



REVIEW ARTICLE

A Review on Video Enhancement Using Contourlet Transform and Bilateral Filter

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Abstract

Resolution and contrast are the two important attributes of an image. In this paper we developed a method to enhance the quality of the given image. The enhancement is done both with respect to resolution and contrast. The proposed technique uses CT(Contourlet Transform) and Bicubic Interpolation also we had used Bilateral filter for denoising. To increase the resolution of test image, the proposed method uses Contourlet Transform decompose the given image into Multiple sub-bands, out of which one is of low frequency and the rest are of high frequency. The Low freq components and H freq components are interpolated using Bicubic technique. Then find the difference image using interpolated LF and input image and add that difference image with all modified HF sub bands. We use Inverse Contourlet Transform to combine the interpolated high frequency and low frequency components. To increase the contrast, we use adaptive filter. The experimental results show that proposed technique gives good results over conventional methods.

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INTRODUCTION

Video enhancement problem can be formulated as follows: given an input low quality video and the output high quality video for specific applications. How can we make video more clearer or subjectively better? Digital video has become an integral part of everyday life. It is well-known that video enhancement as an active topic in computer vision has received much attention in recent years. As the use of large displays is increasing, the demand for higher quality videos is growing fast in consumer market. New devices have been implemented to capture images and videos with much finer details. To this end more powerful optics and complex image stabilization mechanisms are required. Although many improvements have been made over the capturing devices and cameras, further enhancements are subjected to hardware complexity and restrictions.

In many applications including cell phone and webcam the imaging sensors capture low resolution images due to low cost sensors or physical limitation of the hardware and then a software alternative improves the quality of the captured frames. There are techniques to increase the resolution in an offline manner after that the image or video has been captured. Super-resolution (SR) is among techniques to improve the quality of the images received by the users of consumer applications such as video streaming on the Internet, cell phone devices and video conferencing. Super Resolution makes a high resolution frame out of one or a set of Low Resolution (LR) frames. In fact in low resolution images the high frequency components are missed and SR tries to estimate those missing frequencies in a way that the difference between the original image and the reconstructed SR is minimum [1].

There are different methods to generate HR images from the LR ones. Some methods used the reconstruction based approaches and some others use the learning algorithms. Reconstruction based approaches use the information in separate frames for solving the problem of SR. In fact these methods use the independent

information in different frames and fuse them to make one HR image. Projection onto Convex Sets (POCS) [2] and Iterative Back-Projection [3] Methods are among the famous SR+ methods in literature. Learning based approaches use a specific image sequence set to learn their characteristics and use those known characteristics as extra information to reconstruct the HR image. Recently there are some new methods introduced which only use a single LR image for finding the HR image. This is an ill-posed problem and more conditions should be considered to solve the problem.

Image interpolation is a solution for generating a HR image from the associated LR capture. It is currently used in consumer applications such as medical imaging and up conversion of standard definition video frames. Some algorithms like bilinear and bicubic are easy and fast in implementation but they fail to capture the varying pixel structure around edges, as a result the picture would be blurred and with ringing artifacts around edges [4]. With the increasing demand for higher resolution images more powerful methods for interpolation were proposed to preserve edge sharpness and produce images with fewer artifacts. An edge directed interpolation was presented by Li and Orchard where the authors estimate the covariance of the HR image from the variance of the LR image [5]. Zhang *et al* proposed a method in which a missing pixel was interpolated in multiple directions and the results were fused by minimum mean square-error estimation [6]. An up scaling approach for resizing images in the DCT transform domain was proposed by Park *et al* [7]. The paper uses the property that the multiplication in spatial domain corresponds to the symmetric convolution in DCT domain. Sen *et al* use the sparsity of an image in the wavelet domain and Compressive Sensing (CS) theory to interpolate the HR image [8]. The sparse mixing estimator method [9] proposed a new class of adaptive estimators acquired by mixing a family of linear inverse estimators which are derived from different priors on the signal regularity. Yang *et al* use local gradient features to propose an interpolation method which preserves edge sharpness [10].

A contourlet method was proposed by Jiji *et al* which uses learning concepts [11]. Mueller *et al* used wavelet and contourlet transform and a simple thresholding step to find the largest contourlet coefficients and reconstruct the HR image [12]. A generalization of image interpolation is image sequence interpolation which is referred as video resolution enhancement. In video resolution enhancement a sequence of HR frames for a given video stream is produced in a manner that is visually pleasing and artifact-free. Video resolution enhancement can be divided in two groups according to the type of information used. The first group of algorithms which is called spatial methods, only uses the information available in the current frame and is basically single image super resolution applied to each frame. The second group incorporates the information available from neighboring frames to increase the quality and is referred to as spatiotemporal methods. Takeda *et al* introduced a method based on multidimensional kernel regression, where each pixel in the video sequence is approximated with a 3-D local (Taylor) series, capturing the essential local behavior of its spatiotemporal neighborhood [13]. Also in MASK paper [14] a 3-D steering kernel regression approach has been proposed which is based on motion assisted steering kernel (MASK).

