Reconstruction of Multi Frame Remote Sensing Images Using Super Resolution

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Abstract: In general, we wish to see every particle clearly in any of the image, but by the by some of the situations like atmosphere, sensors and some other conditions we lose at least some data in our original image. This leads to the unsatisfied images. This will be the main drawback in remote sensing images (satellite images). To eradicate this problem, the process which was introduced was Super Resolution. This is very much helpful for analyzing and to get the detailed information the complete image. The process of Super Resolution is to reconstruct the low resolution (LR) image to high resolution (HR) image. In this paper, we reconstruct the three bands low resolution image to single band high resolution satellite image by using this reconstruction super resolution block diagram.

Key words: original image, Low resolution, High resolution, Super Resolution, reconstruction.

I. INTRODUCTION

Mainly, Resolution is the important consideration in the images (satellite images). Resolutions are of the types. The main idea of Super-Resolution (SR) is to construct a Super (higher) resolution image from lower resolution images. High resolution image gives a high and clear pixel density and complete details about the image. The requirement of high resolution image is common in image processing for analysis and further processing of the image.

Super-resolution (SR) method is a best and good output oriented method in digital image processing that aims at producing a detailed and full resolution image from multi frame low resolution (LR) images. Super resolution can be done with the single LR or the multi frame (more than one LR images). Super resolution does not depend on the HR image. We combine only the same scene independent LR images.

Then by taking all the LR images and arranges it in one frame by select one reference point on the reference image, this is called image registration. This will be done based on the two categories they are geometric and photometric. By that we get a single scene registered image. That image is named as a mosaic image for that map estimation is done and the output image is the single super resolution image. This leads to some drawbacks. For this purpose, we proposed a method based upon the multifractal analysis of image. This is described on next section.

However, high resolution images will not be available always in the nature. Processing of the high-resolution image directly from the satellite is expensive and due to the limitations of the sensor it will not produce the HR image. For that process only, these algorithms and methods are introduced and based on the processing, this leads to the concept of super-resolution. This concept leads to the aimed outputs without any investment of physical things in this world, but just depends on the existing LR images.

The algorithm works on the single low-resolution image taken by the satellite. The normal basic super resolution algorithm is based upon the process shown in the below flow chat (figure 1). In that process, we take the LR images of the same scene taken at one place this will be the input of this process

