

Abstract

When the images are captured from primary source such as camera or video devices, sometimes they get the distorted capturing because of some technical, professional or environmental reasons. In such case, there is requirement of image reconstruction so that the image features will be identified effectively. One of such approach to enhance the image by using two or more partially correct images is called image fusion. Fusion is about to combine the good features of multiple images to construct a complete featured image. In this paper, a study of image fusion utility and the approaches available for image fusion are discussed and presented.

Keywords : Image Fusion, Reconstruction, Featured Image, Partially Correct.

Introduction

Image fusion is one of the most effective approaches to reconstruct the information if more than one similar kind of image instances is available for same image. Fusion is the term to combine more than one featured information in such way, the overall reconstructed information will be formed. Image fusion is available at different feature levels based to process on signal and images under different decision vectors. In case of image processing, the fusion is performed at pixel level or area level. The fusion types are shown in figure 1. The pixel level fusion is also called signal level fusion in which the pixels of multiple images present at same position point are analyzed under the information analysis. The fusion is applied on these raw information images to reconstruct the overall effective image. This fusion type actually compares the pixel values under the intensity value analysis. The intensity is here analyzed in terms of brightness, contrast or the color depth values for multiple images[1][2][3]. Once this kind of information is captured, the next work is to apply some decision rule to form the final result image.

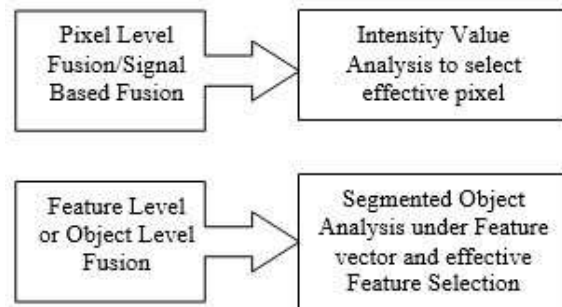


Figure 1 : Types of Image Fusion

Another kind of fusion type is object level fusion or sometimes called feature fusion. This kind of fusion is based on the segmentation approach in which at first the object extraction over the multiple images is performed to identify different objects over the image. Once each individual objects over the image are identified and represented as the image feature, the next work is to fuse the feature objects to construct a valid featured object. The probabilistic or the rule based decision vector is defined to perform the valid feature or object selection over the multiple images[4][5][6].

The pixel level fusion can also be used to enhance the single image by performing the pixel level analysis on different areas over the image. The local feature analysis is performed along with effective decision making to generate the reconstructed image in which the feature values are enhanced. The local feature analysis is effective to

produce the effective result image. This kind of fusion approach is effective also in case of blur image enhancement or noisy image reconstruction [7][8][9]. It is not always possible to generate an effective result image from fusion process. Sometimes, the fusion gives some information loss so that the distorted outcome can be drawn from the fusion process. The loss data over the image can be the reason of contrast loss over the image or the effective information minimization at certain level. This process also affects the illumination level of the image[10][1].

The pixel level performance analysis of image fusion is considered under the evaluation mechanism in which the visual information analysis is performed and the information preservation is analyzed for the image. The fusion process contain the information and reduce the information loss without affecting the performance of the fusion algorithm. The analysis of the fusion process is based on the information loss analysis. The fusion process is affective if it gives the minimum information loss. The analysis parameters for fusion process are MSE (Mean Square Error) analysis, PSNR (Peak Signal to Noise Ratio) analysis, BCR (Bit Correct Ratio) etc[12][13].

A) Challenges

The complexity of the fusion process also increases in case of color images. In such case, the color value analysis is performed in terms of color tone identification in different image pixels or features. It gives the analysis under different vectors so that effective image reconstruction will be performed. Another challenge to the fusion process is the processing on compressed images or different format images. When the pixel level or object level fusion is performed on multiple compression and uncompressed image set. The complexity of the of the fusion process also increases for real time video images. In such images, the time vector based image fusion is required. It means the, features over the multiple images are arranged in order of time vector so that effective pixel level fusion will be performed. More challenging fusion process application is the medical image processing. Medical images requires more attention along with minimum information loss, because of this in such images fusion process requires more analysis. This kind of analysis can be performed based on visibility, contrast and feature level. Once the complete attribute level analysis is done, the next work is to reconstruct the images under these vectors [14][15].

