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Research paper

Interpolation Techniques in Image Resampling

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Abstract

The procedure of converting a sampled image from any coordinate structure to other structure is called Image Resampling. When forgeries are introduced in digital images, generally the operations like rotation, resizing, skewing etc., are included to make it relational with respect to adjacent original area. So there is a recognizable loss in the quality of the image and it will become an important signature of manipulated images. Hence resampling is the default interpretation present in most of the tamped image. Resampling detection is an attractive standard tool in digital image forensics. Generally resampling objects are not visible to human eye in an altered images but periodic relationships get familiarized in image pixels. Because of it the changes is going to happen in certain characteristics of the image and it is going leaving behind periodical artifacts which are used as fingerprints for the forensics. These periodic interpolation objects present in the intensities of pixels or other format of data illustration such as DFT, wavelet are the structures which detectors look for in order to decide whether an image, or a part of an image, has endured a geometrical transformation. This serves as an evidence of manipulation or tampering. This paper gives comparative study of different resampling techniques like Cubic Splines, Nearest Neighbor, Cubic convolution and Linear Interpolation, which can be used as detectors for an altered image containing resample portions

Keywords: *Digital image forgery detection, Resampling, Image interpolation, Tampering, forensics.*

1. Introduction

In today's digital world, Digital Image Forensics is highly a challenging region. Digital Image forensics [1] is a relatively hot research area aiming at gathering information on the history of an image. In current digital era, the digital media or digital image has played an important role in today's regular life**.** So we can express doubt about the reliability of digital visual information. With the propagation of digital images and due to availability of easy-to-use media manipulating tools such as Photoshop, which can be found anywhere on the digital systems or internet has become increasingly easy to manipulate images to alter content and meaning. Any person can manipulate the information of their digital record in order to attain their intention without leaving any clues that are recognizable by others. The demonstrative potential of visual media and availability of their, storage, acquisition, and distribution is such that they are more and more advantage to deliver the information. As a result of that, now a days images and videos plays an vital role as a proof for both trials and every-day life argument. Some video clips in television program or news is generally recognized as a certification of the genuineness of that program or news. Similarly, a CCTV footages can be a part of fundamental probationary material in a trail.In conjunction with unquestionable gains, the availability of digital media leads a major complication. The experts in Image processing can easily alter the content of an image. In general, with the increase of low cost and user friendly photo editing software, the method of altering and copying the know data is no more controlled. Hence digital image forgery detection is a hot research field which focus at accuracy of the originality of images by regaining the facts about the history. There are several cases involving media forgery presented and analyzed [2]. In several papers, they presented the detail classification and brief survey on Image forgery detection [3][11][16]. This article defines the process of resampling and then observes the Interpolation functions. The interpolating function can be choose for the resampling process is depends upon the work.

2. Literature Surevy

The following literature survey provides the summary of work carried out by some listed authors about resampling detection. The authors [4,5] come up with the distinguished procedure to find resampling[17] in images. The main idea is that resampling establishes a regular interrelationship between pixels by interpolation. To find these interrelationships, a linear model is used under which every pixel is pretended that it belongs to a non-resampled group and a resampled group, each with equal possibility. The restricted possibility for a specific pixel closeness to the resampled class is suspect to be Gaussian, while the conditional or restricted possibility for a specific pixel associated to the other group is assumed to be identical. An Expectation Maximization (EM) algorithm [4][5] can be used to carryout assessment of a pixel's possibility in linear consortium with its adjacent pixels and the unidentified weights of the grouping. In the Expectation step, the possibility of a pixel belonging to the resampled group is intended. In the step, Maximization the exact

method of the correlations between samples is assessed. The stopping condition is prescribed when there is a mismatch in the weights among two succeeding reiterate is quite small. During this stage, the matrix of possibility values got in the expectations step for all image pixels is called the "Probability map (p-map)". For that image this p-map is periodic and crest in the 2D Fourier spectrum of the p-map signifies the resampling. In p-map, a probability value very near to 1 then it shows there is resampling of pixel.

In [6], a constructive method has offered to discriminate the periodicity established by JPEG compression and resampling. At the beginning, the probability map of an image was derived with help of EM algorithm [1]. Then it was Fourier transformed and equivalent with template of affine transform and a template of JPEG to find the manipulation of image is done or not. They have presented the experimental outputs to demonstrate the stated method is trustworthy and beneficial in all types of digital manipulations.

