# Image Interpolation Technique and Issues: A Review

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*Abstract*— In computer graphics, image interpolation is the process of resizing a digital image. Interpolation is a non-trivial process that involves enhancement in sense of efficiency, smoothness and sharpness. With bitmap graphics, as the size of an image is enlarged, the pixels that form the image become increasingly visible, making the image appear "soft" if pixels are averaged, or jagged if not. Image interpolation methods however, often suffer from high computational costs and unnatural texture interpolation. This work intends to give an overview of image Interpolation, its uses & techniques. The paper work is an implementation of Image interpolation of images.

***Key words:*** CUDA (Compute Unified Device), PAR (Pixel Accept Ratio), PEE (Percentage Edge Error), Peak Signal-To-Noise Ratio (PSNR), NN (Nearest Nabors)

## I. INTRODUCTION

Image interpolation refers to constructing a high-resolution (HR) image from a low-resolution (LR) image. In the mathematical field of numerical analysis, interpolation is a method of constructing new data points within the range of a discrete set of known data points.
In engineering and science, one often has a number of data points, obtained by sampling or experimentation, which represent the values of a function for a limited number of values of the independent variable. It is often required to interpolate (i.e. estimate) the value of that function for an intermediate value of the independent variable. This may be achieved by curve fitting or regression analysis.

Digital Image is a discrete representation of its continuous counterpart perceived through our eyes, a camera or any such devices. Its representation and processing in computer requires storing it in digital format. Sampling the image for computer storage often degrades its visual representation in a variety of display units. So the image needs further processing to suit our demands. Image interpolation is one such image processing task to find the values of the pixels of the image which are not originally present in the image. It finds application in medical image processing like X-ray imaging, representation of multimedia content in web, satellite images processing for weather forecasting, industrial inspection for defective manufactured parts which requires image resizing, high resolution. In this technological endeavour several interpolation techniques have been developed ranging from very simple to highly complex techniques. Image interpolation becomes the pre-processing step for other image processing tasks like image registrations, image rotation. Image registration needs interpolation to accurately register the image at sub-pixel level.

Regression analysis is a set of statistical processes for estimating the relationships among variables. It includes many techniques for modeling and analyzing several variables, when the focus is on the relationship between a dependent variable and one or more independent variables (or 'predictors'). More specifically, regression analysis helps one understand how the typical value of the dependent variable (or 'criterion variable') changes when any one of the independent variables is varied, while the other independent variables are held fixed.

Many image interpolation techniques are already been developed and designed we are proposing a new method is been used for edge-adaptive image interpolation which uses Newton forward difference. This difference provides very good grouping of pixels ones we consider target pixel for interpolation Proposed approach estimates the enlarged image from the original image based on an observation model. The estimated image is constrained to have many edge-directed smooth pixels which are measured by using the edge-directed smoothness filter. Simulation results for the work will can get by MATLAB and expecting that for the proposal method it will produces images with higher visual quality, higher PSNRs and faster computational times than the conventional methods.

Nearest Neighbour method for image interpolation: This is the simplest form of interpolation, where the interpolated pixel value determined by nearest neighbour in the proximity. Simplicity of calculation is the reason for its cheap computational cost. This interpolation also called pixel replication bilinear method for image interpolation: As the name suggests, it is linear interpolation in two directions, first in horizontal direction then by a vertical direction or vice-versa. Bilinear interpolation uses weighted average of the 4 neighbourhood pixels to calculate its final interpolated pixel. Bilinear interpolation performs better than NN as reduction of the stair-case effect makes the image looks smother. However, blurring effect is occurred by averaging the surround pixels. Since the pass-band is attenuated moderately, it causes smoothing of image. Interpolation kernel for linear interpolation samples the input with the following kernel.

Interpolation techniques are mainly divided in two categories:

1) Non-adaptive techniques
2) Adaptive techniques

Non-adaptive interpolation techniques are based on direct manipulation on pixels instead of considering any statistical feature or content of an image. These are kernel based interpolation techniques where unknown pixel values are found by convolving with kernel. Hence they follow the same pattern of calculation for all pixels. Moreover most of them are easy to perform and have less calculation cost. Various non-adaptive techniques are nearest neighbor, bilinear, bicubic, etc.

