Study of Image Recovery by Object and Noise Removal by Using Enhanced Inpainting Techniques

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Abstract — Filling dead pixels or removing uninteresting objects is often desired in the applications of remotely sensed images. It is used in Structure and texture filling in of missing image blocks and image reconstruction applications. In this paper a method for image denoising and inpainting is proposed. Inpainting method consists in performing first the inpainting on a coarse version of the input image and used to recover details on the lost areas. The benefit of this approach is that it is easier to inpaint. Experimental results in a context of image editing demonstrate the effectiveness of the proposed method.

Keywords — Image inpainting, Median filtering, Noise removal.

I. INTRODUCTION

Image inpainting fills the missing or damaged region in an image utilizing spatial information of neighboring region. Exemplar-based inpainting iteratively synthesizes the unknown area, i.e., target region, by the most similar patch in the source region. According to the filling order, the technique fills structures in the missing regions using gradient information of neighboring regions. This method is an efficient approach to reconstructing large target regions. Generally, exemplar-based inpainting methods use a fixed patch size and search the whole region of the source region [1]. Existing methods can be classified into two main types. The first type concerns diffusion-based approaches which propagate linear structures or level lines (so-called isophotes) via diffusion based on partial differential equations and variational techniques. The diffusion-based methods tend to initiate some blur when the hole to be filled in is big. The second family of approaches concerns exemplar-based techniques which sample and copy best matching texture patches from the known image neighborhood. These techniques have been inspired from texture synthesis techniques and are known to work well in cases of regular or repeatable textures [2]. With the proliferation of digital cameras in general, cell phones equipped with cameras in particular, and the increase in consumer-level computational power, digital image manipulation is becoming ubiquitous. Thus, one may remove an undesired object in the scene, and fill the missing part with its background [3]. To solve the inpainting problem of remotely sensed images, quite a few methods have been proposed. The approaches can be grouped into three categories. The first category comprises multi-temporal-complementation-based approaches. These approaches consist of selecting the best measurement among a set of measurements acquired over a limited time period. The second category comprises the multi spectral complementation-based approaches. Most of these approaches make use of another clear and complete band of data to recover the contaminated band of data by modeling a relationship between the contaminated band and the reference band. A third category of approaches is discovered, which consists of filling in the missing data regions using the remaining parts in the image. The goal of the approaches in this category is to seamlessly synthesize a complete, visually plausible, and coherent image [4]. Image prior knowledge plays a critical role in the performance of image restoration algorithms, designing effective regularization terms to reflect the image priors is at the core of image restoration [5].

II. BACKGROUND

Demands on texture synthesis and image restoration of digital images are growing according to population of consumer digital cameras. Inpainting algorithm has been used in various post processing applications. It is used for restoration of old films and object removal in digital photographs. It is also helpful to red-eye correction, hole-filling in depth image based rendering (DIBR), super resolution, compression, and so on [1]. A recent approach combines an exemplar-based approach with super-resolution. It is a two-steps algorithm. First a coarse version of the input picture is inpainted. The second step consists in making an enhanced resolution picture from the coarse inpainted image. Although tremendous progress has been made in the past years on exemplar-based inpainting, there still exists a number of problems. The most significant one is related to the parameter settings such as the filling order and the patch size. This problem is here addressed by considering multiple inpainted versions of the input image. To generate this set of inpainted pictures, dissimilar settings are used. The inpainted pictures are then combined yielding the final inpainted result [2]. The image completion problem lies at the intersection of computer graphics, image, and signal processing. Formally, given a corrupted image I and a hole region mask H marking the unknown area, the goal of image inpainting is to fill in H to form a visually plausible image I [3]. The recovery of dead pixels and the removal of selected objects from remotely sensed images can be unified into one problem, i.e. image inpainting, which has been intensively studied in the field of digital image processing. The purpose of image inpainting is to reconstitute the missing or damaged portions of the image, in order to make it clearer and to restore its unity. To solve the inpainting problem of remotely sensed images, quite a few methods have been proposed. The approaches can be grouped into three categories. The first category comprises multi temporal-complementation-based approaches. The second category comprises the multispectral complementation-based approaches, & a third category which consists of filling in the missing data regions using the remaining parts in the image. The goal of the approaches in this category is to seamlessly synthesize a complete, visually plausible, and coherent image [4].
III. PREVIOUS WORK DONE