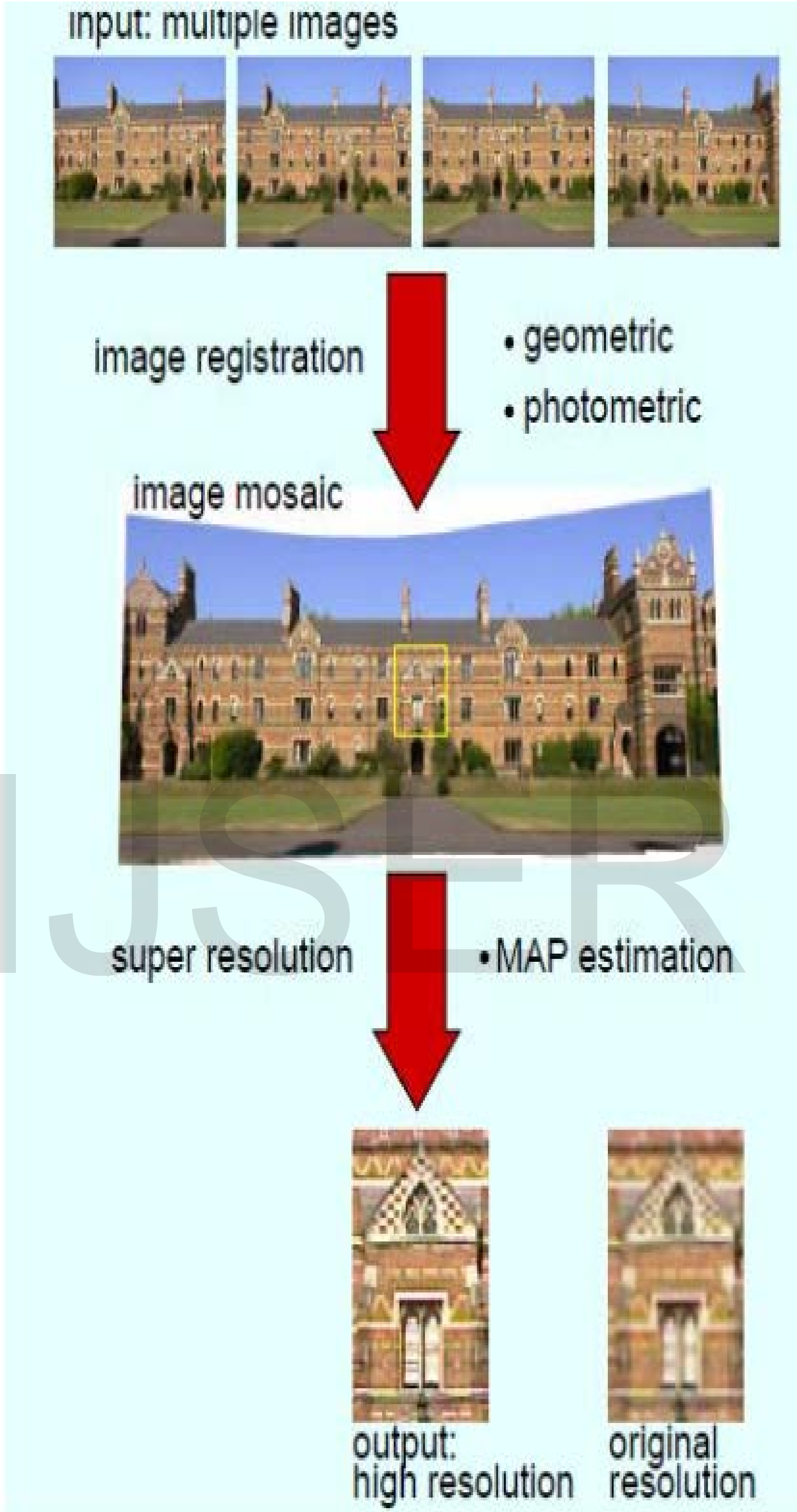


Figure 1: Stages in Super Resolution

II. LITERATURE SURVEY

To transform the sub-pixel shift to an image then it is described efficiently that to register a set of LR images. In that band 1 and band 2 are not aligned correctly then it leads to producing unregistered separate bands. The shift between the two bands varies along the whole image. Therefore, this method is to change the inconsistent shift between the two bands into a constant shift and this shift is used to produce super resolution image with merged spectral information from both band 1 and 2.

- Divide all the input LR image bands into small patches (N block of size M×M)
- Error surface is constructed between the two bands by computing the shift in x, y directions for each block
- Using of joint frequency distribution analysis to determine an optimal x and y shift
- Project one of the input LR bands into an empty grid shifted by delta x, y derived
- High Pass Filtering (HPF) the second (shifted) Egyptsat-1 image band 2
- Decomposing of the LR input band 1 and the HPF of band 2 into their wavelet planes in the steerable wavelet domain
- Convolving their outputs using the normalized convolution technique
- Reconstructing the SR output image using the inverse decomposition process

SRVPLR algorithm core is based on the VPLR. Fruchter and Hook developed an implementation of this algorithm (known as drizzle) for the combination of all the under sampled images (LR images).

Therefore, some variations and additional functions had to be added to the core VPLR algorithm to develop an SRVPLR implementation useful not only for typical astronomical images but also for satellite remotely sensed images. Some of these new added functions are as follows: Automatic co register of the LR images, Interpolation and/or recombination of the LR images onto a HR grid or image, Restoration of the HR or LR images to reduce the noise, blur, and point spread function (PSF) effects.

In the method, a multifractal means similarity characteristic is required to reconstruct an SR image. Then we estimate the additive white Gaussian noise distribution parameter e and the information transfer function s. Finally, a single SR image was regenerated by de noising and downscaling of the low-resolution image. Another flow of the SR image reconstruction is given below:

(a) Parameter estimation which includes the information transfer functions and noise distribution;

(b) Fractal image encoding and image restoration and upscaling of the LR image.

