International Journal of Internet, Broadcasting and Communication Vol.7 No.1 36-41 (2015)
http://dx.doi.org/10.7236/IJIBC.2015.7.1.36

IJIBC 15-1-8

Wavelet Transform based Image Registration using MCDT Method for Multi-Image

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Abstract

This paper is proposed a wavelet-based MCDT(Mask Coefficient Differential and Threshold) method of image registration of Multi-images contaminated with visible image and infrared image. The method for ensure reliability of the image registration is to the increase statistical corelation as getting the common feature points between two images. The method of threshold the wavelet coefficients using derivatives of the wavelet coefficients of the detail subbands was proposed to effectively registration images with distortion. And it can define that the edge map. Particularly, in order to increase statistical corelation the method of the normalized mutual information. as similarity measure common feature between two images was selected. The proposed method is totally verified by comparing with the several other multi-image and the proposed image registration.

Keywords: *MCDT Method, Multi-Image, Image Enhancement, Image Registration, Image Fusion, Statistical Correlation, Normalized Mutual Information, Wavelet Transform, Edge, JPEG2000*

1. Introduction

The image registration is a part of the image fusion technique that uses to improve the object recognition, reliability of tracing and accuracy by conflating two or more mutual complementary image information. The image fusion of multi-image and the preconditioning process of image compression·coding can be separable into 3 steps. [1]

Manuscript Received: Jan. 7, 2015 / Revised: Jan. 15, 2015 / Accepted: Feb. 6, 2015
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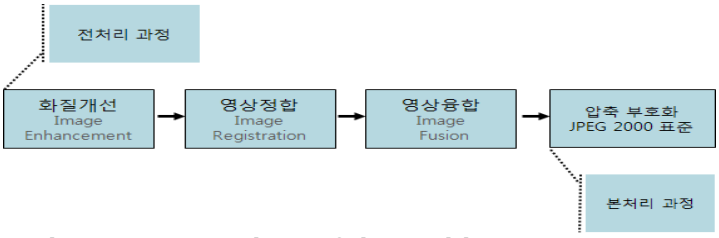


Figure 1. Procedure of the Multi-Image process

Due to the development of image acquisition, each has different image characteristic. Therefore the diversity and complexity of an image are independently studied by each step. Especially in this thesis, an image fusion algorithm considering the characteristic of different multi-image like EO (Visible image) and IR (Infrared image) are proposed. As the general two-dimensional image fusion is expressed independently on each related pixel, the images that obtained from different circumstance (time and angle of field etc.) produces to be located on different pixel. The image registration process is needed to put into one coordinate system (reference coordinate system).[2] To increase the crucial matters on different image registration efficiency, the first step is to analyze the strong edge component that is presumed as a common feature by applying a MCDT(Mask of Coefficient Differential and Threshold) technique based on a new algorithm wavelet extracting different image feature. And through this feature selection process, it removes the incorrect feature points. According to the calculated characteristic in the second step, select a region distance map with high statistical relation and by calculating the parameter through the transform model with maximum similarity measurement, NMI (Normalized Mutual Information) is proposed to fulfill image registration. In the outcome of performance evaluation, image enhancement was necessary and an extensive method of wavelet [3] within the average weight method on image fusion is used. The compression encoding process used JPEG2000 standard [4] to proceed in the experiment.

2. Body

2.1 Image registration

2.1.1 Transform model

(P) (P_{final}) A feasible transform model through the specific parameter, T (Transform Image) and R (Reference Image) set a fixed conversion model by standard of expression image under the equivalent coordinate system. Then transform the coordinate via the fixed conversion model to calculate the similarity measurement on overlapped region. The final goal is to find transform model parameter to reach the maximum of similarity measurement like in the equation (1).

$$P_{final} = \arg\max_{P} S(R, T(P)) \quad (1)$$

2.1.2 Normalized Mutual Information

When a transform model between two images is found out, the normalized mutual information is used in order to measure the extent of overlapped image region and image registration. [5][6] Entropy is a similarity measure which shows the statistical relation on random variable. When selecting a random pixel in the image entropy, the normalized mutual information gets to be a measurement of uncertainty due to predicting brightness value.

$$E(X) = -\sum_{x} p_x(x) \log p_x(x) \quad (2)$$

$p_x(x)$ Here, is the probability value of X according to the discrete random variable X.