In this paper, an effective image reconstruction approach is suggested based on fusion process on multiple images. In section I, the exploration to the fusion process and the basic types of fusion along with characteristic analysis is defined. In section II, the work defined by earlier researchers is discussed and presented. In section III, some of the effective image fusion approaches are discussed. In section IV, the conclusion obtained from the work is presented.

Existing Work

In this section, the work defined by the earlier researchers is discussed and presented. R. Maruthi[1] has presented a fusion process based on information level analysis for multiple images. Author performed region level analysis over these images for image reconstruction. The analysis parameters considered by the author includes the spatial frequency analysis, visibility analysis. To generate the effective reconstructed image, the fusion process is implemented under the selection mode in which the magnitude values of the pixels are compared and analyzed under the activity measure used for image fusion process. Author presented a work on multi focus fusion process to regain the information loss and reconstruct the effective image over it. Shuo-Li Hsu[2] has presented an intelligent neural network based approach for region based image fusion and to reconstruct the image from it. Author presented the pixel based fusion to replace the pixels so that the effective segmented visual image will be constructed. Author obtained the analysis under the fusion parameters so that the region proof images will be constructed and new fusion image from the work will be obtained. Author presented the region analysis under adaptive capacity and determination so that image reconstruction will be obtained.

Manjusha Deshmukh[3] has defined a quality analysis based work to perform the fusion on multi focus images. Author presented a PCA based approach along with wavelet decomposition. At the initial step author implemented the DWT approach for image decomposition and to obtain the sub images from the main image. Once the image decomposition is done, the next work is to perform the pixel value analysis over these decomposed objects to perform the information fusion so that new image will be reconstructed. Author considered the random space analysis over the image for pre analysis and to regenerate the quality image to perform the image enhancement after the fusion process. Author defined the fusion process based on the plentiful information and analysis and reconstruction. Milad

Ghantous[4] has presented an object extraction approach along with image fusion to regenerate the feature image by performing the gradient level enhancement and the pixel level enhancement. Author defined the work in two stages. In first stage, the separation of background and foreground is done and later on the reliable feature selection is performed to reconstruct the result image Tao Wan[5] has defined the image fusion for compressed image. Author perform the sample based pattern analysis over the image so that the performance of the reconstruction process will be improved. Author defined the fusion algorithm along with compressive sampling pattern. Author presented the image fusion under the acceptability analysis and the compressive vector analysis so that effective sample selection will be obtained that will result the generation of effective image from the set.

Andreja Svab[6] has presented a image fusion process for high resolution images by preserving the spatial and spectral resolution images. Author defined the high resolution image analysis under the fusion process. Author defined the panchromatic image processing under multispectral analysis so that new high resolution image will be constructed. Saurabh Singh[7] has defined a fusion approach for reconstruction of biometric images. The biometric face images are considered by the author that are extracted with partial occlusion. Author defined the Eigen space domain analysis along with genetic algorithms to generate the new fusion image so that the regeneration of the image will be done. Author also combined the Eigen space analysis along with genetic process with optimum strategy analysis for fusion process. Author has improved the recognition process by using the fusion experimentation. Hong Zheng[8] has presented parametric analysis approach along with wavelet decomposition for image reconstruction using fusion process. Author performed multi-level wavelet decomposition to apply the fusion rule under different levels and to perform the generation of effective result image. G. Simone[9] has presented an effective approach along with image acquisition, process so that the region value analysis will be performed and the reconstruction of image will be done. Author defined the wavelet based analysis for quality analysis on decomposed objects and the generation of effective result image based on fusion process. Author defined the fusion method under quality assessment so that the multi band based image reconstruction will be done. Wenzhong Shi[10] has presented a transformation approach under two band wavelet analysis for image

reconstruction. Author divided the complete image in high frequency and low frequency images. Author defined the performance analysis under different vectors and taken the intelligent decision for reconstruction of images. The quality assessment is here defined for reformation of image so that the fusion image will be improved.