The below block diagram shows the basic process of the de noising of the image, this is based on the fractal coding and Gaussian function.

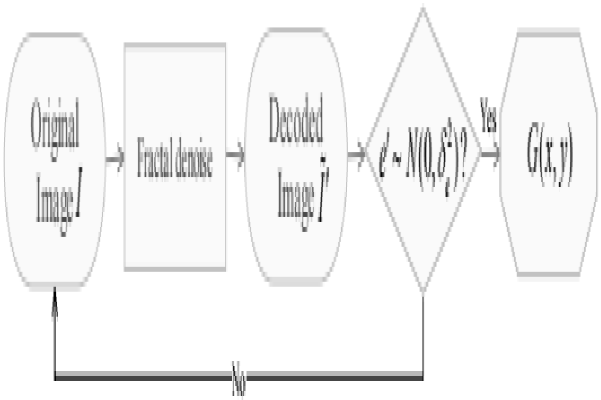


Figure 2: Block diagram of ITF

III. METHODOLGY

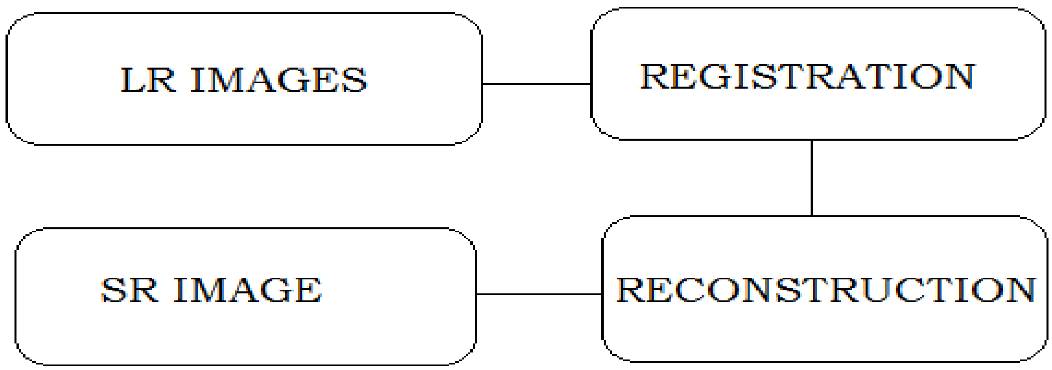


Figure 3: Block diagram of Super-Resolution

The above block diagram is the main process we follow in this paper to generate single super resolution image from multi frame low resolution images, here the process involves three steps:

- Taking Low Resolution images as input
- Registration
- Reconstruction
- SR image

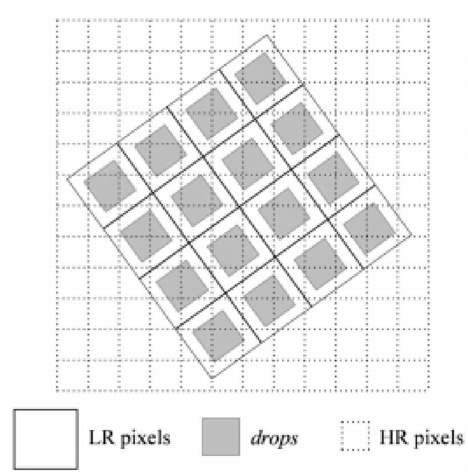
Step 1) Take the input as the image stack (multi frame) of Low Resolution, main purpose of processing the low-resolution image is the improving the resolution for getting the detailed information from the image, making the image qualitative.

Step 2) This is the heart process of this method, that is registration. Registration is the process of combining one or two images by using one reference point from one low resolution image from the we will combine all the images; this process leads to one registered image. In this step we cannot get the super resolution image because this image may have noise, bad enhancement and other unnecessary parameters. So, we proceed to the next step

Step 3) The registered image is not the final image of this super resolution. In this step we reconstruct the image by using different type of filters (Weiner Filter, Gaussian filter, nonlinear filter. etc.). In this we also perform enhancement process for the better result of the image.

