



# “Super Resolution By Using Gradient Profile Sharpness” (Survey Paper)

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## Abstract

To generate high resolution image from a low resolution input image single image super resolution is used. Single image super resolution is used to enhance the quality of image. In this paper there is a image super resolution algorithm is proposed which is based on GPS Gradient Profile Sharpness. Extract GPS from two gradient profile description models. GPS contain two model one is triangle model and second is mixed Gaussian model. Finally the HR(High Resolution)image is generated which has better visual Quality, lower resolution error. The aim of single image super resolution is to construct a high resolution image from LR(low resolution)image input. transformation gradient profiles to generate the target gradient field in HR image.

**Keywords:** Super Resolution, Gradient profile, Triangle model ,Gaussian Mixture Model.

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## 1. Introduction

The main aim is the generation of high resolution image from low resolution image .Image super resolution process is widely used in some application. This application may be the image display, remote sensing and satellite imaging[1]. sometime take only one input image called as single image super resolution. In some of the Cases Multiple input image may be considered The goal of conversion from low resolution image i.e blurred image to better quality image. Denoising and deblurring are the applications of image processing[6]. when we construct high resolution image from low resolution image there is one challenge that is the quality of edge should be maintain. super resolution is the technique of enhancement of image resolution. The pixel density within the image is high that is the meaning of high resolution[4]. To recover a high resolution image by using one or more low resolution input images is the aim of super resolution methods[9]. In this field previous work in this field are classified into three category. first is the Interpolation based approach ,second is the Learning based approach and third is the reconstruction based approach. The main aim of image



interpolation approach is to reconstruct the edge of the original image. Interpolation is used to solve high dimension of set of equation.[1]. Interpolation method is used to calculate the value of function at position between its sample it reduce the signal bandwidth by using low pass filter to the digital signal .in image processing it is one of the fundamental operation[2]. Nearest neighbor, linear and spline interpolating techniques are the most commonly used methods. polynomial and language interpolation methods are less commonly used methods. The fundamental operations in image processing is the process of interpolation. The quality of image is mostly depend on the used interpolation technique[2]. In interpolation process the information of edge direction is very important[3].The interpolation direction is equal to the edge with the another edge. By using sequence of images to perform the interpolation super resolution interpolation can be improved[5]. In learning based approach we take low resolution image which is not clear by using this approach we compare this image to that image which is already stored in dictionary. The content which are lost in low resolution image are retrieve from that dictionary[1]. In Learning method with the help of training data set that predicate high frequency detail lost in LR image. learning method classified into 3 category.[8]

1)Nearest Neighbour Embedding Based SR method

2)Sparse Representation Based SR method

3)Regression Based SR method

In Reconstruction method it require different patches from images then it resize the SR output. super resolution is the process of converting LR image into HR image[10] . Reconstruction based SR algorithm that will require the patches of image from one or more images when synthesizing the SR output[10]. statistical prediction model can be useful for single image super resolution. The model used to avoid any invariance assumption. This model to further enhance performance that suggest data clustering. Image super resolution are technique aiming at resolution improvement of images acquitting by low resolution sensors, minimizing visual effects. Recently several attempts have been made beyond the invariance assumption aiming at improving the stability of recovery. The statistical model and the basic single image SR scheme: The main motivation of this model to suggest the desire predict for each LR patch .The missing high resolution detail This is mainly for two reasons first is the aims at characterizing signal of different quality, so it use fewer atoms for the lower quality contend. second is Use for avoiding high complexity sparse coding computation. In this paper GPS is used to maintain gradient magnitude and spatial scattering of gradient profile then two models that is triangle model and Gaussian mixture model is proposed. Profile shape and profile gradient magnitude is maintained based on gradient profile transformation. Finally HR image is generated from transformed gradient profile. That image added as a image prior in HR reconstruction image

## 2. Related Work

Gradient profile is for describing the shape and sharpness of image when we convert low resolution image into high resolution image the gradient profile is used for edge sharpness[12]. gradient profile prior are used for improving the low resolution of image[6].For interpolation of the image the several information on the sparsity of image has also useful[5].Reconstruct a high resolution image by using low resolution image is the aim of image interpolation[3].for recovering sharp edges of low resolution image the image super resolution will be use. when we convert the image from low resolution to high resolution it will be useful in many application such as medical image diagnosis, computer vision, satellite imaging and also in entertainment. Because of the imaging environment and the expensive imaging equipment when we capture the HR image by using CCD and CMOS it is difficult to getting an image at the desired resolution level. so because of this many super resolution methods are developed[8]. Low resolution image is the down sampled and blurred version of original HR image . To improve the resolution of given image SR technique are used[11].There are two types of edges first is roof edge and ridge edge[14].



### 3. Methods

When we are generating HR image it is very important to preserve the constraint of edge preservation in interpolation algorithm.so for that purpose use gradient profile sharpness. To understand better description of gradient profile two models are proposed first is Triangle model and second is mixed Gaussian model. triangle model is with short length and the mixed Gaussian model having heavy tails. This two models are describe the gradient profile with both symmetric as well as asymmetric shapes.

#### 3.1 Triangle Model:

The Triangle model is useful for profile description. The triangle model having two sides that are fitted separately using the extracted gradient profile points of each side[1].

$$mT(x) = \begin{cases} kdx + h & \text{if the value } \geq 0 \\ 0 & \text{otherwise} \end{cases} \dots\dots\dots(1)$$

In equation (1) mT(x):is the gradient magnitude of pixel x.

dx:is the distance between the pixel x and profile peak x0.

