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Original Research Article

# MULTIFOCUS IMAGE FUSION USING WAVELET TRANSFORM

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**Abstract -** Image Fusion is defined as the process of combining two or more different images into a new single image retaining important features from each image with extended information content. To improve the accuracy both spectral and spatial information from input images is utilized. Image Fusion is used in various applications like satellite imaging, medical imaging etc. Multifocus image fusion aims to combine a set of images that are captured from the same scene but with different focuses for producing a sharper image. This project makes use of wavelet transform for multi focus image fusion. The fused image has greater PSNR and entropy whereas it has lesser MSE.

## Introduction

The major objective of multi-focus image fusion is to produce sharper image based on multiple images that are captured using different camera settings (e.g., at different focuses) of the same scene. The cameras that are widely used in current computer vision systems usually have a limited depth of field. Consequently, when they are used to capture the scene, objects at a certain distance from the lens will be focused whereas objects at other distances will be defocused (or blurred). Therefore, the multi-focus image fusion technique is desirable to fuse a set of images that yield different focus levels to reconstruct a sharper image which contains all objects are in focus.

The key challenge of multi-focus image fusion is how to evaluate the blur of each image and then select information from the most informative (sharp) image.

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## Proposed Approach

The proposed approach combines multiple source images that are captured at different focus levels to reconstruct a single image.The Discrete Wavelet Transform is applied on each input image. The approximation and the detail wavelet coefficients are obtained for each input image. These wavelet coefficients are combined using different pixel-level fusion rules. Finally, the fused image is obtained by applying the inverse wavelet transform on the fused wavelet coefficients.

1.Combination of detail subbands

2. Combination of approximation subband

In this section, the approximation subbands of input images are combined. Conventional approaches usually just average the input approximation images. However, such equally weighing usually leads to the issue of contrast reduction in the case of opposite contrasts in different source images. Furthermore, the region entropy [16] is used to measure the amount of information from the approximation images contributing to the fused result. The `region entropy is calculated for each approximation wavelet coefficient using its corresponding (i.e.,child) detail subbands coefficients overall levels and all orientations. Hence, each approximation coefficient of the fused image is combined using that of two source images as

$$C_F^L(k) = \frac{E_A(k)}{E_A(k)+E_B(k)} C_A^L(k) + \frac{E_B(k)}{E_A(k)+E_B(k)} C_B^L(k),$$

where EA(k) and EB(k) are the region activity measures for two source images at the position k using the corresponding detail subbands coefficients over all levels and all orientations. That is they are defined as:

$$E_A(k) = \sum_l \sum_\theta \sum_{i \in \Omega_k} C_A^{l,\theta}(i) \log(C_A^{l,\theta}(i))^2 .$$

$$E_B(k) = \sum_l \sum_\theta \sum_{i \in \Omega_k} C_B^{l,\theta}(i) \log(C_B^{l,\theta}(i))^2 .$$

Experimental results:

Image Fusion without using wavelet transform:

| Methods | Entr0py | MSE | PSNR |
|---|---|---|---|
| **1.Maximum pixel intensity** | **6.985** | **0.00094** | **78.506** |
| **2.Minimum pixel intensity** | **6.934** | **0.00122** | **77.188** |
| **3.Average pixel intensity** | **6.962** | **0.000544** | **80.807** |

Image Fusion using proposed approach:

| Methods | Entropy | MSE | PSNR |
|---|---|---|---|
| **1. wavelet transform** | **7.029** | **0.000592** | **80.442** |

A

B

C

D

E

F

(A) and (B) are the two source images of same size but having focus on different part in the image (i.e. having different part blur in each image) are considered.
(a)Image obtained by comparing corresponding pixel intensities from two source images (A) and (B) and considering minimum pixel intensities from both the images((A) and (B)) .

1. Image obtained by comparing corresponding pixel intensities from two source images (A) and (B) and considering minimum pixel intensities from both the images((A) and (B)).
2. Image obtained by comparing corresponding pixel intensities from two source images (a) and (b) and taking the average of pixel intensities from both the images((a) and (b)).
3. Fused Image obtained by proposed approach

**Conclusion:**

With the proposed approach we get the better results, we have greater entropy and PSNR with less MSE.

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