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Enhance Example-Based Super Resolution to Achieve Fine Magnification of Low Resolution Images Using Neighbour Embedding Method

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Abstract: *Images with high resolution (HR) often required in most electronic imaging applications. There are two types of resolution first is high resolution and other one is low resolution. Now high resolution means pixel density with in an image is high and low resolution means pixel density with in an image is low. Therefore high resolution image can offer more detail compare to low resolution image that may be critical in many application. Super resolution is the process to obtain high resolution image from one or more low resolution images. Here in paper explain such robust methods of image super resolution. This paper describes the learning-based SR technique that utilizes an example-based algorithm. This technique divides a large volume of training images into small rectangular pieces called patches and patch pairs of low-resolution and high-resolution images are stored in dictionary. After that there are low resolution patch is extracted from the input images. The most alike patch pair is searched in the dictionary to synthesize high resolution image using the searched high resolution patch in the pair.*

Index Terms: *Super resolution (SR), training, example based, patch, image restoration.*

I. Introduction

Image super resolution plays important role in multimedia application. Super resolution is a technique to achieve a clear high resolution image from a low resolution image. This technique is widely adopted to improve a quality of images shots by a digital camera. When image captured by low resolution camera three main artefacts occur, namely aliasing, blurring and additive noise. An aliasing occurs due to the low sampling rate. This causes the loss of high frequency contents from the image. High frequency having information about edges and textures, so there are ultimate artefacts occurs at the edges in the image. A blurring occurs due to the relative motion between image and camera. An atmospheric noises like rainy atmosphere and dusty atmosphere cause additive noise in image. So, one can say that the super resolution is the process of recovering the missing high frequency details and removing the degradation that arise during the image acquisition process. Super-resolution techniques can be applied in various domains. Image processing applications are like remote sensing, enlarging consumer photographs, medical imaging, and online image exchange, image viewing and converting NTSC video content to HDTV demands high resolution image.

Super-resolution techniques can be applied in various domains. Image processing applications are like remote sensing, enlarging consumer photographs, medical imaging, and online image exchange, image viewing and converting NTSC video content to HDTV demands high resolution image. The high resolution image not only gives the viewer pleasing appearance but also gives additional information that important for the analysis in many applications like medical imaging. There are many practical applications of SR reconstruction.

Satellite imagery is one obvious application. If the slight offsets between images taken from separate orbits are of sub-pixel accuracy, SR image reconstruction is viable. Land-cover-mapping is an area where SR techniques are necessary for resolving landscape features, especially rural hedges and other thin formations. Also, at some position image captured by satellite is LR image then it has to wait until it complete one revolution to recapture the same scene. In such case SR technique helpful to obtain HR image.

Super-resolution methods can also be used to create high resolution still pictures or video from video sequences. The sub-pixel motion requirement necessary for SR image reconstruction does not have to come from movement of the imaging system. In the case of a video sequence, global motion of objects in the scene may be adequate in the temporarily shifted frames, even if the camera remains static. For static scenes, SR image reconstruction is viable so long as long as sub-pixel accuracy can be attained due to vibrations in the camera. The same techniques can also be applied to improve the resolution of existing (low resolution) video content for use in high definition television sets.

The enhancement of smaller, ROI objects within a field of view (FOV) is very important in imaging, especially surveillance. An example of this is digital zoom, where a ROI is up-sampled ("blown up") to the dimensions of the original FOV. Super resolution reconstruction is also used to obtain HR image by some form of using single LR image. Surveillance system like License Plate Recognition (LPR) system needs to identify the vehicle license plate images taken from the camera. Most LPR systems are designed for toll gates and parking place or any other places for security purpose. In order to full fill this need we can use technique to reconstruct HR image from low resolution images or single LR image. In medical imaging, SR image reconstruction is useful in resolution-limited imaging systems such as computed tomography (CT) and magnetic resonance imaging (MRI) which can easily acquires multiple images of the same scene. Apart from these, there are number of application of super resolution reconstruction used to obtain the HR image from multiple LR images or single LR image.

