Statistical Goodness Factor ‘r’ for Image Fusion Algorithm Based on UGGD Parameters

MSA Srivatsava, T. Ramashri, K Soundararajan

ABSTRACT: In this paper we propose a novel pyramid decomposition based Image fusion metric, Gamma Factor or Goodness of Fit ‘r’ which describes the statistically amount of information fused by the image fusion algorithm. We first apply steerable pyramid decomposition and then a fitting model for Univariate Generalised Gaussian Distribution (UGGD) parameter estimation. From the UGGD; P and S fitting model coefficients are computed. To estimate the optimum weights for computation a huge data set of complimentary images are used. Using these weights, amount of information contributed by each image to form a fused image can be estimated. Experimental results show the tremendous matching with the quantise information

Keywords: Pyramid, UGGD, Weights, fitting model, Fused Image

I. INTRODUCTION

THE objective of image fusion is to coordinate data from different info images to make a combined one that is progressively instructive for human or machine observation as contrasted with any of the information images [1]. Image fusion procedures have been utilized in different application zones counting remote detecting, biomedical imaging, and multi-exposure multi-center image coordination[2]. In optical remote detecting, a gathering of sensors may cooperate, each of which catches some particular parts of ghastly as well as spatial data[3]. Melding both the spatial and otherworldly data from all sensors gives an increasingly enlightening image, and as it were the melded image should be put away for resulting investigation of the scene [4]. In biomedical imaging, diverse imaging modalities are corresponding in nature in securing unique parts of organic structures and exercises. For instance, attractive reverberation imaging (MRI) is frequently helpful in uncovering anatomical structures though metabolic exercises might be caught all the more dependably utilizing positron discharge tomography (PET). By utilizing fusion innovations, it is conceivable to get a single image that adequately portrays anatomical structures also, metabolic exercises at the same time [5].

Because of the vast number of uses and the decent variety of fusion procedures, impressive endeavours have been made to create target execution measures for image fusion. Customarily, the appraisal of a fusion plot is conveyed out by abstract assessment, which is known to be moderate, costly, and above all, can't be installed into robotized structures for framework and parameter enhancements. A significant option in contrast to abstract assessment is objective image fusion estimates that are steady with human visual system.

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There are many methods proposed by researchers, like Mutual Information [6], relative amount of edge information preserved [7], measures based on SSIM[8], some of them were based on Contrast Visual System based on Human Visual System[9], Local amplitude, Contrast Preservation leads to Fusion Quality Measure[10]. Natural image wavelet coefficients have zero high peaks with tails being wider[11]; we adopt a natural scene statistics based model using UGGD[12].

II. SYNGO FASTVIEW SYSTEM

III. PROPOSED METHOD

Formulae used:

Generalised Gaussian Distribution:

A random variable X is distributed as generalised Gaussian if its probability distribution function (*pdf*) is given by

$$gg(x;\mu,\sigma,p) = \frac{1}{2\Gamma\left(1+\frac{1}{p}\right)A(p,\sigma)} e^{-\left|\frac{x-\mu}{A(p,\sigma)}\right|^{p}}, x\in R \quad (1)$$

Where $\mu \in R, p,\sigma > 0$ y $A(p,\sigma)=\left[\frac{\sigma^2\Gamma\left(\frac{1}{p}\right)}{\Gamma\left(\frac{3}{p}\right)}\right]^{1/2}$

The parameter μ is the mean A(p,σ) is a scaling factor which allows $Var(x)=\sigma^2$ and p is the shape parameter[12].

Weights Computation:

$\alpha(MRI)+(1-\alpha)PET=Fusion$

$W_p(P_m)+(1-W_p)(P_p)=P_f$

$W_s(S_m)+(1-W_s)(S_p)=S_f$

$[W_p,W_s]$- Optimum weights

$$W_p=[(P_f-P_p)/(P_m-P_p)] \quad (2a)$$

$$W_s=[(S_f-S_p)/(S_m-S_p)] \quad (2b)$$

Proposed Method:
Flow chart

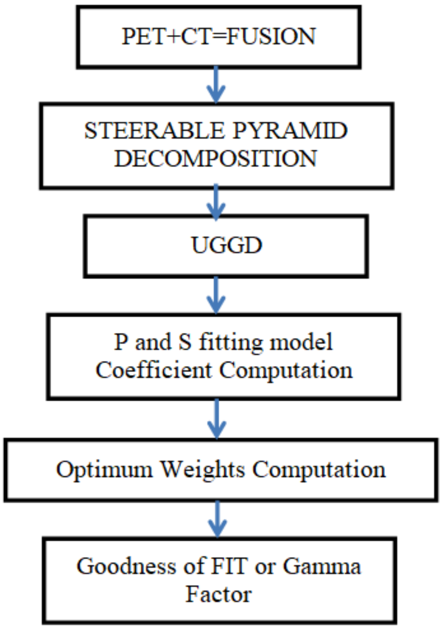


Fig1: Block diagram of our proposed method

Our Algorithm can be explained in steps as follows

Step 1: 50 images of each CT(I_1), PET (I_2)and Fused images(I_3) are taken from ‘*Siemens Syngo Fast View system’*

Step 2: Steerable Pyramid Decomposition is applied on these 3 sets of images I_1, $I_2$and I_3.