Lee et al. [1] proposes a robust exemplar-based image inpainting algorithm using region segmentation. Exemplar-based inpainting techniques iteratively search the source region and fill the missing or damaged region, i.e. target region, with the most related patch in the source region. The proposed technique uses segmentation map to get better performance of robust inpainting, in which a segmentation technique is used to utilize spatial information in the source region. With the segmentation map, proposed technique automatically selects parameter values of the robust priority function, adaptively determines patch size, and decreases search region. Meur et al.[2] introduces a novel framework for exemplar-based inpainting. It consists in performing the inpainting on a coarse version of the input picture. A hierarchical super-resolution algorithm is then utilized to recover details on the missing regions. The benefit of this approach is that it is easier to inpaint low-resolution pictures than high-resolution ones. The gain is both in conditions of computational complexity and visual quality. However, to be less sensitive to the constraint setting of the inpainting technique, the low-resolution input image is inpainted several times with different configurations. Outcomes are efficiently combined with a loopy belief propagation and details are recovered by a single-image super-resolution algorithm. Gepshtein et al. [3] proposed a framework for image inpainting that utilizes the diffusion framework approach to spectral dimensionality reduction & show that on formulating the inpainting problem in the embedding field, the field to be inpainted is smoother in general, particularly for the textured images. Therefore, the textured images can be inpainted through simple exemplar based and variational techniques. Cheng et al. [4] proposed approach that takes advantage of a nonlocal method, which has a better performance in dealing with textured images and reconstructing major areas. Also, it makes use of the multichannel data of remotely sensed images to achieve spectral coherence for the reconstruction result. To optimize the variation model, Bregmanized-operator-splitting algorithm is employed. Zhang et al. [5] proposed the concept of group as the basic unit of sparse illustration, which is composed of nonlocal patches with similar structures, and establish a novel sparse representation modeling of natural pictures, called group-based sparse representation (GSR). The proposed GSR is able to sparsely represent natural images in the field of group, which enforces the intrinsic local sparsity and nonlocal self-similarity of images simultaneously in a unified framework.

IV. EXISTING METHODOLOGY

Robust Inpainting method: This method constructs a segmentation map using an input image, where a target region is manually selected. Then, the method determines parameter values of the robust priority function, in which selecting parameter values for the robust priority function largely affects inpainting results. To select appropriate parameter values that reflect properties of each segment, the difference of Gaussians (DoG) is used. In the robust exemplar inpainting step, this method computes the priority of target patches using robust priority function and searches the best matching source patch [1].

Super-resolution algorithm: Super resolution approach is used to reconstruct the high resolution details of the image. This approach stresses the point that the single-image SR method is applied only when the input picture has been down sampled for the inpainting purpose. Otherwise the SR method is not required [2].

Diffusion framework approach: Diffusion map used for represent a graph of any generic data set as a cloud of points in a Euclidean space, where the chosen affinity measure allows quantifying a particular, application-specific distance measure. This method mainly discusses on following approaches:

1. Approximate Diffusion Mapping Inversion
To solve for the best patch candidates that would allow a globally optimal solution, method assigns each image location to one of the potential matches. The pair wise matching potentials quantify the spatial smoothness between neighboring patches inside of unknown part, while enforcing consistency with the pixels on the boundary of unknown part. This method makes smoothness in the image domain by minimizing the discrepancies between overlapping image patches.

2. Multiscale Formulation
This scheme extends by deriving a multiscale inpainting scheme, using a Gaussian pyramid of images. The inpainting is applied at the coarsest scale, and the recovered patches are used as anchors in the inpainting.