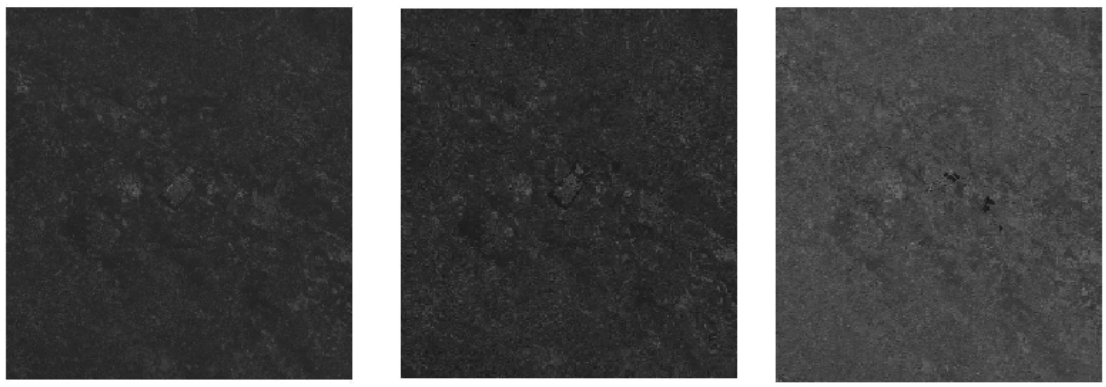
Step 4) This is last step for this process of super resolution, the result is the image with better resolution than the input images (Low Resolution).

By following the above three steps, we can get our desired output that is single Super resolution image from the multiple Low-resolution images. The main important among these is the process of registration and finding the common or reference point of the reference image (one image from the Low-resolution image).

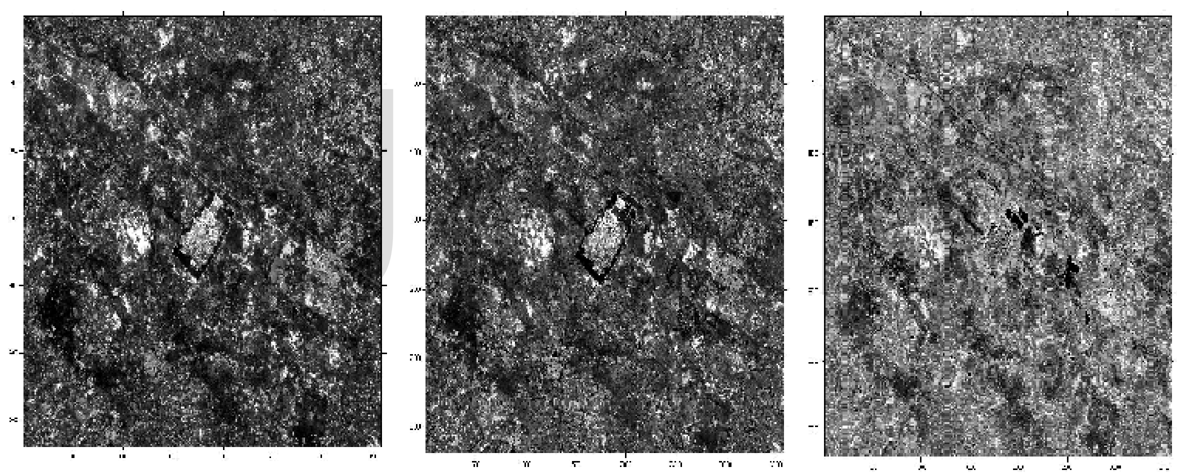


IV. RESULTS

The below images are the input, processed images and the single super resolution image, tables show the parameters of the input (LR) and the output (SR) images.

