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COHERENT MIP USING DUAL-TREE QUATERNION WAVELET TRANSFORM FOR GEOMETRIC IMAGE FEATURES

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ABSTRACT

In this paper, Coherent Multiscale Image Processing(C-MIP) technique is proposed alongwith an algorithm. Dual-Tree Quaternion Wavelet Transform (DT-QWT) is multiscale analysis tool for Geometric Image Features (GIF) of C-MIP. DT-QWT can be easily analysed using Dual Tree filter banks. For verification of properties of DT-QWT of an image, complete flow for searching and analysing geometrical structure is proposed. The proposed algorithm finds dissimilarity between two given images alongwith sub-pixel estimation, complexity and unwrapping.

KEYWORDS: C-MIP, dual-tree, DT-QWT, complexity, GIF, wavelets etc.

INTRODUCTION

The estimation and encoding plays a vital role in edge detection, image compression and target detection etc. In edge detection, the main aim is to predict object outlines in an image. In image compression, performance improvements can be achieved by giving information on the relative locations of big transform coefficients. Phase of the Fourier transform is used to compute and represent relative location information in signals[1]-[2]. The shifting property of Fourier gives linear relationship between the signal shift and phase[2]–[3].

Fig.1. H,V,D bands from 2-D DWT basis obtained using Daubechies filter(length-14)

DUAL-TREE QUATERNION WAVELET TRANSFORM (DT-QWT)

In dual-tree quaternion wavelet transform (DT-QWT), each quaternion wavelet has one part that is real three imaginary parts as shown in fig2. QWT has a quaternion magnitude-phase(M-P) representation from the quaternion Fourier transform (QFT)[8]-[9]. QWT's first two phases encod shifts of image features in H/V coordinate i.e., an absolute system, while the third phase encodes edge orientation mixtures analysis. Shift variance is the main drawback of DWT[6]. A small shift in signal create considerable fluctuations in wavelet coefficient energy, making it very difficult to extract and model signal information from the coefficient values. Again , lack of notion of the phase is the second drawback of DWT to encode signal location data as done in Fourier.Complex wavelet transforms (CWTs) and Dual Tree (DT) CWTs provide a good platform to overcome these two drawbacks of the DWT. The 1-D DT-CWT having a slightly repeatitive type tight frame and magnitudes of its coefficients are shift invariant and played important role in image propeeties and features. The 2-D DT- CWT for images is based on theory of 2-D Hilbert transform (HT) and 2-D analytic signal[4]-[5]

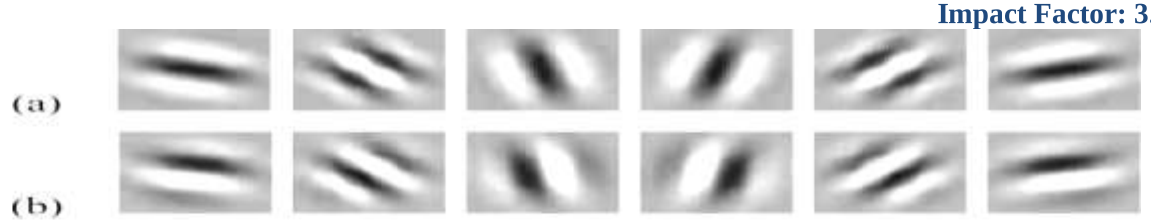


Fig. 2. Six complex wavelets from the 2-D DT- CWT (a) Real parts (b) imaginary parts

COHERENT MIP USING DT-QWT

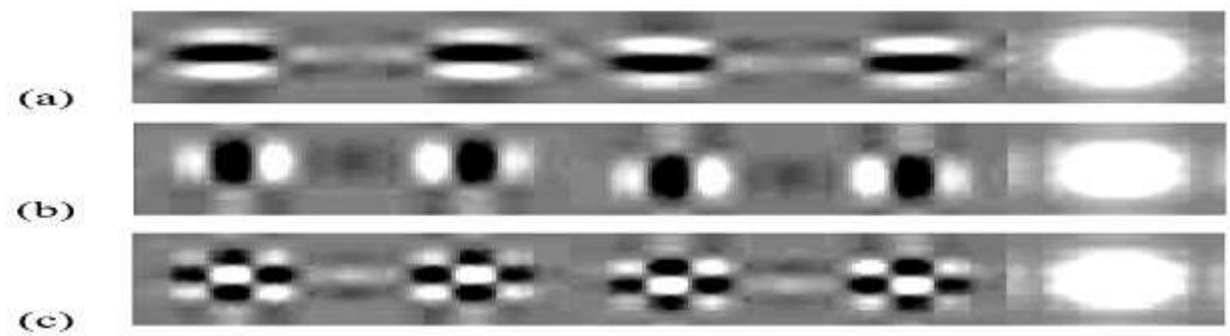


Fig. 3. Three quaternion's from the 2-D DT- QWT frame.

The QWT has magnitude-phase representation from *Quaternion Fourier Transform* (QFT). First two QWT phases i.e $\phi_1$and ϕ_2 invokes and encodes shifts of image features in the *absolute H/V coordinate system*, while third phase,ϕ_3 encodes edge orientation mixtures and texture data[6]-[7].

