Bicubic Interpolation Algorithm Implementation for Image Appearance Enhancement

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Abstract
Aliasing is a typical antique in low-resolution (LR) pictures produced by a down-sampling procedure. Recuperating the first high-determination picture from its LR partner while in the meantime evacuating the associating ancient rarities is a testing picture introduction issue. Since a characteristic picture ordinarily contains repetitive comparable patches, the benefits of missing pixels can be accessible at composition applicable LR pixels. In light of this, the paper proposes an iterative multiscale bicubic interpolation technique that can successfully address the associating issue. The proposed technique appraises each missing pixel from an arrangement of surface pertinent semilocal LR pixels with the composition closeness iteratively measured from a succession of patches of differing sizes. In particular, in every emphasis, top surface significant LR pixels are utilized to build an information constancy term in a most extreme a posteriori estimation, and a respective aggregate variety is utilized as the regularization term. Exploratory results contrasted and existing interjection strategies exhibit that our strategy can considerably reduce the associating issue as well as produce better results over an extensive variety of scenes both as far as quantitative assessment and subjective visual quality.

Keywords
Antialiasing, Image Interpolation, Bicubic Interpolation, Iterative Multiscale, Semilocal

I. Introduction
Image Interpolation addresses the matter of getting a high-resolution (HR) image from its low-resolution (LR) counterpart [1]. It’s basic to several real-world applications, such as life science, police work, and security, where the resolution of the captured pictures tend to be terribly low and the apparent aliasing effects usually seem attributable to the restricted number of charge-coupled-device pixels utilized in industrial digital cameras, supported the Nyquist–Shannon sampling theorem if the oftenest is smaller than doubly the maximum frequency of unit of time image, all the image data above 0.5 the often square measure removed. Then, the LR image is corrupted by aliasing (such because the mast and jib occurred within the image “Sail”). Commonly used linear interpolation ways like the bicubic technique perform interpolation supported the unvaried assumption and square measure thus unable of adapting to various image structures, usually manufacturing blurred edges [2,4].

II. Related work
The focus of this paper is to develop image bicubic interpolation methods that can effectively address the aliasing problem [3]. Since a natural image normally contains redundant similar patches, the values of missing pixels can be available at texture-relevant LR pixels [2, 5]. Based on this basic idea, we propose to recover each missing pixel with antialiasing from a set of texture-relevant LR pixels within its neighborhood, whose pixel-centered patches are similar to the corresponding patch centered by the missing pixel. Compared with the nonlocal idea, finding the similar patches within a neighborhood substantially reduces the computational complexity [6], and these types of methods are generally known as semi local methods [11]. Specifically, we propose an iterative multi scale interpolation method to estimate each missing pixel from a set of texture-relevant semi local LR pixels, where the texture similarity is measured from large to small patch sizes iteratively. The similarity measurement with large patch sizes can alleviate the influence of aliasing artifacts of the LR image, whereas the measurement with small patch sizes can avoid over fitting effects for fine and dense textures [12]. To further enhance performance, the outputs of all previous iterations are grouped together as inputs for the next smaller scale interpolation. This can not only inherit the advantages of using large-scale patches but also filter out inaccurate results of previous outputs and gradually recover the finer details. In each iteration, top texture-relevant semi local LR pixels are selected to construct a data fidelity term in a maximum a posteriori (MAP) estimation, and a bilateral total variation (TV) [11] is used as the regularization term. Experimental results compared with existing interpolation methods proves that implemented method can alleviate aliasing artifacts substantially, and at the same time, it also outperforms other methods both in terms of quantitative evaluation and subjective visual quality across a wide range of images. It is a challenging task to generate a low resolution image from a high resolution by down sampling with loss of information; fig. 1 represents the conversion of image from HR to LR.

III. Proposed Methodology
In this paper an iterative multi-scale bicubic interpolation method that explores texture-relevant semilocal LR pixels in an iterative multiscale way has been processed. Basically interpolation is technique used in different image operations such as image enlargement, shrinking, image rotation, quality improvement. In this paper two methods has been elaborated as follows.
A. Nearest neighbor interpolation

In nearest neighbor interpolation each nearby pixel has similar characteristics, hence it becomes easier to add or remove the pixels as per requirement. The major drawback for this method is unwanted artifacts like sharpening of edges may get added in an image while resizing, hence generally not preferred [13].

B. Bilinear Interpolation

In bilinear interpolation four nearest pixels has been considered to derive the desired pixel. Bilinear is more accurate as compare to nearest neighbor interpolation. Let us assume that \((x,y)\) are the coordinates of the location from which we want to find out the new pixel and intensity of the pixel is \(v(x,y)\), as shown in eq. 01. For bilinear interpolation, the assigned value is obtained using the standard equation,

\[
v(x,y) = ax + by + cxy + d
\]  

(1)

Bilinear interpolation gives much better results than nearest neighbor interpolation, with a modest increase in computational burden. Fig. 2 represent bicubic pixel and bilinear pixel consideration in interpolation.

