Discrete Transform Based Image Fusion: A Review

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ABSTRACT
With the advancement of image processing, the distinct area of image fusion has been explored. The word fusion represents a way of obtaining data acquired in several domains. A technique of merging useful data from input images is defined as image fusion. It improves features and performance. Fused image includes all the important features of input images without introducing any artifacts. This paper depicts the basic of image fusion and fusion techniques. Paper mainly focuses on frequency domain techniques. Image fusion widely used in surveillance, medical diagnosis, biometric, enhanced vision system and remote sensing.

KEYWORDS
Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT), Inverse Discrete Cosine Transform (IDCT), Principal Component Analysis (PCA), Stationary Wavelet Transform (SWT)

INTRODUCTION
Image fusion is a procedure of merging the efficient data from two or more images of an object into a single image. This produces a single output image with improved quality. The technique of image acquisition has been tremendously improved day by day. In simple way, image fusion can be define as getting a more clear image from two or more blur images. Extraction of information from images improves quality. Two requirements must be satisfied by image fusion technique. First, most meaningful property from the input images must be acquired by fused image with no loss. That means the properties of input images that do not contribute much in output image, can be ignored. Second, no artifacts or mismatch should be introduced by image fusion technique (Prasannakumar et al., 2015). Properties which are not available in given input image cannot be add in output fused image. These two requirements must be fulfilled by each fused image. Images are presented in matrix form and fusion of these images produces new single matrix (Lixin et al., 2013). Image fusion includes three steps as shown in Figure 1:

- **Image Acquisition**: First step of any visual system. It is the process of obtaining images from multiple devices.

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Image Registration: it ensures that all the images should be in one coordinate system. Compatibility of pixels is checked. Before any image fusion technique, it is necessary to apply image registration.

Image Fusion: Finally, image fusion techniques are used to obtain fused images.

In first step of image fusion the properties that are needed in output images are extracted. After getting the important properties, some compatibility check is done to ensure that all the pixels from both the images are in same coordinate system. After doing compatibility check image fusion rule are applied to get an output fused image.

Image fusion can be implemented by four ways that are:

1. Multi View: In it, a set of images of the view is captured by a device from different position. By this way, we can obtain directional based property from all promising views. In multi view scenes are captured with same modality and are taken at the same time. Main advantage of the multi view is that if some important feature could not be captured in single view, we can achieve it in another view.

2. Multi Modal: Different modalities are used for multi modal image fusion such as visible, infrared, CT, ultraviolet, etc. The motto of this type of fusion is to emphasize band specific data and to decrease the amount of data. Multimodal image fusion can be achieved by different methods such as fusion in transform domain, object level fusion and weighted averaging pixel-level fusion.

3. Multi Temporal: In this images are obtained at different time to see the changes between them. After this theses images are fused to obtain the final image. Multi temporal image fusion uses only single view and same modality.

4. Multi Focal: In this images are captured from different focal length, after obtaining images these images are fused to obtain final image (Brundashree et al., 2015).

Various types of image fusion techniques are as follows:

Techniques of image fusion (Figure 2) are divided into two subparts:

- **Space Domain Image Fusion Technique**: This type of image fusion technique considered the pixel values of images which are then fused in linear or nonlinear manner (Dong et al., 2011).

- **Frequency Domain Image Fusion Technique**: Multiscale coefficient are obtained from the decomposition of input images. Various fusion rules are used to select these coefficients to obtain fused image.
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