The authors in [7][12], presented the review about the interpolation techniques for Image scaling under two types Adaptive and Non-Adaptive methods. They described clearly that the adaptive techniques are good with respect to visual aspect of image but it needs more processing time. When there is no restrictions in time then we can select the adaptive method otherwise non-adaptive methods are desirable.

The authors in [8][14][18], presented the comparative study of Interpolating methods for Image resampling. They compared all interpolation functions and stating that the limited magnitude convolving functions would offers the better interpolation. The response was achieved with the high-resolution cubic spline methods. The position of the resampled points with respect to the primary coordinate system has a measurable result on the reply of the sampled interpolating methods.

The authors in [9], given a case study in resampling techniques. This case study has useful variety of resampling techniques in alliance with several classifiers in order to expand the organization of commit messages in software depositories. They proposed a methodology to improve the state-of-the-art in multiple types by attaining a very good precision.

3. Resampling

Resampling is the method of varying sampling rate of the targeted discrete image. During manipulation, geometrical transformation of digital image are usually involved, which is definite at one set of coordinate points. Image resampling is a complicated process, so a frame work is required which can be used to classify and analyze resampling methods. Many times the formation of conclusive image forgery demands geometrical transformations. Totally, such geometric transformation propose a resampling of the source image. These operations imposed in the pixel domain, it will affect the locations of samples. Therefore the image must be resampled to a new sampling lattice. Resampling establishes specific interrelationship in the samples of image[4], which can be used as an proof of tampering. During resampling procedure [19], when sample is down, meaning that it reduces the pixels in image, facts are destroyed from the image. When sample is up, or escalation of the pixels in the image. Hence it affects the display size of image.

Resampling is decomposed in to 3 sub process as shown in figure 1.

1. Reconstruction of a continuous intensity surface from a discrete image.
2. Transformation of that continuous surface.
3. Sampling of the transformed surface to produce a discrete image.

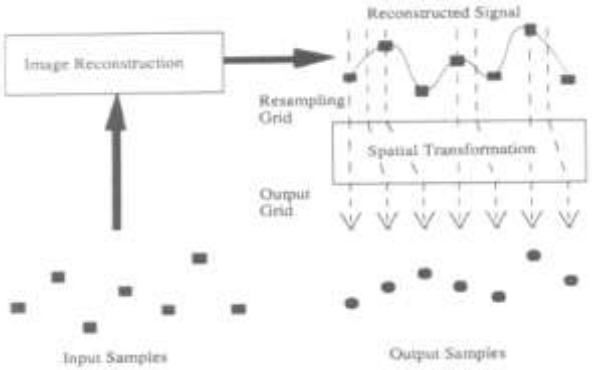

Fig. 1: Process of Image Resampling

4. Resampling Techniques

There are 4 interpolation techniques used in resampling namely,

1. Nearest neighbor
2. Bilinear interpolation
3. Bicubic interpolation
4. Basic-splines(B-spline)

1. Nearest Neighbor**:** It is a very simple and desires the less computational time compared to remaining techniques. This is also called point – shift algorithm. It selects the value of the pixel which is very nearby surrounding coordinates of the intended interpolation point. By using of this, it will finds nearest comparable pixel in the source image for each pixel in the final image [12,10,8]. The dots or pixels of color are alike to generate a new pixels as the size of the image enlarges. It creates edges that splits up curves into jagged edges or steps. This form of interpolation effects for both reduction and enlarging of images. The interpolation kernel for the nearest neighbor algorithm is defined as

$$f(x) = \begin{cases} 0, & x < 0 \\ 1, & x > 0 \end{cases} \qquad 3.1$$

The distance between grid point and interpolated point is denoted by x.

2. Bilinear Interpolation: It will accept the weighted mean value of the 4 surrounding area pixels to calculate its final value. This will be used to find values at the random position from the weighted average of the four nearest pixels to the enumerate input coordinates and assigns that value to the output coordinates [12,10,8]. This technique performs interpolation in both directions, vertical and horizontal. The interpolation kernel for Bilinear interpolation is [14].

$$u(x) = \begin{cases} 0, & |x| > 1 \\ 1 - |x|, & |x| < 1 \end{cases} \qquad 3.2$$

The distance between grid point and interpolated point is denoted by x.

