# "MEDICAL IMAGE FUSION USING WAVELET TRANSFORM"

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**Abstract -**Image fusion refers to the process of combining the information from two or more images into a single highly informative image. The resulting fused image contains more information than the input images. In this project, two medical images are fused based on the Wavelet Transform (WT) using Principal Component Analysis(PCA) fusion techniques. The objective of the fusion of an MRI image and CT image of the same organ is to obtain a single image containing as much information as possible about that organ for diagnosis.

**Keywords:** DWT, Bi-cubic Interpolation, PCA Fusion Techniques

**Introduction-**The wavelet transform is a two dimensional which provides multi resolution, sparse resolution, and useful characterization of the structure of an image. Further; it purveys a high degree of shift-invariance in its magnitude. In mathematics, bi-cubic interpolation is an extension of cubic interpolation for interpolating data points on a two dimensional regular grid. The interpolated surface is smoother than corresponding surfaces obtained by bilinear interpolation or nearest-neighbor interpolation. Bicubic interpolation can be accomplished using Lagrange polynomials, cubic splines, or cubic convolution algorithm. In image processing, bi-cubic interpolation is often chosen over bilinear interpolation or nearest neighbor in image resampling, when speed is not an issue. PCA is a mathematical tool which transforms a number of correlated variables into a number of uncorrelated variables. In this project PCA fusion technique is used to fused the two or more images.

**Discrete Wavelet Transform-** The most common form of transform type image fusion algorithms is the wavelet fusion algorithm due to its simplicity and its ability to preserve the time and frequency details of the images to be fused. A discrete wavelet transform represents a time domain signal into time frequency domain and the signals are called wavelet coefficients. To ensure that high and low frequencies disturbance are extracted, two scale signal decomposition are performed. The wavelet transform

output consists of two decomposed signals, with different levels of resolution. The range of frequencies for the first and second scaled signal are (f/2-f/4) and (f/4-f/8) respectively, where f is the sampling frequency of the time domain signal.

**Bi-cubic Interpolation-** In mathematics, bicubic interpolation is an extension of cubic interpolation for interpolating data points on a two dimensional regular grid. The interpolated surface is smoother than corresponding surfaces obtained by bilinear interpolation or nearest-neighbor interpolation. Bicubic interpolation can be accomplished using either Lagrange polynomials, cubic splines, or cubic convolution algorithm. In image processing, bicubic interpolation is often chosen over bilinear interpolation or nearest neighbor in image resampling, when speed is not an issue. In contrast to bilinear interpolation, which only takes 4 pixels (2×2) into account, bicubic interpolation considers 16 pixels (4×4). Images resampled with bicubic interpolation are smoother and have fewer interpolation artifacts.

**Principle Component Analysis (PCA) Fusion-** It is a mathematical tool from applied linear algebra .It is a simple non-parametric method of extracting relevant information from confusing data sets. PCA is a useful statistical technique that has found application in fields such as face recognition and image compression, and is a common technique for finding patterns in data of high dimension. The

origins of PCA lie in multivariate data analysis, it has a wide range of other applications PCA has been called, 'one of the most important results from applied linear algebra and perhaps its most common use is as the first step in trying to analyses large data sets. In general terms, PCA uses a vector space transform to reduce the dimensionality of large data sets. Using mathematical projection, the original data set, which may have involved many variables, can often be interpreted in just a few variables (the principal components).