Image Fusion Methodologies

Image fusion is the methodology to process two or more partially images in such way, the reconstruction of fusion image will be done. The fusion process can be performed at pixel level analysis or feature level analysis as described in section I. Some of the existing approaches under image fusion are given here under

A) Averaging Method

This method performs the image fusion based on pixel level analysis. In this approach, the pixel value of same position points from multiple images is obtained and the averaging of the pixel value is computed. Now in new reconstructed image this average value is substituted. This is one of the most general methods that cannot assure effective fusion results. The fused result image is shown in figure 2. This method is not acceptable for high level distortion or for high resolution images.

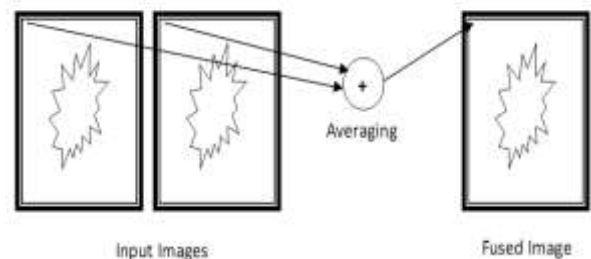


Figure 2 : Averaging Method

B) Maximum Selection Method

In this method, instead of substituting the average value, the maximum intensity value will be considered. The method is based on specific attribute analysis such as contrast based tone value analysis etc. As the high intensity pixel is always considered, the reconstructed image will be always a high intensity image. This method can also be used for low resolution or low quality images.

C) PCA

PCA is the vector space analysis in which the distance based analysis is performed on feature vector. The feature vector considered in this work is

the Eigen vector analysis under internal structure extraction. According to this approach, the highly correlated points will be highlighted over the image to reconstruct the image pixels or area. The structural analysis over the image is performed under distance based analysis and the new image will be constructed. PCA approach uses the covariance analysis approach for image transformation and to generate new effective image. The algorithmic approach adopted by PCA is given here in table 1.

Table 1 : PCA Algorithm

1. Convert the input image in column matrix
2. Generate the covariance matrix along with column vector analysis
3. Perform the covariance analysis under diagonal vector with window size specification
4. Compute eigen value and generate eigen vector under covariance matrix analysis.
5. Normalize the column vector analysis with difference analysis from mean eigen image.
6. Normalize the eigen vector analysis under-weight distribution analysis under pixel value estimation
7. Sum up the scaled of matrix and use the obtained value as fusion image

D) Decomposed Pyramid Fusion

This kind of fusion approach basically divides the input images in smaller sub blocks by using the decomposition approach. Now instead of processing the complete image collectively, the decomposed parts of different images are fused for regeneration of image. The decomposition process is based on the intensity value analysis or frequency based. The decomposition levels are also defined to represent the depth of fusion process. The number of fusion process is based on the fusion type and decision the merging of decomposition levels for regeneration of result image. The decomposition is based on low pass filtering and high pass filtering process are also defined. Once the decomposition is done, the level based analysis over the image is performed for regeneration of result image. Once the analysis is performed, the merging of decision

oriented fusion image is performed. The algorithmic approach adopted here is shown in table 2.

Table 2 : Algorithm

1. Generate the input image matrix
2. Setup the mask as dimensional filter for image
3. Decide the decomposition level for fusion.
4. Decomposition the images under the level specification and filter mask definition.
5. Generate the distance matrix on decomposed image part under the fusion image analysis.
6. Select the merging algorithm for reconstruction
7. Collect all merge parts and form the complete reconstructed image.

In this section, some of the most effective fusion approaches are discussed along with algorithmic approaches.

Conclusion

In this paper, a study on different fusion processes is shown for real time images. The paper has discussed, the type of fusion under the feature vector analysis as well describe the challenging areas of image fusion. Later on the research methodology of some of the most effective fusion algorithms is defined in this paper.

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