain through boundaries.

C. Research methodology to be employed for TV inpainting:

•Design a function to solves the Total Variation inpainting problem

min TV(X) subject to || X(Ic) - B(Ic) ||_F <= delta

where B is a noisy image with missing pixels, Ic are the indices to the intact pixels, X is the reconstruction, and delta is an upper bound for the residual factor. The TV function is the 1-norm(factor)of the gradient magnitude, computed with help of neighbour pixel differences. At the image borders, we imposed reflexive boundary conditions for the gradient computations.

•The information regarding the intact and missing pixels is given in the form of the mask M which is a matrix of the same size as B, and whose nonzero elements indicate missing pixels.

•The parameter delta should be of the same size as the norm of the image noise. If the image is m-times-n, and sigma is the standard deviation of the image noise in a pixel, then we recommend to use delta = tau*sqrt(m*n)*sigma, where tau is slightly smaller than one, say, tau = 0.85.

•The function must return an epsilon-optimal solution X, meaning that if X* is the exact solution, then our solution X satisfies TV(X) - TV(X*) <= epsilon = max(B(Ic))*m*n*eps_rel, where eps_rel is the specified relative accuracy; the default is eps_rel = 1e-3.

IV. Expected Result

A . Repairs the scratches on gray scale photograph and image

B. Removal of labeled text like subtitles, dates or publicity

C. Repairs the scratches on RGB image and photograph

V. Future Work

Proposed algorithm has to be hardware implemented i.e the HDL coding of algorithm has to be written using VHDL/ Verilog and generating RTL of proposed design. Implement the algorithm in FPGA. Design has to be done with low power and low RTL required. High throughput has to be achieved by using high throughput core i.e Virtex6 or Cyclone –II core.

VI. Conclusion

In this paper two algorithms of inpainting are to be implemented:

1. CDD(Curvature Driven Diffusion)
2. TV(Total Variation)

The choice of using CDD and TV algorithms with super resolution depends on the nature of the image to be inpainted.

The time required for the inpainting process depends on the size of the image and the regions to be inpainted, and it ranges form few seconds to several minutes for large images.The time analysis will be undertaken.

Some expected sample results have been shown.It is expected that our developed algorithm should reproduce texture and at the same time keep the structure of the surrounding area of the inpainted region.

References

1. Olivier Le Meur ,Christine Guillemot,: Super resolution based inpainting IEEE Trans. On Image processing vol.pp no. 99 2013
2. Bugeau, A., Bertalm´ıo, M., Caselles, V., Sapiro, G.: A comprehensive framework for image inpainting. IEEE Trans. on Image Processing 19 (2010)2634-2644
3. Glasner, D., Bagon, S., Irani, M.: Super-resolution from a single image. In: In 2009 IEEE 12th International Conference on Computer Vision (ICCV). Volume 10.(2009)349356
4. Minqin Wang: .TV-Based Texture Image Inpainting:In: International Conference on MultiMedia and Information Technology.(2008)272-275
5. Criminisi, A., P´erez, P., Toyama, K.: Region filling and object removal by examplar-based image inpainting IEEE Trans. On Image Processing 13 (2004)1200-1212
6. Drori, I., Cohen-Or, D., Yeshurun, H.: Fragment-based image completion ACM Trans. Graph.2 (2003)303-312
7. Freeman,W.T., Jones, T.R., Pasztor, E.C.: Example-based super-resolution. IEEE Computer Graphics and Applications 22 (2002)56-65
8. Chan T., Shen J.: Variational restoration of non-flat image features: models and algorithms. SIAM J. Appl. Math. 61 (2001)1338-13619)
9. Efros, A.A., Freeman, W.T.: Image quilting for texture synthesis and transfer. In: SIGGRAPH. (2001)341-346
10. Bertalmio, M., Sapiro, G., Caselles, V., Ballester, C.: Image inpainting. In: SIG-GRPAH 2000. (2000)
11. Efros, A.A., Leung, T.K.: Texture synthesis by non-parametric sampling. In: International Conference on Computer Vision. (1999)