C. Bicubic Interpolation Method

Bicubic interpolation method is somewhat complicated than bilinear interpolation. In bicubic interpolation sixteen nearest neighbor of a pixel have been considered as shown in above fig. The intensity value assigned to point \((x,y)\) is obtained using the equation,

\[
v(x, y) = \sum_{i=0}^{3} \sum_{j=0}^{3} a_{ij} x^i y^j
\]  

(2)

where the sixteen coefficients are determined from the sixteen equations in sixteen unknowns that can be written using the sixteen nearest neighbors of point \((x,y)\). Observe that Eq. (02) reduces in form to Eq. (01) if the limits of both summations in the former equation are 0 to 1. Generally, bicubic interpolation does a better job of preserving fine detail than its bilinear counterpart. Bicubic interpolation is the standard used in commercial image editing programs, such as Adobe Photoshop and Corel Photo-paint [5].

D. Pixel-centered Patch Matching

Pixel centered patch matching is again one of the way to find missing pixel, neighboring pixels within a patch centered by the current missing pixel can be used as the reference to find texture-relevant LR pixels. Most of the time natural images have an exponentially decaying power spectrum; the aliasing effect is more prominent in high frequency areas as compare to low frequency areas. Most image pixels in low-frequency areas can be interpolated well through initial bicubic interpolation [2]. By considering proper patch size the unwanted artifacts can get removed in low frequency area.

E. Iterative Multiscale Interpolation

It is always preferred to have large patch sizes so that more coverage will be there to find texture relevant LR pixels. On the other hand, smooth textures in an image require smaller patch sizes to avoid edge sharpening [7]. However, it is difficult to determine the suitable patch size from the observed LR image with aliasing. Hence, an iterative multi-scale interpolation procedure is used to integrate advantages from both the large- and small-scale patch matching.

IV. System Architecture

The whole process of the proposed method is described in Fig. 3. Low resolution image will be the input which we want to resize without artifacts. Initial bicubic interpolation has been done. More specifically, in the first iteration, bicubic interpolation is used as the input. Then, the semi-local interpolation is executed with maximum patch size to overcome the aliasing artifacts. In the second iteration, map estimation has been carried out and anti-aliased image is given as a output. In this procedure, the semi-local interpolation is done from large to small patch sizes iteratively. The output of first iteration has been given as input to the next each interpolated semi-local masked patch centered by LR pixel is compared with missing pixel centered masked patch. Most relevant LR pixel is continued and unwanted is filtered out. MAP estimation has given high resolution image. Experimental results for bicubic is more superior than nearest neighbor interpolation.

V. Result & Conclusion

The experiment has been carried out using different interpolation method. The results are shown in fig. 4. The PSNR values have been compared for different method and different images. It has been proved that bicubic interpolation gives much superior results.
Fig. 4 (a) Original Image, (b) Initial Bicubic Interpolated Image, (c) Identification of Aliased Areas, (d) Anti-aliased Image

References
using multiple dictionaries and bicubic interpolation,”
23rd Signal Processing and Communications Applications

neural network for better reconstruction quality,” 2016
International Conference on Communication and Signal
Processing (ICCSSP), MELMARUVATHUR, pp. 0710-0714,
2016.

for video/image interpolation,” 2016 International Conference
on Communication and Signal Processing (ICCSSP),

interpolation methods for improving sub-image content-based
retrieval,” 2016 3rd International Conference on Computing
for Sustainable Global Development (INDIACOM), New

[6] S. Sonnad,”A survey on fusion of multispectral and
panchromatic images for high spatial and spectral information,”
2016 International Conference on Wireless Communications,
Signal Processing and Networking (WiSPNET), CHENNAI,
pp. 177-180, 2016.

resolution iris recognition via Eigen-patch super-resolution
and matcher fusion,” IEEE 8th International Conference
on Biometrics Theory, Applications and Systems (BTAS),
Niagara Falls, NY, USA, pp. 1-8, 2016.

with guided back-projection and LoG sharpening,” 18th
Mediterranean Electrotechnical Conference (MELECON),
LEMESOS, pp. 1-6, 2016.

scaling using DWT and bicubic interpolation,” International
Conference on Green Computing Communication and
Electrical Engineering (ICGCCEE), COIMBATORE, pp. 1-5,
2014.

[10] X. Kang, S. Li, J. Hu,”Fusing soft-decision-adaptive and
bicubic methods for image interpolation,” Proceedings of
the 21st International Conference on Pattern Recognition

Interpolation With Antialiasing,” In IEEE Transactions on

”Multiscale local multiple orientation estimation using
mathematical morphology and B-spline interpolation,” 7th
International Symposium on Image and Signal Processing
and Analysis (ISPA), Dubrovnik, pp. 575-578, 2011.

[13] Z. Dengwen,”An edge-directed bicubic interpolation
algorithm,” 3rd International Congress on Image and Signal

Algorithm Based on the ICM and the Bicubic Interpolation,”
International Symposium on Intelligent Information
Technology Application Workshops, Shanghai, pp. 817-820,
2008.