

# Satellite Image Enhancement Making Use of Improved Wavelet Decomposition and Bicubic Interpolation

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**Abstract:** Satellite Images (SI) enjoy a important function in several civilian and military apps for weather foretelling of, monitoring of options through the earth, environments studies, observing organic and natural disasters and organic and natural calamities, etc. When these SI usually are employed in armed service programs many just about all some other apps for effective examine, the best trouble is its top quality. In wavelet adjustments based satellite photo enhancement techniques, choosing a proper wavelet change plays a new important part in addition to vary along together with the image inside order to graphic. To boost the image resolution, a book robust improved wavelet corrosion and the bicubic interpolation-based satellite television image improvement technique is proposed. Within this method, the particular Stochastic Diffusion Research (SDS) algorithm can be used to get the particular optimized wavelet decomposition of the picture into different sub bands and bicubic interpolation can be used to enhance the resolution. Image will be decomposed using the particular optimized wavelet filtration system bank based upon the SDS formula, decomposed sub-bands are usually interpolated with bicubic interpolation and inverse wavelet transform will be applied to create the interpolated sub-bands right into a high-resolution picture. The proposed performance is tested upon satellite images plus other images furthermore. Compared to the particular proposed method along with the current strategies and proved that this proposed method will be better than current strategies and applicable in order to any kind of picture.

**Keywords:** Bicubic interpolation, Discrete Wavelet Transform, Optimized Wavelet Transform, PSNR, UIQI.

## I. INTRODUCTION

Graphic Enhancement (IE) is incredibly vital pre-processing approach in many graphic processing applications just like analysis of health care images to identify the various tumours [1], satellite tv images to review weather monitoring, geoscience, geographical situations, and so forth [2]. Inside almost all individuals applications images have got to be increased to enhance typically the good quality analysis inside the photos. Typically the main aspect in the IE method is usually getting typically the resourceful determination augmentation without troubling generally the advantages and smoothness or getting the most effective measurable (maximum PSNR) and qualitative (best visual) results inside IE procedure.

Naturally the image may be superior regarding resolution [3] [4] to get qualitative and quantitative enlargement [5]. Image resolution Enhancement (RE) enhances the number of px in a image. Interpolation is a extensively used up testing method in LSO ARE, image zooming, graphic resizing, etc. Interruption is a approach to assign a fantastic intensity value to be able to be able to be able to unknown pixels. Typically there are concerning three varieties regarding interpolation strategies usually are widely-used in generally the IE method; individuals are the area neighbour, bilinear besides bicubic interpolation. Regional

neighbour interpolation could be the earliest method besides intensity value linked to the unknown -pixel full by the certain intensity value regarding the particular local neighbouring -pixel. That produces bias and lots of artifacts. So of which it is scarcely ever utilized inside IE methods. Inside bilinear interpolation, typically the unknown -pixel benefit is designated coming from the weighted standard from the several encircling pixels. This system gives better effects in comparison to the nearest neighbour interpolation, but bicubic interpolation gives typically the particular best effects amidst these about three interpolation techniques. Inside Bicubic interpolation, the particular strength associated along with the unfamiliar -pixel is designated through the weighted common from the 16 encircling pixels [5].

RE may become required for the particular spatial domain name plus spectral domain name strategies. Generally within space domain LSO ARE, upward selection or even interruption is used straight on the particular aircraft itself. These kinds of sorts of LSO ARE process will be extremely quick yet produce undesired artifacts in the boundaries, then origins the particular blurring plus ringing artifacts within an image. Within spectral-domain RE procedure, first image will be converted into the particular spectral domain, use the interpolation plus then apply the particular inverse renovate in order to get back the particular improved image in to the 3-D domain. For the image is transformed from spatial domain name to spectral domain name, the image may be separated in to feature constants plus estimate constants. After that interpolation could be used calculation coefficients in order to reservation the fine feature constants.

