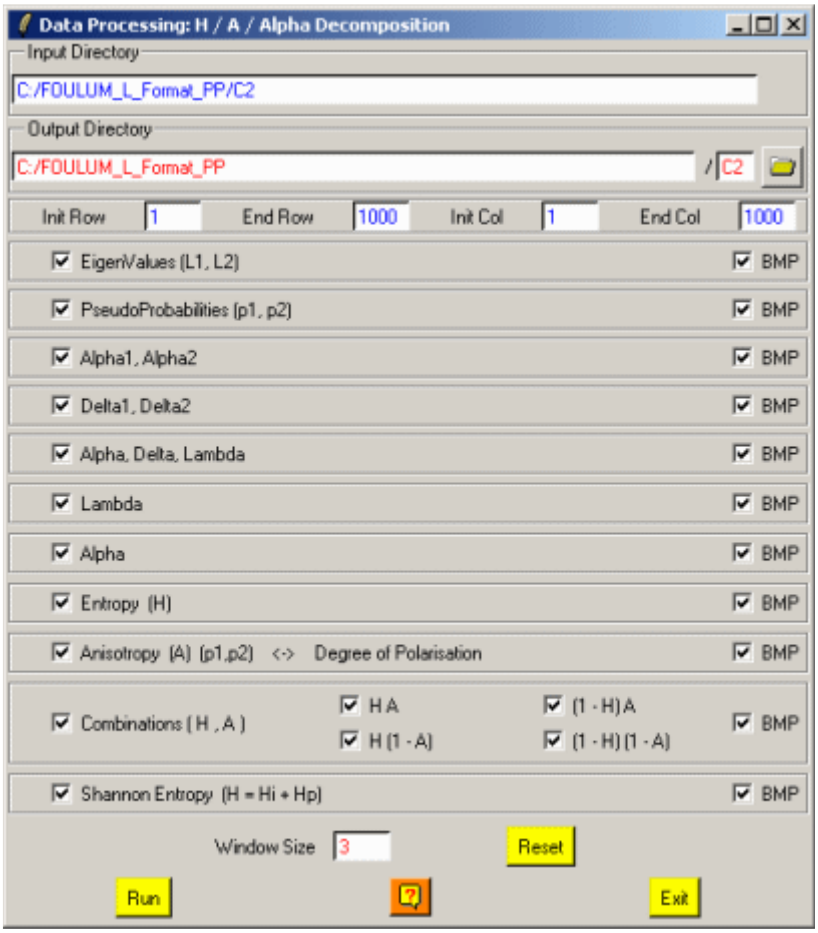
# H/A/Alpha Decomposition




This program creates binary files corresponding to the different polarimetric descriptors obtained from the H/A/Alpha decomposition of the (2x2) complex Covariance matrix **[C2]** 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 (2*2) complex Covariance **[C2]** matrix.

The (2x2) complex Covariance **[C2]** matrix being hermitian, semi-definite positive, its eigenvectors are orthogonal and its eigenvalues are real positive.
The eigenvector decomposition of a distributed target Covariance matrix is considered as a simple statistical model consisting in the expansion of the (2x2) complex Covariance matrix into a weighted sum of two Covariance matrices.

Pseudo-probabilities of the (2x2) complex Covariance **[C2]** matrix expansion

elements are defined, from the set of sorted eigenvalues.

The distribution of the probabilities can be fully described by two parameters :

- The entropy (**H**) indicates the degree of statistical disorder of the scattering phenomenon.
- For high entropy values, i.e. superior to 0.7, a complementary parameter is necessary to fully characterize the set of probabilities. The anisotropy (**A**) is defined as the relative importance of the secondary scattering mechanisms.

Each unitary eigenvector of the (2x2) complex Covariance **[C2]** matrix may be parameterized using **2** real angular variables.

The condition of mutual orthogonality between the eigenvectors involve that the **2** polarimetric parameters sets resulting from the expansion are not independent. For this reason, each polarimetric parameter is associated to a **2** symbol Bernoulli statistical process.
In this way, the estimate of the mean polarimetric parameter set is given by:

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

$$SE = SE_I + SE_P$$

Avec :

$$SE_I = 2\log\left(\frac{\pi e Tr[C2]}{2}\right) \qquad SE_P = \log\left(4\frac{det[C2]}{Tr[C2]^2}\right)$$

***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*

**Note** : In the Partial Polarimetric Case, the Anisotropy is equivalent and equal to the Wave Degree of Polarization.

## 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 / C2 (MD / C2)** containing the **[C2]** 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 / C2 (MD / C2)**. |

## 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**.

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