3. Bicubic Interpolation**:** This method is improved version over the cubic interpolation in 2 dimensional regular grid. The interpolated surface is smoother than equivalent surfaces gained by an above mentioned methods, Bilinear interpolation and Nearest neighbor [12,10,8]. Bicubic goes one step outside the limitations of bilinear by taking into consideration of the closest 4x4 surrounding pixels for a total of 16 pixels. For this cause it became a standard in almost all image editing software or tools such as printer drivers, in-camera interpolations and Adobe Photoshop, The interpolation for Bicubic interpolation is [14-2014 10new].

$$\mathbf{U(x)} = \begin{cases} \frac{3}{2}|x|^3 - \frac{5}{2}|x|^2 + 1 & 0 \le |x| < 1 \\ -\frac{1}{2}|x|^3 + \frac{5}{2}|x|^2 - 4|x| + 2 & 1 \le |x| < 2 \\ 0 & 2 < |x| \end{cases} \quad 3.3$$

4. Basic Splines (B-Splines): The nearest neighbor and Bilinear Interpolations come to an understanding the quality of image over efficiency due to rectangular shape in the pass band and infinite side lobes. Just like Bicubic interpolation, this algorithm interpolates from the nearest 16 source pixels [12,10,8]. This algorithm uses B-spline interpolating functions as an auxiliary of cubic splines, which yields a quite fair output. It has compulsive characteristics of smoothness that suggest it is a better choice for selected types.

The interpolation kernel for B-spline interpolation [14]

$$\mathbf{U(x)} = \mathbf{1/6}\begin{cases} 3|x|^3 - 6|x|^2 + 4 & 0 \le |x| < 1 \\ -|x|^3 + 6|x|^2 - 2|x| + 8 & 1 \le |x| < 2 \\ 0 & 2 \le |x| \end{cases} \quad 3.4$$

5. Experiments and Results

A MATLAB\R 2017 implementation on Intel(R) Core(TM) i3-6006U CPU @2.00 GHz, 8GB RAM computer is developed to test the performance of all the algorithms. 40 images are selected as a representative images for testing. It is observed that from the table 1, the SNR (Signal to Noise Ratio) values with different interpolation techniques for some set of images.

Table 1: SNR values with different interpolation methods

Image / Method	Nearest Neighbor	Bilinear	Bicubic	Spline
Fig1.tif	24.3200	25.2684	25.8365	28.6900
Fig2.tif	25.9544	27.3471	27.8160	40.5510
Fig3.tif	25.4760	26.9244	27.3626	32.3114
Fig4.tif	22.6283	23.3439	21.9608	30.9051
Fig5.tif	26.7347	27.0129	27.0471	46.8910
Fig6.tif	26.1706	30.2784	32.8654	34.4444

It is observed from the table 1 that, the SNR values with different interpolation methods can reflect the quality of images. The higher the SNR value, higher the quality of the image. It can be observed that from the table 1, that the SNR values of an image from nearest neighbor interpolation is the minimum compared to all other and the B-spline is largest than the remaining techniques. The complexity and average running time also varies. The average running time of all the techniques with respect to the test images is as shown in Figure.2

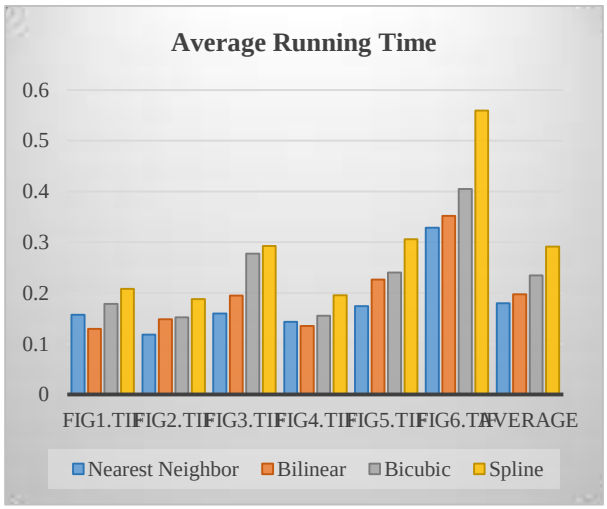

Fig.1: Average running time of different interepolation algorithms

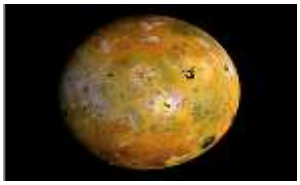

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

5. Conclusion

The present work is carried out to understand four different image interpolation techniques using different sample images. The observations from the experiments are summarized as follows.