The paper suggests an algorithm for multi-frame video interpolation and denoising. Zhang *et al* propose a robust video super-resolution method [15] considering temporal information reliability with registration efficiency model following by a spatial-temporal steering kernel. Method proposed by Takeda *et al* [16] is a novel framework for adaptive enhancement and spatiotemporal up scaling of videos which contain complex activities without the explicit need for motion estimation. Wu *et al* proposed a new hybrid DCT-Wiener based interpolation [17]; where the authors take advantage of interpolation in both spatial and DCT domain and fuses this two approaches to design an improved up sampling method. An implementation of a super resolution algorithm for video sequences based on a Digital Signal Processor (DSP) is proposed by Lopez *et al* [18], where the method is used for real time consumer applications. A number of fast block matching algorithms are compared by Callico *et al* [19], to select the one which presents the best tradeoff between the computational load and video quality. In this work first an interpolation algorithm is proposed in the contourlet domain and by incorporating the paradigm of Compressive Sensing (CS). The main contributions here are: 1) The problem of interpolation is posed in the CS frame work 2) The sequence is considered to be sparse in the transform domain which in this work is contourlet domain. In the second step a 3-D filter is applied to the estimated HR frames to increase the quality of the reconstructed image. The proposed technique is used as software based method to increase the quality of images in consumer applications that need streaming high quality videos.

Proposed Method

The proposed system has mainly five modules: Bilateral filter, Contourlet Transform (CT), Bicubic Interpolation, Adaptive filter and parameter analysis. Preprocessing is done by Bilateral filter. Contourlet Transform is used to find

the low and high frequency components of the image. Then we will use Bicubic interpolation to increase the resolution and adaptive filter is used to increase the contrast of the image

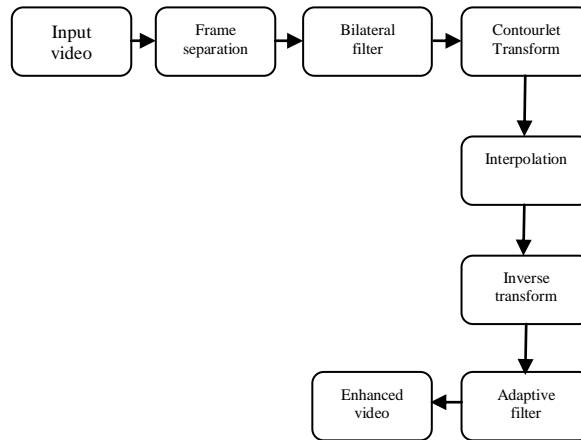


Fig.1 Block diagram of proposed method

Bilateral Filter

The bilateral filter maintains edges by performing a Gaussian convolution but attenuates the contributions of pixels by how different their intensities are from the intensity at the center of the kernel. In Preprocessing of the proposed system the following steps namely Gray scale conversion, Noise removal is involved. In computing, a gray scale digital image has the value of each pixel is a single sample, it carries only intensity information. This sorted images, also known as black-and-white, are composed specially of shades of gray, varying from weakest intensity to strongest i. e. from black to white . Gray scale images are observed from one-bit bi-tonal black and white images with only the two colors i.e. black and Gray scale images have different shades of gray in between.

Contourlet Transform (Ct)

In our proposed work we will implement segmentation algorithm using kernel weighted fuzzy clustering. This can be applied to wide range of problems like feature analysis , clustering and classifier design and therefore it is also called as unsupervised clustering algorithm. It follows a set of procedure. Finally, the final clustering result can be obtained by processing the pixels on edges. This method is normally used for pattern.

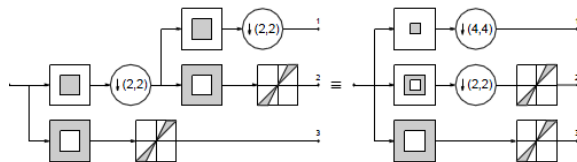


Fig. 2. Block diagram of the contourlet transform with two levels of multiscale decomposition. Gray regions represent the ideal passband support of the component filters. Left: The iterated form. Right: The equivalent parallel form.

Bicubic Interpolation

Bicubic interpolation is an extension of cubic interpolation for interpolating data points on a two dimensional regular grid. The interpolated surface is smoother than corresponding surfaces obtained by bilinear interpolation or nearest-neighbor interpolation. Bicubic interpolation can be accomplished using either Lagrange polynomials, cubic splines, or cubic convolution algorithm.



Fig 3. (a) Implementation of Bicubic Convolution Interpolation, and (b) Output of Bicubic Convolution Interpolation.

Adaptive Filter

The adaptive filter method consists of three important parts:

(a)luminance image and background image, (b)adaptive adjustment, (c) color restoration.

Firstly, Using color space conversion we will obtain the luminance image and background image, and afterwards adaptively managing the luminance image. The intensity limits can identify at one time is minimum, so the High Dynamic Range image is compressed. Contrast enhancement can modify important visual details so that we can get an image with better visibility.

Conclusion

This paper provides the enhancement approach for the videos. We will be using the method of contourlet transform and adaptive filters technique based on that video enhancement. Two-dimensional wavelets, with tensor-product basis functions lack directionality, and are only good at catching point discontinuities, but do not capture the geometrical smoothness of the contours. Contourlets were developed as an improvement over wavelets in terms of this inefficiency. The primary goal of the contourlet construction was to obtain a sparse expansion for typical images that are piecewise smooth away from smooth contours. Adaptive filter uses local information to guarantee noise insensitiveness, but it often produces boundary zones due to the mix pixels near the edges of different regions.

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