RESULT AND DISSCUTION

To understand the power of coherent processing, we can consider some image processing applications like development of a new magnitude-and-phase-based algorithm for edge orientation and offset estimation in local image blocks[17]. Our algorithm is entirely based on the QWT shift theorem and interpretation of the QWT as a QFT that is local analysis. Again we can have perticular design of a new image disparity estimation algorithm that is multiscale based. The QWT provides a natural multiscale framework for measuring and adjusting local disparities and performing phase unwrapping from coarse to fine scales with linear efficiency that is computational[10]-[11].The convenient QWT encoding of location information in the absolute H/V coordinate system facilitates averaging across subband estimates for more performance that is robust. Our algorithm offers estimation that is sub-pixel and runs faster than existing disparity estimation algorithms like block matching and phase correlation etc. When many sharp edges and features are present and the image that is underlying field is smooth, our method has better performance indices than existing techniques[16]. Previous work in quaternions and the theory of the 2-D HT and signal that is analytic image processing.It includes blows extension of the Fourier transform(FT) and complex Gabor filters(CGF) to Quaternion Fourier transform (QFT).Our QWT can be interpreted as a QFT that is local having many of its interesting and useful properties that are theoretical as the quaternion phase representation, symmetry properties, and shift theorem whereas QWT is dual-tree, a linear-time[9]

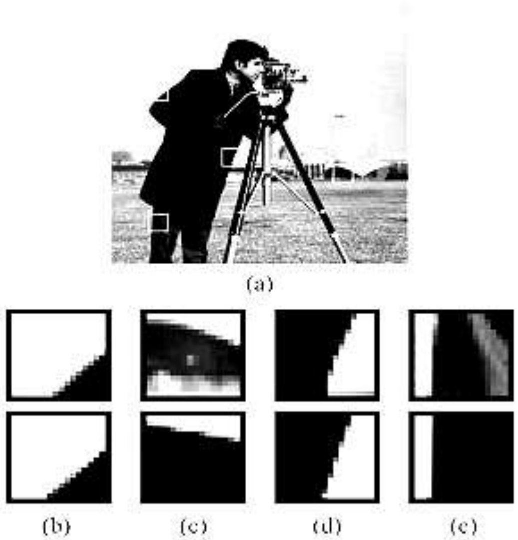


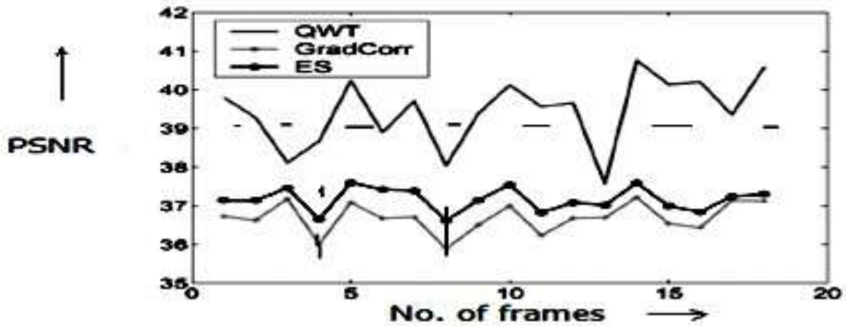
Fig. 4. Geometric Image Feature Estimation using DT- QWT

In DT-QWT data processing, we can easily find disparities between reference image P(x,y) and image Q(x,y) under investigation[12]-[ ]-[13]. *Disparity estimation* is needed for determining the local translations and alignment of different regions in two images. It is amount of 2-D translation required to move a local region of a targeted image centered at (x',y') to match with the region in a reference image centered at(x',y') i.e., at the same location. It is main drawback in a range of image processing and computer vision undergoing tasks, such as video image processing to find out motion between successive frames, time lapse in seismic imaging to study changes in a reservoir for given interval, medical imaging to monitor a patient's body for given interval , super-resolution case and so on[14]-[15].Iterative algorithm in this case can be modified in subbands and scales by proper interpolation and averaging over estimates from all scales containing the identical image blockset and we can also average estimates from three DT-QWT subbands for the same blocksets to yield more precise estimates. Here one care of omitting few unreliable subband estimates (i.e., H-disparity in the horizontal subband , Υ_1 and V-disparity in the vertical subband,Υ_2). To calculate the overall function, peak signal-to-noise ratio (PSNR) between the motion compensated image, R(x,y) and the targeted image, Q(x,y) need to be considered as given below with 'M' pixels[13]-[14]

Formula :-

$$10\log_{10}\left(\frac{(255)^2 M}{\sum_x (Q(x)-R(x))^2}\right)$$

Comparison table for various Images



(a)

	QWT	GC	ES
Rubik	39	36	37
Heart	35	35	38
Taxi	36	36	37
Computation cost	O(M)	O(M log M)	$O(M^2)$

(b)

Fig-5 Analysis of multiscale QWT, gradient correlation and exhaustive search

CONCLUSION

In 2-D MIP , the DT- QWT is useful and efficient method for finding relative location data in images. DT-QWT is based on 2-D HT and 2-D analytic signal as well as on quaternion algebra. The quaternion wavelets includes three phase angles; two of them encode phase shifts in an absolute H/V coordinate system while third encodes textural data. QWT's shift theorem enables analysis of the phase behaviour around boundary regions. QWT has shift-invariance and linear computational complexity during its Dual –Tree implementation approach.

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