K and h:are the slope intercept parameter of the linear function.

Triangle model is most suitable for the profile description in the kind of gradient profile. triangle model and gaussian mixed model are proposed to realize gradient profile. triangle model and gaussian mixed model are proposed to describe different profile shapes. triangle model is proposed for short gradient profile and mixed gaussian model for heavy tailed gradient profile .

#### 3.2 Gaussian Mixture Model:

It is a combination of two Gaussian model. when edge are clear and profile shapes is difficult.in that condition mixed Gaussian model is used. Gaussian mixed model has better performance when gradient profile are symmetric. when there is large threshold set on gradient profile length which is described by mixed Gaussian model. mixed gaussian model used to describe gradient profile when gradient profile length is set[1].

#### 3.3 Gradient Profile Sharpness:

Gradient profile is used for edge smoothness. The work which is done previously on single image super resolution can be divided into three categories first is interpolation based second is learning based and third is reconstruction based. interpolation is fast and easy but blur high frequency details. Edge sharpness is the important factor of image quality. Gradient field is used for reduce the effects of noise while the edge will be enhanced[13]. when we are generating HR image it is very important to preserve the constraint of edge preservation in interpolation algorithm.so for that purpose use gradient profile sharpness. Triangle model and Gaussian Mixed Model contain two feature first is there height h and second is spatial scattering d based on

two gradient profile description model metric of gradient profile sharpness is defined. there for which is the ratio of height to spatial scattering[1].

$$n=h/d$$

h=height represent the edge constraint which is the magnitude of gradient profile

d=spatial scattering represent edge of spatial spread.

The edge contrast and edge spatial scattering this two point are GPS take into consideration .the example of edge contrast is human perception of edge sharpness. edge sharpness are well defined in GPS. Gradient profile is the advantage that describes spatial layouts of edge gradient .triangle model and mixed gaussian model are used to specify gradient profile. By modeling edge gradient profiles solve the image super resolution problem.

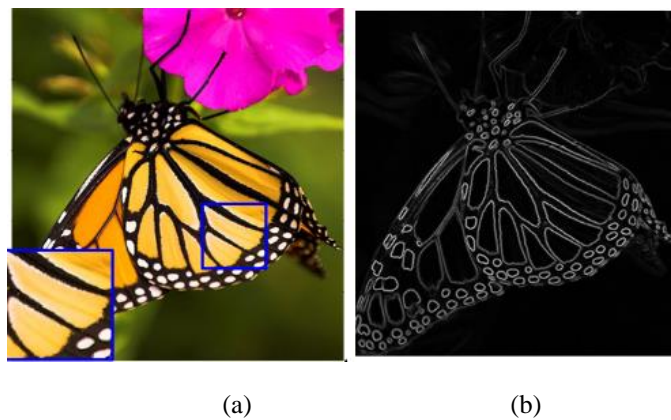


Figure1.edge sharpness using GPS

The original image is (a) and (b) is the edge sharpness image obtained from GPS. sharp edge and smooth edge can be separate easily in image (b).

### 3.4 Gradient Profile Prior:

Gradient Profile Prior can be used to propose image super resolution approach in which shape and sharpness of image is described Gradient profile prior is used for gradient field of natural image. on the basis of more prior information on the signal properties the sparse super resolution algorithm can be enhanced[5].To achieve the better reconstruction quality the patch based approach are basically work with maximally overlapping patches[6].Two widely used priors are generic smoothness prior and edge smoothness prior. Able to provide a constraint on the gradient field of the HR image by using the learned gradient profile prior and relationship. The recovery of high quality HR image by adding the constraint of reconstruction. For image upsampling there are also contain edge statistics. For super resolution, denoising and also for deblurring the sparseness prior can be successfully applied[12].How to apply effective prior or constraint on HR image is the important issue for designing a better super resolution[13].

advantages

- 1)small scale and large scale detail can be recovered in HR image because gradient profile prior is not smoothness constraint
- 2)ringing fact can be avoided[12].



### 3.5 Gradient Profile Transformation(GPT):

Using gradient profile prior they can approximate HR gradient field by transforming LR gradient field this is done on the basis of gradient profile transformation[12]. In this Section two models for GPT is proposed first is Gradient Profile Transformation for triangle model and second is Gradient Profile Transformation for Gaussian mixture model. Three main features are used to preserve the energy and shape of original Gradient Profile during Gradient Profile Transformation

- 1)The sum of profiles gradient magnitude remains unchanged
- 2) Gradient Profile Transformation keeps its peak position remains unchanged to avoid edge shifting
- 3)The shape of Gradient Profile Transformation remains same or unchanged with its original Gradient Profile

a)Gradient Profile Transformation for triangle model:

The GPT between two triangle model is simplified or easy because it's shape is fixed.

b)Gradient profile transformation for Gaussian mixture model:

The GPT between Gaussian mixture model is complicated because it's shape is not fixed.

## 4. Conclusion

Gradient profile sharpness is developed using single image super resolution. Then GPS transformation relationship is studied based on GPS transformation two model are proposed that models keep profile magnitude and profile shape during the transformation. Finally high resolution image is reconstructed.

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