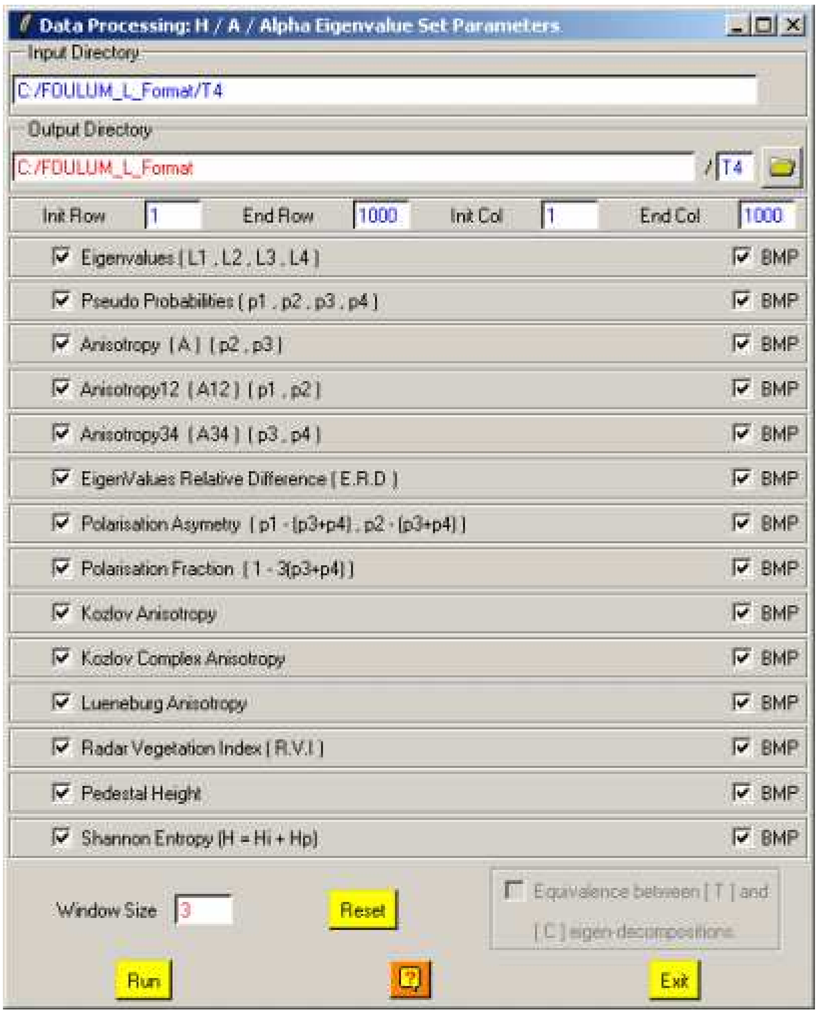
Coherency [T4] matrix - H/A/Alpha Eigenvalue Set



This program creates binary files corresponding to the different polarimetric descriptors obtained from the H/A/Alpha decomposition of the (4x4) complex Coherency matrix **[T4]** raw binary data.

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An option may be set to simultaneously create the corresponding bitmap image files.

Description:

The H/A/Alpha polarimetric decomposition is based on an eigenvector decomposition of the (4*4) complex Coherency **[T4]** matrix, with:

Pseudo-probabilities of the (3x3) complex Coherency **[T4]** matrix expansion elements are defined, from the set of sorted eigenvalues.

$$p_i = \frac{\lambda_i}{\sum_{i=1}^{4}\lambda_i} = \frac{\lambda_i}{span} \quad with \quad p_1 \geq p_2 \geq p_3 \geq p_4$$

The different Polarimetric Descriptors proposed from the Eigenvalue Sets are:

- The anisotropy (**A**) : $A = \frac{p_2 - p_3}{p_2 - p_3} \quad with \quad 0 < A < 1$
- The anisotropy12 (**A12**) : $A12 = \frac{p_1 - p_2}{p_1 - p_2} \quad with \quad 0 < A12 < 1$
- The anisotropy34 (**A34**) : $A34 = \frac{p_3 - p_4}{p_3 - p_4} \quad with \quad 0 < A34 < 1$
- The Single bounce Eigenvalue Relative Difference (S.E.R.D) and the Double bounce Eigenvalue Relative Difference (D.E.R.D) (see publications by S. Allain)
- The polarisation asymmetry (**PA**) :

$$PA = \frac{p_1 - (p_3 + p_4)}{p_2 - (p_3 + p_4)} \quad with \quad 0 < PA < 1$$

(see publications by T. Ainsworth)

- The polarisation fraction (**PF**) : $PF = 1 - 3(p_3 + p_4) \quad with \quad 0 < PF < 1$

(see publications by T. Ainsworth)

- The Radar vegetation Index (**RVI**) :

$$RVI = \frac{4\,p_3}{p_1 + p_2 + p_3} \quad with \quad 0 < RVI < 1$$

(see publications by J.J. Van Zyl)

- The Pedestal Height (**PH**) : $PH = \frac{min(p_1, p_2, p_3)}{max(p_1, p_2, p_3)} \quad with \quad 0 < PH < 1$

(see publications by J.J. Van Zyl)

- The Kozlov Anisotropy (**KA**) : $KA = \frac{|s_1|^2 - |s_2|^2}{|s_1|^2 + |s_2|^2} \quad with \quad 0 < KA < 1$

Where ***s1*** and ***s2*** are the pseudo eigenvalues of the 2x2 Complex Sinclair Matrix

- The Kozlov Complex Anisotropy (**KCA**) :

$$KCA = \frac{s_1 - s_2}{s_1 + s_2} \quad with \quad 0 < |KCA| < 1$$

Where ***s1*** and ***s2*** are the pseudo eigenvalues of the 2x2 Complex Sinclair Matrix

- The Lueneburg Anisotropy (**LA**) :

$$LA = \sqrt{\frac{3}{2}}\sqrt{\frac{p_2^2 + p_3^2}{p_1^2 + p_2^2 + p_3^2}} \quad with \quad 0 < LA < 1$$

- The Shannon Entropy (**SE**) :

$$SE = SE_I + SE_P$$

Avec :

$$SE_I = 4\log\left(\frac{\pi e Tr[T4]}{4}\right) \qquad SE_P = \log\left(4^4 \frac{\det[T4]}{Tr[T4]^4}\right)$$

Shannon entropy of partially polarized and partially coherent light with Gaussian fluctuations, *P. Refregier, J. Morio, JOSA A, Vol. 23, Issue 12, pp. 3036-3044, December 2006*

Application of Information Theory Measures to Polarimetric and Interferometric SAR Images, *J. Morio, P. Refregier, F. Goudail, P. Dubois-Fernandez, X. Dupuis, PSIP 2007, Mulhouse, France*

Comments:

Parameters written in Red can be modified directly by the user from the keyboard.

Input/Output Arguments:

Input Directory	Indicates the complete location of the considered **Main Directory / T4 (MD / T4)** containing the **[T4]** matrix data to be processed.
Output Directory	Indicates the location of the processed data output directory. The default value is set automatically to : **Main Directory / T4 (MD / T4)**.

Output Image Number of Rows/Columns:

The output image numbers of rows and columns are initialised to the input data set dimensions.

Users wishing to process a sub-part of the initial image can modify the **Init** and **End** values of the converted images rows and columns.

Note: init and end values have to remain within the range defined by the input image dimensions.

Processing parameters:

Window Size	Data to be decomposed may be processed through an additional filtering procedure consisting of a boxcar filter. Users have then to set the size of the (N*N) sliding window used to compute the local estimate of the average matrix. The default value of N is set to **0**. Users wishing to avoid additional filtering may set N to **1**.