**Fig: 1 image fusion process**

**Formulation of PCA-** Let us consider X be a d-dimensional random vector and assume it to have zero empirical mean. The orthonormal projection matrix V would be such that Y=VTX with the following constraints. The covariance of Y, i.e., cov(Y) is a diagonal and inverse of V is equivalent to its transpose (V-1=VT). Using Matrix Algebra,

$$cov(Y) = E\{YY^T\}$$
$$cov(Y) = E\{(XV^T)(V^TX)^T\}$$
$$cov(Y) = E\{(XV^T)(VX^T)\}$$
$$cov(Y) = V^T conv(X)V$$

Multiplying both sides of equation (4) by V, we get,
$$Vocv(Y) = VV_T conv(X)V = conv(X)V$$

Substituting equation (4) into the equation (5) gives,
$$[\lambda_1 V_1, \lambda_2 V_2 \ldots \ldots, \lambda_d V_d]$$
$$= [conv(X)V_1, Cov(X)V_2, cov(X)V_d]$$
This could be rewritten asb
$$\lambda_i Vi = cov(X) Vi$$
Where, i =1, 2, ... , d and Vi is an eigenvector of cov(X ).

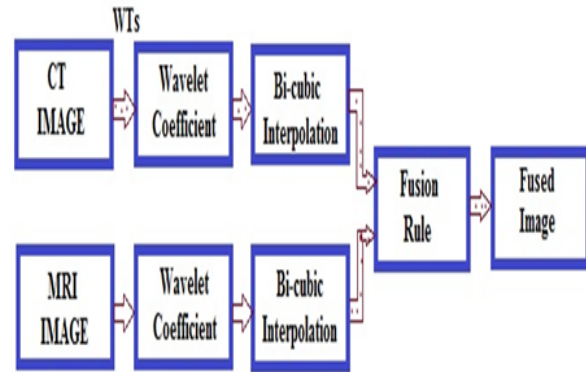**Proposed Methodology-** In the proposed method noise is removed from medical images using combination of wavelet transform and bicubic interpolation. First the medical images are taken as the input and wavelet transform and bicubic interpolation technique are applied to the input image. And then the output of this transform is applied as a input to the PCA fusion technique. And we get the output enhanced image and more informative images as compare to the input images.

**Results-**
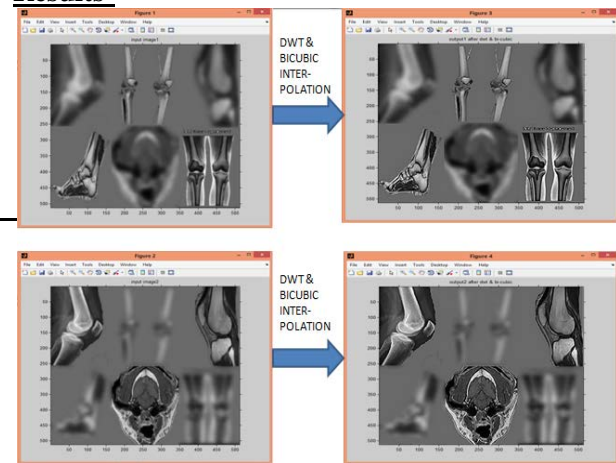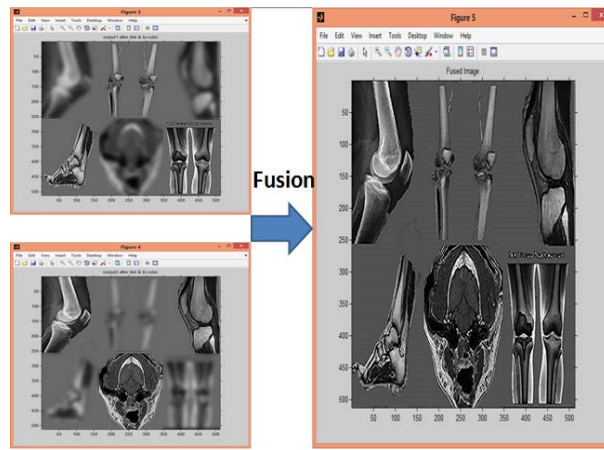
**Conclusion-** The wavelet transform which is used in this project performs better in terms of noise removal and edge enhancement. Bicubic interpolation is used for resolution enhancement. And PCA technique is used to fuse the images.

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## Author profile-

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