Wavelet Changes (WT) [6] play an important role in numerous image processing programs to decompose a good image into various frequency sub-bands. Lately, numerous types of wavelet converts are consuming in IE, image compression [7] and other signal and image treating presentations [8]. WT is utilized over Fourier Transform (FT) to get multi determination scrutiny. FT may be used to convert the 1-D signal or 2-D image from the time domain to the frequency domain. But FT does not spread over to non-stationary signals, while WT gives good time determination and good frequency determination for stationary and non-stationary signals and images. Choosing the mother wavelet is the key area of the corrosion stage of photos to putrefy usually the picture into regularity sub-bands and restore the particular image properly simply by conjoining typically the particular sub-bands. Freshly with regard to instance using various WT are in fact suggested by simply the several scientists.

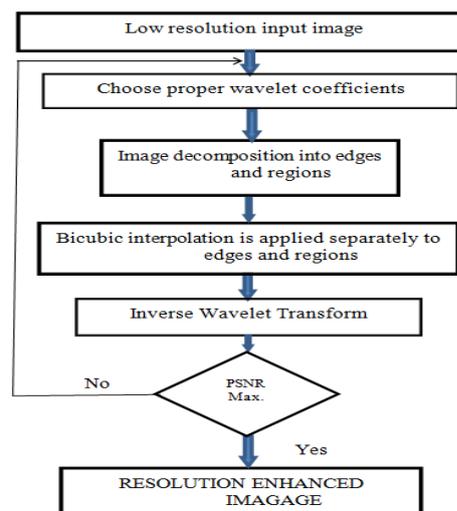
**Hassan Demirel et.** just about all future RE applying Discrete Wavelet Transform (DWT) and bicubic interpolation [9]. In this strategy, image is deconstructed using DWT straight into four various sub-bands explicitly LMOST ALL, LH, HL, plus you do not really need. Where almost all possessing very low-Frequency Elements (FC), LH possessing low FC, HL having higher FC having very high FC. In this post frequency means usually the variant associated with the power linked to the cote by nearby cote passion worth. These sorts of 4 sub-bands usually are usually interposed with usually the bi-cubic interruption in addition in order to then spread over usually the inverse DWT to be capable to recreate the particular graphic. This technique in comparison together with the particular previously present methods with the bicubic interpolation. This DWT dependent method provided much

better consequences when compared with bicubic interruption, because of this associated with edge preservation concerning images by the DWT image decomposition. Because a result associated with down-sampling of DWT initiated many artifacts and distorting bring about DWT centred FOR example procedures. In order to conquer this downside the particular same creators.

**Hassan Demirel ou.** Almost all established for example procedure using Figé Wavelet Convert (SWT) and DWT with each other with bicubic interruption. Credited to shift-invariance associated with SWT boosts the specific visual consequences in addition PSNR than previously existed methods [8]. The usefulness of image enhancement process will depend upon the particular picture decomposition method plus interruption. Therefore selecting a mother wavelet to decay the particular is a large problem and differs utilizing the image in order to picture. To eliminate this particular disadvantage, we suggested a strong quality improvement technique which is frequently placed on any sort of image.

## II. PROPOSEDMETHOD

Enhanced wavelet transform dependent image decomposition along with bicubic interpolation method is proposed to enhance the visual results plus quantitative results and it is demonstrated in figure1



**Fig1. Flow chart for the proposed Method.**

### A. Discrete Wavelet Transform

DWT is a wavelet transform that makes utilization of the wavelet coefficients. A DWT technique imprisons both the frequency and also the location material for an image. The resolution is a critical feature in case of satellite imaging. This has some frequency contents that are both high and low. So, this DWT technique is employed for a resolution for preserving the parts of a high frequency in the satellite images [9]. The method further decomposes an input image into a total of four different sub-band images which are the Low–Low (LL), the Low–High (LH), the High–Low (HL), and the High–High (HH) where all of them are down-sampled images. The bi-cubic interpolation factor two is applied to the images to resize them. The LL sub-band picture with a low-resolution input image will give

you a difference picture which is mixed with the remaining sub-band images which are the LH, the HL and the HH for figuring out 3 other sub-band pictures. The bi-cubic interpolation and also a factor  $\alpha/2$  continue to be applied in order to all the approximated images along with the input pictures of a low-resolution. The Inverse Discrete Wavelet Transform (IDWT) is employed with regard to creating an increased determination of the insight image. The elements of a high frequency are not managed due to the DWT being used for down-sampling a good image [10].