2.2 Suggested Algorithm

3×3 The proposed image registration in this thesis introduces a mixture of two existing image matching technique to perform an effective image registration. The entire structure of the image matching technique is shown in the figure 3. When entering two images from different camera, it extracts common edge component through strong edge component that is characterized from different image by applying Robert mask differential operator and threshold value. This has been applied on detail subband after high frequency regions (HL, LH, and HH) which contain the edge component are separated via each image wavelet transform. As a result of removing the extracted distortion component of the edge, the ability to ensure the reliability on MCDT techniques applied. Then calculate the value between the each image edge and distance map of pixel for implementing the image registration from normal mutual information with high relative statistical correlation to a similarity measure.

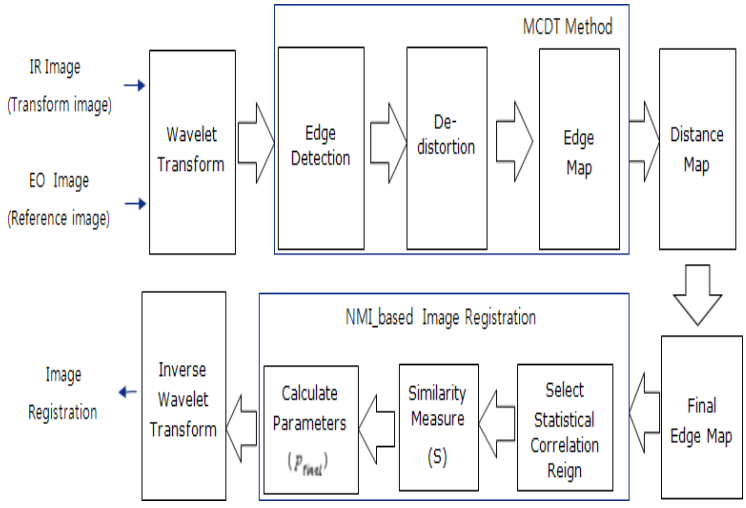


Figure 2. Proposed Image Registration System

The figure 4 is a result image of the edge map that is obtained by applying suggested MCDT technique on infrared image and visible ray image.

(a) (b) (c)

(d) (e) (f)

Figure 4. (a) EO image, (b) IR image, (c) Edge maps of (a), (d) Edge maps of (b), (e) results of Distance maps, (f) results of Distance maps

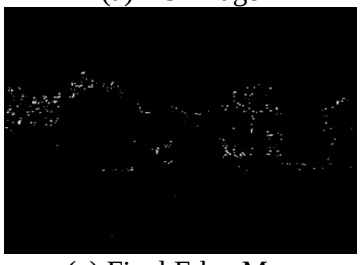
The step by step explanation of the MCDT technique is as below.

[Step 1] Perform a discrete wavelet transform on the image.

[Step 2] LH, HL, HH Find the edge component by differentiating detail subband coefficient and through the result, calculate binary mask that indicates the location of the distortion.

[Step 3] By multiplying the obtained mask from the second step and detail subband wavelet transform coefficient, it eliminates the damaged distortion coefficient to get the final edge component. The figure 5 is a edge map which shows the removal of distortion components in the two original image component.

(a) EO Image (b) IR Image



(c) Final Edge Map

Figure 5. Application results of MCDT method to final Edge maps.

2.3 Hardware configuration of implementation board and experimental environment

In order to carry out image data management process, the image data management and compression process are planned for JPEG2000compression·encoding received condition. The implemented hardware board in this study, PMC, PCI I/F, CPLD and ADV212(JPEG2000 CDDEC)of JPEG2000hardware engine. Moreover, the PCI interface is applied to JPEG2000compression card in main control board Power PC Embedded Board.

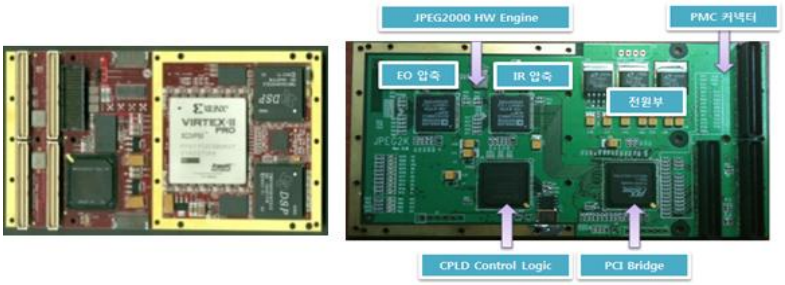


Figure 6. The Shape of H/W Board

The basic environment of a test board is as follows.