3. Affinity Measures
In order to achieve a suitable Diffusion embedding, one has to choose an appropriate affinity measure to define the Diffusion kernel. The chosen metric reflects the sort of similarity author interested in the resulting image manifold. Using color descriptors will result in an embedding parameterizing the color manifold of the image. In contrast, in image inpainting author found it most useful to use texture descriptors. This scheme uses two texture descriptors: the first being the Local Binary Pattern (LBP) descriptor that characterizes the image texture in the vicinity of each pixel. The use of LBP results in a spatially smooth eigenvectors corresponding to the spatial similarity of the image texture [3].

MNLTV (Multichannel Nonlocal Total Variation Model) method: It is used to deal with the remotely sensed image reconstruction problem. This approach takes advantage of a nonlocal technique, which has a superior performance in dealing with textured images and reconstructing large-scale regions. Furthermore, it makes use of the multichannel data of remotely sensed images to achieve spectral coherence for the reconstruction result [4].

V. ANALYSIS AND DISCUSSION

Robust inpainting method, simply defines selection rules for suitable patch size and candidate search region with segmentation result. Next, to prevent undesirable source patch selection, it restricts search region using adjacent segments. This method searches corresponding candidate source regions that contain target region & reduces the computation time and error propagation. This robust inpainting method is tested with various test images. In Fig. 1, shows comparison of result images of proposed method with existing methods.
VI. PROPOSED METHODOLOGY

1. **INPUT IMAGE**
2. **NOISE REMOVAL**
3. **IMAGE INPAINTING ALGORITHM**
4. **INPAINTED IMAGE**

Fig. 1. Comparison of result images (342x512, “Bungee”): (a) input image, (b) target region and curve connection result (c) result image by Region filling and object removal by exemplar-based image inpainting (d) result image from Fully automatic inpainting method for complex image content (f) result image by the robust inpainting method.

In diffusion domain inpainting using the best-exemplar author applies Criminisi’s Best exemplar inpainting approach in the Diffusion domain, and show it provides improved results compared to its use in the spatial domain. Fig.2 shows inpainting results. In Fig. 4 the proposed scheme proved superior to the other approaches.

Fig. 2. Image completion through the 5-D texture descriptor and best-exemplar inpainting of the eigenvectors. (a) Original image. (b) Leading embedding eigenvectors and their inpaintings. (c) Diffusion framework scheme. (d) Tschumperle method (e) Best exemplar method (f) Komodakis method (g) Isotropic heat equation.

Fig. 3. Steps for proposed method

The figure 3 shows basic algorithm of proposed method which is consist of noise removal approach to remove the noise in the image and then it is applied to image inpainting algorithm to recover the damaged image and to fill the regions which are missing in original image in visually plausible way.

**Noise removal:**

Noise appear often in most images, during the gaining and digitization steps due to the size and shape lens and appear as dark bands with different widths. These need to be removed because it might interfere with the subsequent border detection steps. Therefore Decision based adaptive median filter is used to remove the noise.

**Image Inpainting:**

Inpainting involve the following steps:

1. Initialize the target region: This is performed by marking the target region in some special color.
2. Find the boundary of the target region.
3. Select the patch from the region to be inpainted. The patch size should be a bit bigger than the largest distinguishable texture element in the image.
4. Find the patch from the image which best matches the selected patch. This matching can be done using a suitable error metric. The mean squared error is used to find the best matching patch.
5. Update the image information according to the patch found in the previous step.

VII. POSSIBLE OUTCOME AND RESULTS

Fig. 4 (a) Batsman noisy image (b) Recover by using proposed filter. (c) Batsman original image (d) Object removed by using proposed inpainting method.
CONCLUSION

A novel inpainting approach has been presented in this paper. The input image is first filtered by the decision based adaptive filter and then inpainting is performed. Proposed method improves image accuracy and its efficiency & used to recover the details. Combining multiple inpainted images results blur and spatial consistency.

REFERENCES


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