### B. Bicubic Interpolation

Inside the processing of photos, a bi-cubic interpolation is selected over the bilinear interpolation or use the nearest neighbour interpolation at the moment speed is not really a great issue. Contrastingly, typically the bilinear interpolation will take only 4 px (2x2) into thing to consider. The photographs resembled typically the bi-cubic interpolation which often is smoother in addition to have a reduced amount of interpolation contortion [11]. In case of both function standards and products are known at all four corners,  $f$ ,  $f_x$ ,  $f_y$ ,  $f_{xy}$  and the  $(0, 0)$   $(1, 0)$   $(0, 1)$   $(1, 1)$  of a unit square. An interpolated surface is written in (1).

The problem interpolation contains the determination of a total of 16 coefficients  $a_{ij}$ . These will match with function values which are  $p(x, y)$  yielding about four equations (2),

1.  $f(0,0) = P(0,0) = a_{00}$
  2.  $f(1,0) = P(1,0) = a_{00} + a_{10} + a_{20} + a_{30}$
  3.  $f(0,1) = P(0,1) = a_{00} + a_{01} + a_{20} + a_{30}$
  4.  $f(1,1) = P(1,1) = a_{00} +$
- (2)

Benefits: The Bi-cubic interruption is selected more than that of the particular bilinear interruption or even the nearest neighbours in the picture resembling at the particular time speed will be not seen because a problem. This will be because this offers a lesser distortion associated with interpolation.

Disadvantages: This particular has a far more complicated calculation on becoming compared to 2 other methods that have been described. There will be a requirement for a lot more time for the generation of the output on being compared to either the nearest neighbour or bilinear methods.

### C. Stochastic Diffusion Search (SDS)

There may be another new technique that is launched which is known as the SDS. This particular has a dispersed computation mode that makes usage of the relationship between all the particular simple agents given that it is really a worldwide search depending on multi-agent population plus some methods of optimization. The particular root of the particular SDS is dependent on the Geoff Hinton's 3-Ditem classification. Compared to numerous other algorithms, the particular SDS includes a numerical model that is strong and this explains the behaviour associated with a technique discovered in the studying of allotment associated with resources, their global optimal affluence, a condition regarding minimum convergence, thread time complexity in addition to its robustness. [12]. The job provides suggested a wavelet filter bank approach of optimization which includes produced the filtration set which is usually problem-specific using typically the Stochastic Diffusion Lookups (SDSs) that could uncover the predetermined styles and their place. The SDS can

even be useful for the routine searches and likewise the matching. The difficulties may also end up being considered to end up being regarding the optimisation from the objective perform definitions  $F(x)$ , for your hypotheses times with relation to be able to the spots regarding the solutions and there is some similarities between target patterns plus the regions at typically the  $x$  in typically the search spaces in addition to discovering the times so that the  $F(x)$  is at its highest [19]. Normally, the SDS is employed easily to the issues in optimization in which the objective functions can be divided into several units that are evaluated independently (3):

$$F(x) = \sum_{i=1}^n F_i(x) \quad (3)$$

So as to locate the best in the specified aim functions, the SDS makes usage of typically the population in the  $e$  agents that preserve this hypothesis. From the time regarding these operations, a new model entails typically the iterations of typically the ensure that you stages until these kinds of time the affluence is conducted. The SDS algorithm contains typically the following steps:

1. Initializing agents ()
2. While (terminating criterion is not fulfilled)
3. Testing hypothesis
4. Diffusion hypothesis ()
5. Stop

### III. RESULTS AND DISCUSSIONS

Generally, a SDS will be to discover the concentrate on inside the search region or its finest instantiation. Consider the particular examine area dimension be  $And$ . Presume that this chance of locating the specific target inside a uniformly random draw become  $pm$  and let the possibility of locating the suboptimal object be  $pd$ . Allow the possibility associated with a fake good and fake unfavourable be  $p+$  plus  $p-$  respectively. Think about  $M$  brokers. The state of the research within the  $n$ th stage will be measured simply by the particular quantity of energetic brokers directing towards the placement of the particular focus on and energetic brokers directing in order to the particular false advantages. Just active brokers are usually measured because helpful data plus effectively they affect the particular search guidelines of other providers. Likewise the sturdy stopping condition makes use of simply data coming from essential ingredients. Thus right now there is usually finite amount regarding discrete declares inside of which they are all assembled by typically the handful of two normal sums. SDS changes hawaii in a new fresh random method. Generally the achievable upcoming advancement inside the SDS is often likely by simply typically the earlier therefore of which may be displayed by approach regarding a Markov Routine [13].