II. Super Resolution Image Reconstruction

The generation of the low resolution image can be modeled as a combination of smoothing and down-sampling operation of natural scenes by low quality sensors. Super resolution is the inverse problem of this generation process. One criteria of solving this inverse problem is minimizing the reconstruction error. Various methods are proposed in literature to deal with the inverse problem. In following section I categorize the different SR methods available in existing literature.

In this method [9] super-resolution problems can use flexible method that in principle with arbitrary magnification factors up to some fundamental limits. Propose a new, using the training examples in more general way so that simultaneously the generation of each image patch can be used multiple training examples in the high-resolution image. This formula is very important when generalization over the training examples is possible and hence there are required limited numbers of training examples.

In this Method [2] a robust first-order regression model for image super-resolution based on justified in-place self-similarity. Model leverages the two most successful super-resolution methodologies of learning from an external training database and learning from self-examples. Taking advantage of the in-place examples, learn a fast and robust regression function for the otherwise ill-posed inverse mapping from low- to high-resolution patches. On the other hand, by learning from an external training database, the regression model can overcome the problem of insufficient number of self-examples for matching. Compared with previous example-based approaches, new approach is more accurate and can produce natural looking results with sharp details. In many practical applications where images are contaminated by noise or compression artefacts, our robust formulation is of particular importance.

In this Method [4] learning patch pairs of low- and high-resolution images use to synthesizes a high-resolution image. However, since a low-resolution patch is usually mapped to multiple high-resolution patches, unwanted artefacts or blurring can appear in super-resolved images. Here propose a novel approach to generate a high quality, high-resolution image without introducing noticeable artefacts. Introducing robust statistics to a learning-based super-resolution, we efficiently reject outliers which cause artefacts. Global and local constraints are also applied to produce a more reliable high-resolution image. Learning-based super-resolution algorithms are generally known to provide HR images of high quality. However, their practical problem is the one-to-multiple mapping of an LR patch to HR patches, which results in image quality degradation.

This algorithm [5] uses learning method to construct super resolution image. The main contributions of these algorithms are: (1) a class-specific predictor is designed for each class in our example-based super-resolution algorithm – this can improve the performance in terms of visual quality and computational cost; and (2) different types of training set are investigated so that a more effective training set can be obtained. The classification is performed based on vector quantization (VQ), and then a simple and accurate predictor for each category, i.e. a class-specific predictor, can be trained easily using the example patch-pairs of that particular category. These class-specific predictors are used to estimate, and then to reconstruct, the high-frequency components of a HR image. Hence, having classified a LR patch into one of the categories, the high-frequency content can be predicted without searching a large set of LR-HR patch-pairs.

In this Algorithm [3] a learning-based super resolution technique using an example-based approach that enables restoration of finely-magnified, high-resolution images by specifying target objects. The proposed method features the unique properties of minutely varied, training images as well as applying weighted searching/synthesizing. Therefore, it can achieve finely-magnified, high-precision super resolution of images efficiently, including those of texts and human faces. Results of text images, car license plate images and human face images demonstrate the great effectiveness of this method. This method consists of two phases, 1) A dictionary construction phase that performs extraction of patch pairs from both HR and LR images, and then stores them as training data in the dictionary, and 2) An super resolution phase that performs synthesizing of HR images by searching patches stored in the dictionary that are best matched to the input images.

Table 1: comparison between super-resolution techniques

	Methods	**Advantages**	**Disadvantages**
1	Nearest Neighbor Interpolation	Preserves the sharpness and does not produce the blurring effect	Produce aliasing.
2	Bi-linear Interpolation	Does not create an aliasing effect.	Produce some artefact
3	Bi-cubic Interpolation	Gives smooth image	Produce some artefact
4	An Efficient Example-Based Approach for Image Super-Resolution	Excellent performance in terms of both quality and computational complexity.	
5	Robust Learning-Based Super-Resolution	Provide high quality image	The one-to-multiple mapping of an LR patch to HR patches, which results in image quality degradation.
6	Fast Image Super-resolution Based on In-place Example Regression	Better at handling real applications	Does not handle noisy input images
7	Super-Resolution Through Neighbor Embedding	Smoothes the texture on the face, better effect on some edges.	Produce some artefact
8	Iterative back projection algorithm	Less complexity and low-less number of iteration is required	Edges are not improve compare to other methods

