Complex Wavelet Filter Bank Algorithm for Hyperspectral Mimetite Spectral Signature –Correlation Compared

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Abstract: The algorithm modified for complex wavelet based spectral signature values to find out the correlation for the first twenty samples of mimetite material .The data received from ISRO, research centre for different wavelength spectrum. The algorithm first considered for real wavelet and correlation is found. The same samples are made complex with the help of Hilbert transform to have the analytic signals The objective of this work is to extend and apply Wavelet based Dimension Reduction overmimetite spectral signature.

Keywords: mimetite spectral signatures, dimension reduction, complex wavelet.

I. Introduction

The spectral signature contains the information about the substances and classes as per the wavelength.(Fig1)[20] compute results based on all the gathered information.

One way to approach this problem is to perform dimension reduction fig(2)[19] as pre-processing, i.e to apply a transformation that brings data from a high order dimension to a low order dimension.

II Dimension Reduction

Complex wavelet dimension reduction:  
As a definition, data or dimension reduction is a process designed to reduce data volumes by filtering out redundant information.

Fig1.example of spectral signature.

The new larger data volumes from hyperspectral sensors present a challenge for traditional processing techniques. Hyperspectral sensors provide much richer information than traditional processing techniques. Hyperspectral sensors provide much richer information than comparable multispectral sensors. However currently we do not have sufficient resources to

Algorithm:

The general description of the wavelet reduction algorithm follows:-

1)For each pixel in a hyperspectral scene, the 1-D signal corresponding to its spectral signatures decomposed using a dual tree complex wavelet filter bank.(fig3)[21]  
2)For each hyperspectral pixel, an approximation of the original spectrum is reconstructed using the synthesis filter bank. The proposed diagram would be reverse of analysis filter bank. The needed level of decomposition for a given pixel is the one that corresponds to producing an acceptable correlation with the original signature.  
3) For each pixel in the hyperspectral scene and for each level of decomposition, the correlation between original and reconstructed signals is computed. All correlations higher than the user- specified threshold contribute to the histogram for that level of decomposition. When all pixels are processed, the lowest level of wavelet decomposition needed to produce such correlation is used for the remainder of the algorithm. The correlation function between the original spectral signature (x) and its reconstructed approximation (y) is shown in (Kaewpijit et al.2003 where N is the original dimension of the signal.
Formula taken for the measure of correlation.

III About the complex wavelet based algorithm:

1) First the spectral signature values of mimetite material is considered for the one level of decomposition with the designed complex wavelet dual tree structures as in figure (3)[18]

2) The data is taken first as real values and with the algorithm mentioned, the correlation is found between the original pixel spectral signature and reconstructed spectral signature.

3) Then the spectral signatures real values are converted into complex with the help of Hilbert transform. The one level decomposition is carried out with the imaginary part and correlation is again found out.

4) The total correlation is the average of both the values and this is an indication of similarity between the pixels.

5) The algorithm is tested on the spectral signatures received from ISRO, RSSC, Nagpur.

Results and Analysis:

The following table is indicating the algorithm implementation for complex wavelet filter bank on the samples of spectral signatures of mimetite material. The samples were taken from the remote sensing centre and introduced in the designed complex filter bank for one level of decomposition. The reconstruction of the spectral signature is then implemented with the help of synthesis filter bank (Table 1)

Conclusion:

The correlation is an indicator of similarity between the spectral signatures. The paper has introduced the complex wavelet algorithm for the reduction process of the hyperspectral spectral signature. The correlation is improved with the complex consideration in the algorithm as compared to the existing algorithm for the wavelet based reduction method.

<table>
<thead>
<tr>
<th>Wavelet Used</th>
<th>Real part Correlation</th>
<th>Imag part corr</th>
<th>Total corr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haar for First twenty spectral Sign</td>
<td>0.9898</td>
<td>0.9928</td>
<td>0.9913</td>
</tr>
</tbody>
</table>

Table 1: Simulation results

References

[6] K. Rasche, R. Geist, and J. Westall, “Detail preserving reproduction of color images for monochromats and...