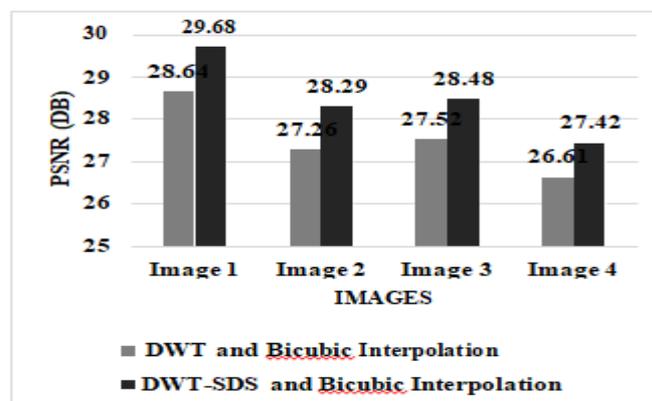
Produce the transition matrix and the situation from your search inside the  $n$ th phase, mentioned as  $X_n$ , be quantified just by a set related to integers  $(a, w)$ , where “ $a$ ” indicates numerous energetic brokers directing in the direction of the concentrate on plus  $w$  -- quantity of essential components directing to usually the false positives. Whenever within the  $n$ th actions a realtor will be lively and factors to have the ability to the particular target it will certainly become sedentary along with probability  $p-$ , otherwise it might remain energetic.

Also an energetic broker directing in order to typically the fake positive remains in order to be inside a energetic together with possibility  $p+$ , more this may be inactive. Subsequent choosing the filtration system rapport which achieve highest PSNR ideals, pictures are decomposed straight into low complete (regions) and higher move (edges) items along with apply the particular bicubic interpolation after that use the inverse wavelet transform in order to write the interpolated sub-bands into higher image resolution picture. The related pictorial results and PSNR results are shown in figures a few &3 respectively.



**Fig 2.(a) ,(b) Gray Scale Low Resolution input Images.(c),(d) DWT & Bicubic interpolation images , (e),(f) are Optimized wavelet decomposition and bicubic interpolation images**

In this section, DWT-SDS and bicubic interpolation method is compared with DWT and bicubic interpolation



**Figure 3 PSNR for DWT-Bicubic and DWT-SDS and Bicubic Interpolation**

**Table1. PSNR values for DWT-Bicubic and Proposed method**

	PSNR in dB	
	DWT-Bicubic	DWT-SDS and Bicubic
Image1	28.64	29.68
Image2	27.26	28.29
Image3	27.52	28.48
Image4	26.61	27.42

Through the figure 3 in addition to table1, it could be observed of which the DWT-SDS in addition to bicubic interpolation provides higher PSNR by simply 3.56% regarding image 1, by simply 3.7% regarding image 2, by simply 3.42% regarding image 3 through 2.99% regarding image 4 in comparison with DWT and bicubic interpolation.

#### IV. CONCLUSION

Enhanced wavelet coefficients plus bicubic interpolation based novel robust Satellite picture resolution enhancement method is proposed. Input picture is separated in to regions and sides to interpolate individually to the areas and edges in order to get rid of blurring impact in edges plus reduce the artifacts by using enhanced low pass plus high pass filtration system coefficients. The precision of this department depends upon the mom wavelet and differs with the picture. Hence, a standard image enhancement technique will not give much better results for all images. But this proposed method selects suitable filter coefficients for any image by the SDS algorithm. The proposed method is tested on several satellite images and also other normal camera captured images. Visual results and PSNR values prove the advantage of the proposed method than existing technique.

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