III. Proposed Method

In my proposed work it will use enhance example learning based super resolution method for avoiding artefact and improve image quality. My proposed method is dividing into two phase. First phase is dictionary construction phase. There is different types of low resolution images classified by minute variations are generated out of a large volume high resolution training images. Patches are extracted from high resolution and low resolution image and patch pair of high resolution and low resolution images are stored in the dictionary. Second phase is Super resolution phase. There are low resolution patch is extracted from the input images. The most alike patch pair is searched in the dictionary to synthesize high resolution image using the searched high resolution patch in the pair.

There are k-mean tree used in dictionary construction phase for arrange the patch pair of low resolution and high resolution patch pair. Now in super resolution phase neighbor embedding method is used for searching the well match patch pair from dictionary and synthesize the high resolution.There are reconstructed high resolution image has some blur so for removing that blur used non-local mean algorithm, by using this algorithm we avoid the blur and improve the image quality.Here algorithm of proposed method,

3.1 Dictionary Construction Phase

There are three steps for develop this phase such as:

Step 1: Input different types of low resolution (LR) images classified by minute variation are generated out of a large volume of high resolution (HR) training images.
Step 2: Patches are extracted from HR and LR images using example based super resolution.
Step 3: Patch pair of HR and LR are stored in dictionary.

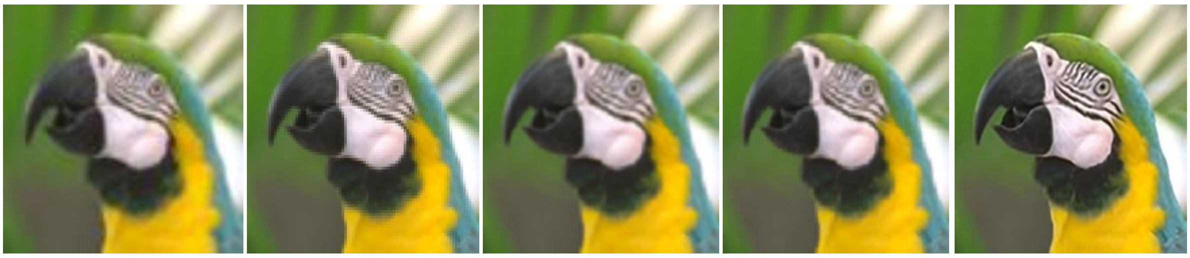
3.2 Super resolution Phase

There are four steps such as:

Step 1: LR patch is extracted from the input image.
Step 2: The most alike patch pair is search in dictionary using Neighbour Embedding algorithm
Step 3: Synthesize an HR image using the search HR patch in the pair.
Step 4: Reconstruction based enhancement.

IV. Experimental Results

In order to show the effectiveness of our proposed method, we introduce the results when our proposed method was applied to a low-resolution text image shot by a digital camera. Here in result input low resolution image and get 3 × magnified output high resolution image.



(a) (b) (c) (d) (e)

Figure 1: (a) Input Image (b) Nearest neighbor (b) Bi-cubic interpolation(PSNR= 26.02 dB) (d) SR image using Euclidean distance(PSNR = 26.15 dB) (e) SR image using Neighbor Embedding Method (PSNR = 30.10 dB).

(a) (b) (c) (d) (e)

Figure 1 : (a) Input Image (b) Nearest neighbor (b) Bi-cubic interpolation(PSNR= 27.56 dB) (d) SR image using Euclidean distance(PSNR = 27.67 dB) (e) SR image using Neighbor Embedding Method (PSNR = 31.01 dB).