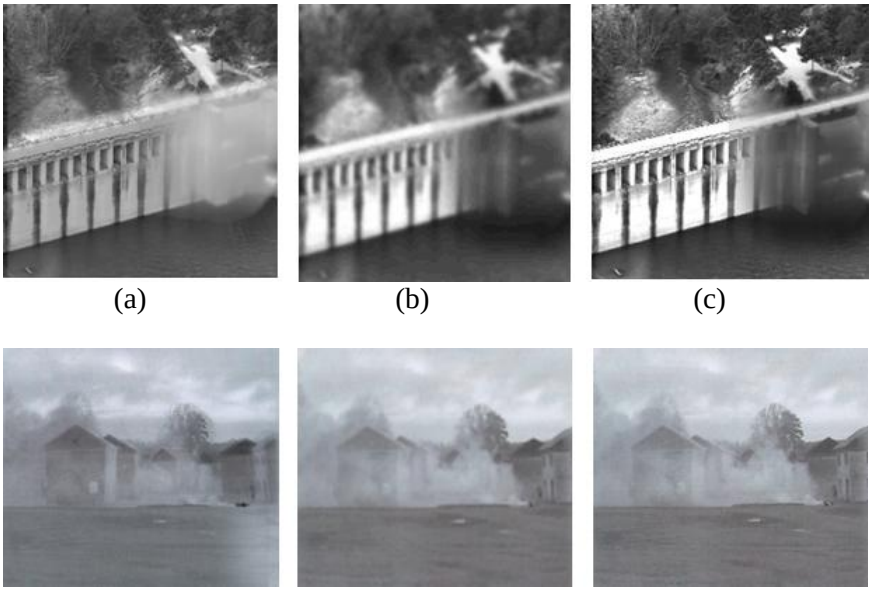
- Hardware environment : PC (intel Core2 CPU E8400 @ 3.00GHz, 3.5GB RAM)
- OS environment : Windows XP
- Compression program : Experimental Window XP

Test Application

- Confirm Compression File Program : kakadu show (version4.2.1)

2.4 The experiment result and analysis

In the figure 7, it illustrates the infrared and visible image within suggested method and existing NIM based as well as the image fusion when mismatches on behalf of comparing the performance of proposed algorithm. Also the table 1 demonstrates the calculated PSNR (Peak signal to noise ratio) in quantitative performance. Through this experiment, it shows more accurate and less overlap results with outstanding matches when applying visibly suggested MCDT technique. The table 1 confirms that the suggested technique produces an excellent accuracy with high matching probability in registration performance than using existing NIM technique.



(a) (b) (c)

(d) (e) (f)

Figure 7. (a),(b) Result Image of Non-Registration, (c)(d) Result Image by NMI Registration, (e)(f) Result Image by Proposed MCDT Registration

Table. 1 Result of Registration Accuracy Measurement

		The Gap of Matching										
		-50	-40	-30	-20	-10	0	10	20	30	40	50
NMI Method	Translation	37	35	35	34	60	95	30	13	14	12	13
	Scale	0	0	0	10	50	83	98	74	50	18	0
	Rotation	0	0	0	9	30	65	98	80	35	0	0
	Average	12	12	12	15	47	91	75	56	33	10	4
Proposed Method	Translation	0	0	5	12	24	95	33	22	12	2	0
	Scale	0	0	5	12	24	95	63	0	0	0	0
	Rotation	0	0	0	17	50	90	50	11	0	0	0
	Average	0	0	2	10	41	93	49	11	4	1	0

3. Conclusion

The image registration with MCDT technique of transform based proposed wavelet has been confirmed with outstanding result among higher accuracy when comparing to the existing normalized mutual information (NMI) image. When the normalized mutual information (NMI) that showing the similarity measure in image registration matches as in the table 2, it reaches the limit and minimizes the local maximum to perform robust matching technique. Furthermore, by using the distance map, the performance speed can be increased as it reduces unnecessary pixels within applying set threshold value. According to the comparison between the existing NMI technique image registration and the final suggested algorithm, the proposed algorithm demonstrated the improvement on accuracy and robust performance as well as in speed aspect. The proposed two steps of algorithm are expecting to have excellent performance in infrared image registration, visible image registration or different image registration with other properties like radar (SAR) image.

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