FUSION BASED IMAGE QUALITY ENHANCEMENT

ABSTRACT
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Abstract

Nowadays, image fusion plays a crucial role in computer vision and various areas of image processing. Image fusion synthesizes all the substantial information from more than one source images into a single image in such a way that the obtained fused image contains better description of the scene than any of the single source images. The obtained fused image yields more pertinent details and hence more suitable for machine or human perception. Image fusion has been used extensively in various disparate fields of image processing tasks such as, digital imaging, medical diagnosis, military, remote sensing, robotics, surveillance and so on. This thesis investigates the methods for image fusion as well as maintaining the original structure of the images. The aim of this work is to enhance the visual quality of images without any distortion and loss of information. Hence, image fusion is an essential tool to obtain the complete and appropriate information of multiple source images into one image.

In this thesis, our aim is to develop novel and improved image fusion techniques using pixel level image fusion approach which provides fused image having better visual quality without destroying any relevant information. The selection of pixel level image fusion is based on the comparison between all image fusion levels (pixel, feature and decision). From the comparison, it has been found that pixel level image fusion methods have an advantage of retaining more original information in the fused image. Furthermore, the methods are rather easy in implementation and computation, therefore this work has been performed using pixel level image fusion. Fusion process has been performed over the two different sets of multi-focus and multisensor images.

In the first approach, a discrete cosine transform (DCT) and sum-modified-laplacian (SML) based image fusion in stationary wavelet transform (SWT) domain is presented to obtain an image in which all objects of the scene are in focus. In this work, DCT is used because of its energy compaction property i.e., collection of most of the information in its few coefficients and SML focus measurement is used to select the sharp focused region.

The next approach is based on gradient method to preserve the sharp and directional information. In this work, we have proposed two image fusion techniques and in both the techniques gradient based fusion is performed to obtain the fused images having more sharp/directional information. The first technique is G-DWT in which the gradient rule is used to fuse multifocus images in DWT domain. The second technique is G-DTCWT, which is based on the gradient method in dual tree complex wavelet transform (DTCWT) domain due to its property of better shift invariance and good directionality over the DWT.

The low contrast image can not provide the complete interpretation of the scene. Therefore, contrast is necessary for an image which gives better visual information of the scene. Therefore in our next work an image fusion approach has been performed to enhance the contrast of the image. In this approach, fusion is performed based on directive contrast using discrete wavelet packet transform (DWPT).

The next approach is designed to develop an image fusion technique based multiresolution singular value decomposition (MSVD). The singular value decomposition (SVD) based fusion techniques are always computationally efficient, as only the few singular values can contain most of the information of the images. Therefore, this approach is based on singular value decomposition which uses the multiresolution property of SVD to obtain the fused images having better visual quality.

Due to the presence of noise in source images or inefficiency of fusion techniques, the fused images may always be not smooth. Hence, finally a cross bilateral filtering based fusion technique has been introduced which produces the smooth while

preserving the sharp changes in the fused images.

Finally, the thesis has been concluded with the future scope of work related to this field.

The performance of the fused images is evaluated qualitatively and quantitatively. Since, the visual criteria is not sufficient to measure the quality of images therefore we have also performed quantitative measurement criteria. Some standard metrics used for quantitative analysis are: peak-signal-to-noise-ratio, standard deviation, correlation coefficient, mutual information and so on. The proposed methods are compared with existing methods and state of the art methods. The results obtained from the proposed methods are better in terms of qualitative and quantitative assessments.