- The Nearest neighbor interpolation technique is the fast and simple.
- The Bilinear Interpolation technique is more complex compared to nearest neighbor method and it has larger calculation time, but operation speed is slightly slower.
- Bicubic interpolation algorithm can get relatively good result when time is not a constraint. It involves large amount of calculations. It is commonly used in image processing software.
- Bicubic b-spline interpolation yield quite smooth results, so it is good option in some cases.

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References

[1] Alessandro Piva, "An Over view on Image Forensics "Hindawi Publishing Corportion ISRN Signal Porcessing, Volume 2013, Article ID 496701, 22 pages, Nonember 2012.
[2] Henry Farid, "Image Forgery Detection", IEEE Signal Processing Magazine, March 2007.
[3] S. Manjunanatha, Dr Malini M Patil."A Survey on Image forgery Deection Techniques" CiiT International Journal of Digital Image Processing, Vol 9, No 5, May 2017
[4] Alin. C. Popescu and H. Farid, "Exposing digital forgeries by detecting traces of Re-sampling," IEEE Trans. Signal Processing, vol. 53, no. 2, pp. 758–767, 2005
[5] A.C. Popescu and H. Farid, "Exposing digital forgeries by detecting duplicated image regions," Dept. Computer. Sci., Dartmouth College, Tech. Rep. TR2004-515, 2004.
[6] Shu-ping Li, Zhi Han, Yi-zhen Chen, Bo Fu, Chunhui Lu, Xiaohui Yao,"resampling Forgery detection in JPEG-Compressed Images',

3rd International Congress on Image and Signal Processing(CISP2010), 2010.

[7] Pankaj S, Parsania, Dr. Paresh V. Virparia, "A Review: Image interpolation Techniques for Image Scaling" , International Journal of Innovative Research in Compuiter and Communication Engineering, Volume 2, Issue 12, december 2014.

[8] Anthony Parker, Robert V. Kenyon, Donald e. Troxel, "Comprision of Interpolating Methods for Image Resampling" IEEE Transactions on Medical Imageing, Volume MI-2, No.1, March 1983.

[9] Seyed Hamid Shekarforoush, Robert Green, and Robert Dyer, "Classifying Commit Messages: A cse study in Resampling Techniques", IEEE Transactions , 2017.

[10] Philippe Thévenaz, Thierry Blu and Michael Unser Swiss Federal Institute of Technology—Lausanne, "Image Interpolation and Resampling",2017.

[11] S. Bayram, I. Avcibas, B. Sankur, and N. Memon, "Image manipulation detection," J. Electron. Imaging, vol. 15, no. 4, p. 41102, 2006.

[12] Dianyuan Han, Dept. of Computer Engineering, wei Fang University Shandong, China,"Comparision of Commnoly used Image Intepolation Methods", 2nd International conference on computer science and Electronics engineering, 2013.

[13] Jason Bunk, Jawadul H. Bappy, etl, "Detection andLOcalization of Image Forgeries using Resampling Features and Deep learning", 2017 IEEE Conference on computer Vision and pattern Recognition Workshops.

[14] Vaishali Patel, Prof. Kinjal Mistree,"A Review on different Image Interpolation Techniques for Image enhancement", International Journal of emerging Technology and Advanced Engineering, Volume 3, Issue 12, december 2010.

[15] Matthias Kirchner and Rainer Bohme, "Hiding Traces of Resampling in digital Images", IEEE Transactions on Inofrmation forensics and Security, volume 3, No. 4, december 2008.

[16] Songpon Teerakanok, Tetsutaro Uehara,"digital Media Tampering Detection Techniques: An Overview", 2017 IEEE 41st Annual computer software and Application Conference,

[17] Nahuel Dalgaard, Carlos Mosquera, Fernando Perez-Ganzalez, "On the Role of Differentiation for Resampling Detection", Proceedings of 2010 IEEE 17th International conference on Image Processing. September -2010.

[18] Shreyas Fadvavis, Pune University, India, "Image Interpolation Techniques in Digital Image Proessing: An Overview", Instituete of journal of Engineering Research and Applilcation, ISSN: 2248-9622, Volume 4, Issue 10, October 2014, PP. 70-73.

[19] Prasad D, Ek.R. Ramaksrishnan ,IISc. Bengaluru, India, "On Resampling Detection and its Application to Detect Image Tampering", IEEE, ICME 2006. Page No. 1325-1328.