Adaptive techniques consider image feature like intensity value, edge information, texture, etc. Non-adaptive interpolation techniques have problems of blurring edges or artifacts around edges and only store the low frequency components of original image. For better visual quality, image must have to preserve high frequency components and this task can be possible with adaptive interpolation techniques. Various adaptive techniques exist for image interpolation NEDI, DDT, ICBI, etc.

 

## II. LITERATURE REVIEW

Image interpolation refers to constructing a high-resolution (HR) image from a low-resolution (LR) image. Traditionally, an HR image can be produced from an observed LR image via the polynomial-based interpolation (bi-linear or bi-cubic interpolations, involving a small number of neighbors around each interpolated position) the advanced interpolation makes use of the so-called "geometric similarity" to design a set of optimal interpolation weighting coefficients. However, better geometric similarities can perhaps be found from a non-local area within the LR source image or even from other but similar images (possibly with higher resolutions).

Jiaji Wu et al [1] Image interpolation, which is based on an autoregressive model, has achieved significant improvements compared with the traditional algorithm with respect to image reconstruction, they use diverse CUDA optimization strategies to make full use of the GPU (NVIDIA Tesla K80), including a shared memory and register and multi-GPU optimization. To be more suitable for GPU parallel optimization, we modify the training window to obtain a more concise matrix operation, Image interpolation based on autoregressive models has achieved significant improvement in visual quality. Tudor Barbu et al [2] their proposed technique uses a nonlinear second order hyperbolic partial differential equation (PDE) - based model that is based on a properly constructed edge-stopping function and an image mask corresponding to the inpainting zone. The hyperbolic model is then discretized using a consistent explicit finite difference-based numerical approximation scheme. Shuyuan Zhu et al [3] a non-local geometric similarity based interpolation scheme to construct HR images. In our proposed method, optimal weighting coefficients are determined by solving a regularized least squares problem which is built upon a number of dual reference patches drawn from the observed LR image and regularized by the variation of directional gradients of the image patch. Dimitris N. Varsamis et al [4] recursive algorithms for the computation of the Newton interpolation polynomial of a given two-variable function. The special case where the interpolation polynomial has known upper bounds on the degree of each indeterminate is studied and applied to the computation of the inverse of a two-variable polynomial matrix.

| Author | Journal | Work | Outcome |
|---|---|---|---|
| Jiaji Wu eat al [1] | IEEE Transactions 2017 | Image Autoregressive Interpolation Model using GPU-Parallel Optimization | PSNR for Image of Lena observe is 32.96 db |
| Tudor Barbu et al [2] | IEEE 2017 | Structural Image Interpolation using a Nonlinear Second-order Hyperbolic PDE-based Model | PSNR for peppers image observe is 31.27 db |
| Sheng Hsien Hsieh et al [6] | IEEE 2015 | Adaptive Image interpolation using Nural network | PSNR is 25.27 db |

Table 1: Literature Work Analysis

The interpolation is a method for enhancing image resolution means enhancing pixel data, here need to guess new value between available pixels problem is that guessing what should be value for new pixel which will be produce a smooth and sharp highly resolute image. available procedure for image interpolation are good enough however only problem is that this methods are using linear interpolation means pixels that they develops between two pixels is computed as per mean value between two continuous pixels.

[1] Has used modified bicubic Interpolation with their own 16 pixel formula they named it BHI (bivariate Hermite interpolating) by using their procedure they achieve better results than available standard methods i.e. bicubic, linear and Nearest neighbour, their procedure was best in interpolation however consume many for computational time which make procedure slow and hence was not suitable in order to real time application. [1] Conclude that if adaptive parameter h that controls the decay of the exponential weights according to local image statistics. In addition, they also could reduce the computational burden by optimizing the whole process further, particularly the available speed-up methods for computing nonlocal weights. Their procedure ware significant but depends on the selection parameter and PSNR that they obtained can be further enhanced.

## III. CONCLUSION

As interpolation is the technique which is used for improving and modification of image, video or any other data, so many interpolation techniques are been developed in the area, basically interpolation was the application of signal processing now it has versatile uses. One can conclude that after implementation of our defined approach of interpolation we will have very good and better quality of image as desired modification in it. One can also conclude that the time taken for the process will not be higher than existing work and proposed work will have better SNR and MSE then existing work.

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