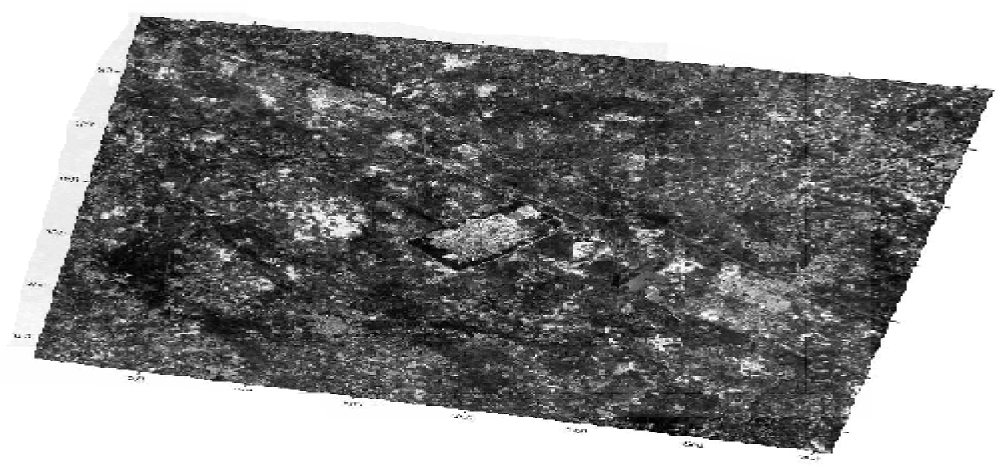


Low Resolution images



Images with enhancement

ISSN 2229-5518



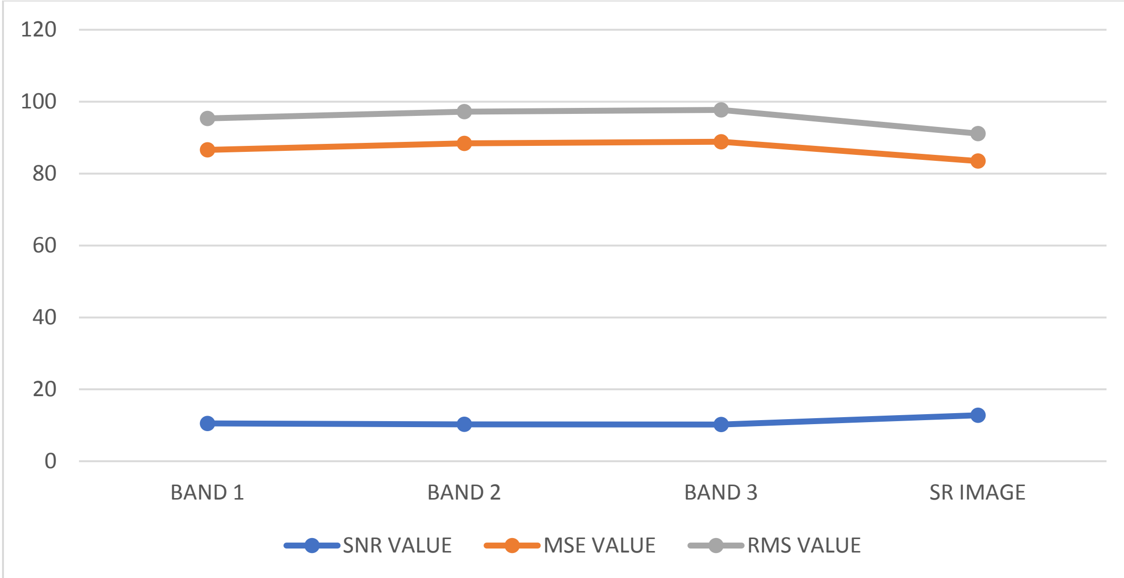
Super Resolution Image

V. TABLULAR FORM OF RESULTS:

The following table shows the values of the input low resolution images and the single super resolution image. The quality of the image can be calculated by the different parameters like signal to noise ratio, mean square error, root mean square, peak signal to noiseratio...etc.,

IMAGE	SNR VALUE	MSE VALUE	RMS VALUE
BAND 1	10.5014	76.11500	8.7244
BAND 2	10.2748	78.1269	8.8389
BAND 3	10.2187	78.6333	8.8675
SR IMAGE	12.7876	70.7170	7.6290

ISSN 2229-5518



The above plot describes the quality improvement between the low-resolution images and the single Super resolution image. By comparing the images with the result values and the plot then we can get the Super resolution image virtually.

VI. CONCLUSION

Exact registration of low resolution images is the most important step and main goal of multi-frame image Super Resolution (SR). In this paper we studied about the reconstruction of the low-resolution image to single super resolution image. The future work is being done is the super resolution video from the low-resolution video.

VII. REFERENCES

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