Step 3: Fitting model using Univariate Gaussian Distribution is applied

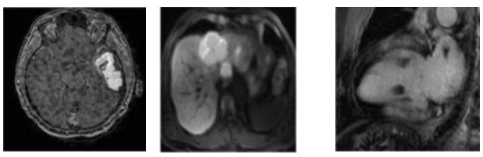
Step 4: P and S fitting model coefficients are computed for the three sets of images I_1, $I_2$and I_3.

Step 4: Optimised Weights are computed from the Mode of P and S train as stated in equation 2 a & b

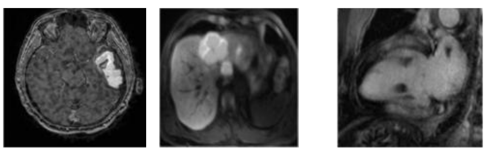
Step 5: Goodness of fit implies the information of image information ratio.

Results

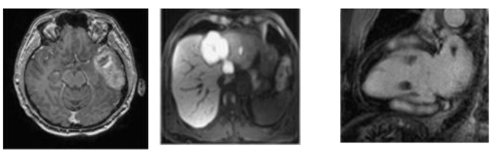
CURVELET



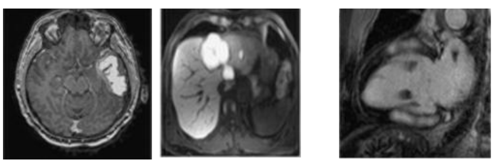
BI-ORTHOGONAL



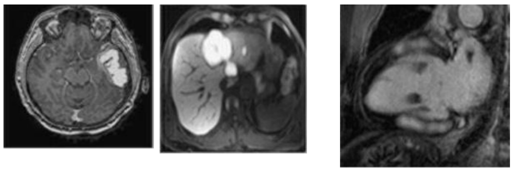
DCT



DISCRETE MEYER WAVELET



DISCRETE WAVELET



Table

	% of Image I_1	% of Image I_2	W_{pOPT}	W_{sOPT}	Goodness of fit
1	50	50	0.2589	0.0129	0.3242
2	10	90	1.0236	1.0289	0.8171
3	90	10	1.0259	1.0296	0.1969

Table: Weighted sums of MRI and CT images.

WP SET	WS SET
0.258919721169276	0.0129039219227337
0.920869667596737	0.484466087733380
0.698261871824475	0.346120718626884
1.00216385936604	0.541660355837595
0.348707953102714	0.270408825372705
3.18125488971714	0.707086191914614
0.550324548185878	0.288144403695189
0.810601709837845	0.570757133804984
2.27445747213095	0.370691172877168
10.2838869879386	0.726758487332387
1.57054363843352	0.769382809562805
0.656061965439615	0.734637210513457
0.910287766840676	1.16283914319346
1.02836516343699	1.20655897847161
1.50042407867641	0.218076596379786
1.54026494468142	0.148255356190310
1.13709042942767	1.74793603312615
2.95473576684454	0.206940414343039
1.17240434280698	2.61060227419103
0.863785254593527	0.508054458050773
1.04672408245578	1.42257166001318
0.990249305242783	1.07706032735647
1.05977952302857	1.34709690495616
1.00234889542323	1.03455894304822
1.01429557036646	1.02264559643994
1.04053575247810	1.16719053134328
0.995587289624544	1.04662170761712
1.03810574914396	1.13527802052763
0.957770816261636	1.00539398311829
1.06388240992019	1.08245613180302
0.997205199105371	1.03424749981303
1.02714348323974	1.08664045030756
0.983999314741400	1.00721348837141
1.02272195125715	1.06079623396757
0.980959527866980	1.02994382110140
0.951619330408008	1.00380140914825
0.786689933621587	0.900993636743907
1.21700152885210	493.204071071688
0.994710951768829	1.93558803040113
1.10275637982769	3.16411825775234
1.33807910425866	0.274716218508962

IV. CONCLUSION

The proposed method opens a new method of evaluating and creating a method of fusion by using UGGD (Univariate Generalised Gaussian distribution) results clearly depict the trade-off between the image fitting factors based on the weighted sums P and S. This new factor ‘r ‘will be a reference factor which can be considered as a Goodness of fit function.

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