V. Conclusion

There are several methods used to improve the quality of low resolution image but some methods can produce blur in the image. Some may avoid blur but occur aliasing in the high resolution image. So, reconstructed image is reducing efficiency and performance due this artefact. So, here developed a new approach of enhance example based super –resolution for magnified low resolution images using neighbour embedding method that reduce blur and artefact from image and improve the efficiency and quality of image . In future, improve quality of image using more number of training images.

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REFERENCES

[1] Dr. S. D. Ruikar and Mr. T.D. Wadhavane "A Single Image Super Resolution Using Advanced Neighbour Embedding" International Journal of Computer Science & Engineering Technology (IJCSET), Vol. 4 No. 04 April 2013.
[2] Jianchao Yang, Zhe Lin, Scott Cohen, "Fast Image Super-resolution Based on In-place Example Regression" computer vision foundation, CVPR2013.

[3] SENDA Shuji, SHIBATA Takashi, IKETANI Akihiko" Example-based Super Resolution to Achieve Fine Magnification of Low-Resolution Images" NEC TECHNICAL JOURNAL, Vol.7 No.2/2012.

[4] Changhyun Kim and Kyuha Choi "Robust learning-based super-resolution", Proceedings of IEEE 17th International Conference on Image Processing, 2010, pp 2017 – 2020

[5] Xiaoguang Li and Kin Man Lam "An efficient example-based approach for image super- resolution" IEEE Int. Conference Neural Networks & Signal Processing Zhenjiang, China, June 2008, pp 575 – 580

[6] M.V.Joshi and S.Chaudhuri " A learning based method for image super-resolution from zoomed observations " Proc. of 5th Int. Conf. on Advances in Pattern Recognition (ICAPR'03) pp.179-182, Calcutta, India, Dec.2003.

[7] S. Dai, M. Han, Y. Wu, and Y. Gong, "Bilateral Back-Projection for Single Image Super Resolution," IEEE Conference on Multimedia and Expo (ICME), 2007, pp. 1039-1042.

[8] W.T. Freeman, T.R. Jones, and E.C. Pasztor "Example-Based Super- Resolution," IEEE Computer Graphics and Applications, vol. 22, no. 2, 2002, pp. 56-65.

[9] Hong Chang, Dit-Yan Yeung, Yimin Xiong" Super-Resolution Through Neighbor Embedding"

[10] R. Gonzalez and R. Woods, "Digital Image Processing", 3rd Edition, Pearson Eduction, Inc, Publishing as Prentice Hall, pp. 714-715.

[11] W.T. Freeman, T.R. Jones, and E.C. Pasztor, "Example- Based Super- Resolution," IEEE Computer Graphics and Applications, vol. 22, no. 2, 2002, pp. 56-65.

[12] M.V.Joshi and S.Chaudhuri," A learning based method for image super-resolution from zoomed observations," Proc. of 5th Int. Conf. On Advances in Pattern Recognition (ICAPR'03) pp.179-182, Calcutta, India, Dec.2003.

[13] Nunez J, Otazu X, Fors O, Prades A, Pala V, Arbiol R. "Multiresolution-based image fusion with additive wavelet decomposition". IEEE Transactions on Geoscience and Remote Sensing, vol 37, no 3, 1999, pp 1204−1211

[14] J.Ma, J. C.-W. Chan, and F. Canters, "Fully automatic sub-pixel image registration of multi-angle CHRIS/Proba data," IEEE Trans. Geosci. Remote Sens., vol. 48, no. 7, pp. 2829–2839, July 2010.

[15] G. Yang, C. V. Stewart, M. Sofka, and C.-L. Tsai, "Registration of challenging image pairs: Initialization, estimation, and decision," IEEE Trans. Pattern Anal.Mach. Intell., vol. 29, no. 11, pp. 1973– 1989,Nov.2007.

[16] Chen- Chiung Hsieh and Yo-Ping Huang "Video Super-Resolution by Motion Compensated Iterative Back-Projection Approach" journal of information science and engineering, vol 27, no 3, 2011, pp 1107-1122

[17] H. Trussel and B. Hunt, "Sectioned methods for image restoration," IEEE Trans. Acoust., Speech Signal Process., vol. ASSP-26, no. 2, pp. 157–164, 1978.