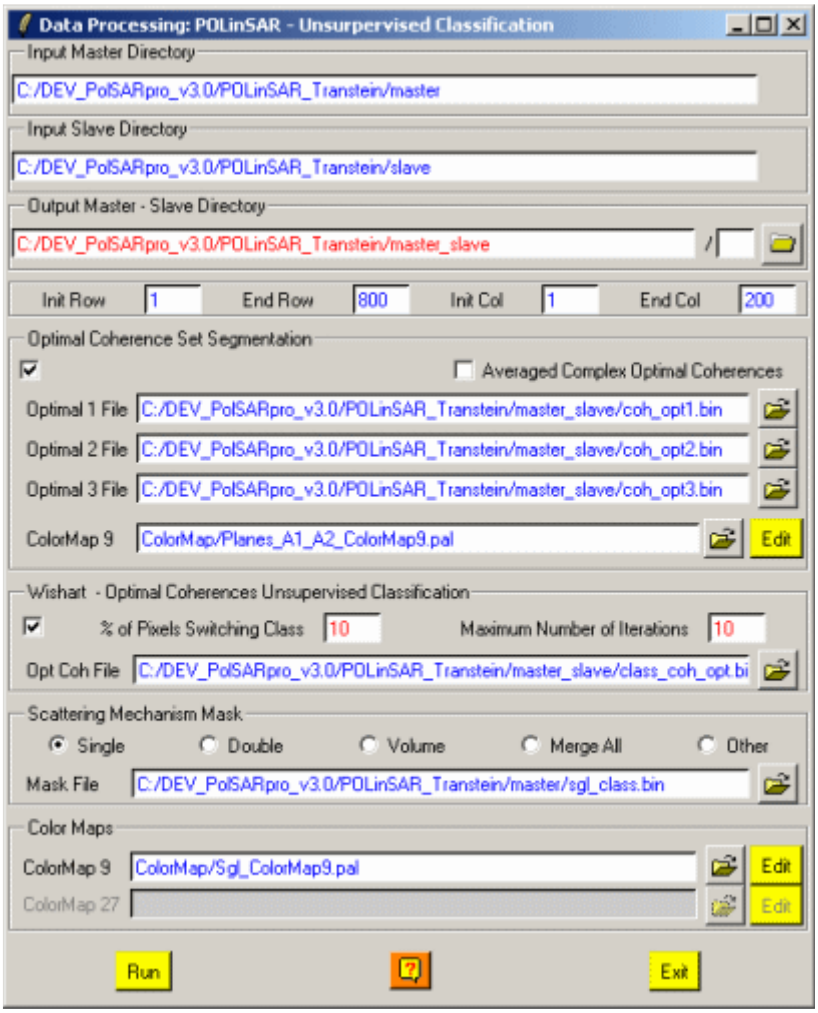
POLinSAR Unsupervised Classification



Description:

This program creates binary and bitmap image files resulting from the POLinSAR unsupervised classification of polarimetric interferometric data using Wishart Maximum Likelihood statistics.

Further information about this classification algorithm can be found in :

L. Ferro-Famil, E. Pottier, J.S. Lee: "unsupervised classification of natural scenes from polarimetric interferometric SAR data", in Frontiers of Remote Sensing information processing, C.H. Chen, Singapore, World Scientific Publishing, 2003, pp 105 – 137.

Comments:

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

Input/Output Arguments:

Input Master Directory	Indicates the location of the considered **Master Main Directory (M-MD)** containing the polarimetric data sets to be processed.
Input Slave Directory	Indicates the location of the considered **Slave Main Directory (S-MD)** containing the polarimetric data sets to be processed.
Output Master-Slave Directory	Indicates the location of the processed data output directory. The default value is set automatically to : **Master-MD_Slave-MD (M-MD_S-MD)**.

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.

Optimal Coherence Set Segmentation:

The optimal coherence set is obtained from the Cloude and Papathanssiou procedure. The complete optimized coherence set represents highly descriptive indicators and are then used efficiently in the proposed unsupervised segmentation process. Two characteristic indicators, A1 and A2, are defined to characterize the relative optimal coherence spectrum as follows:

$$A_1 = \frac{\tilde{\gamma}_{opt\,1} - \tilde{\gamma}_{opt\,2}}{\tilde{\gamma}_{opt\,1}} \text{ and } A_2 = \frac{\tilde{\gamma}_{opt\,1} - \tilde{\gamma}_{opt\,3}}{\tilde{\gamma}_{opt\,1}}$$

$$\text{with } \tilde{\gamma}_{opt\,i} = \left|\gamma_{opt\,i}\right| / \sum \left|\gamma_{opt\,j}\right| \ , \ \tilde{\gamma}_{opt\,1} \geq \tilde{\gamma}_{opt\,2} \geq \tilde{\gamma}_{opt\,3}$$

These parameters indicate relative amplitude variations between the different optimized channels. Similarly to the polarimetric case, the indicators A1 and A2 may be used to estimate the number of independent coherent scattering mechanisms from the optimization results.

A segmentation base on data interferometric properties is performed by projecting pixels in the A1-A2 plane separated in nine regions. This unsupervised segmentation was also found to achieve a high degree of description on other scenes observed with different baselines. This is a consequence of both the coherence optimisation and the definition of a relative coherence set.

Optimal 1,2,3 Files	Optimal polarization state representation of the considered complex coherences The Optimal Coherence input files are:

- M-MD_S-MD / coh_opt1.bin
- M-MD_S-MD / coh_opt2.bin
- M-MD_S-MD / coh_opt3.bin

Averaged Complex Optimal Coherences

Correspond to the use of the averaged optimal polarization state representation of the considered complex coherences
The Averaged Optimal Coherence input files are:

- M-MD_S-MD / coh_avg_opt1.bin
- M-MD_S-MD / coh_avg_opt2.bin
- M-MD_S-MD / coh_avg_opt3.bin

Color Map 9

The colour coding of the bitmap output files is realized by the way of a 9-element dedicated colormap. Users have the possibility to modify the elements of the colormap in an interactive way.

Output Files:

The classification output files are :

- M-MD_S-MD / class_coh_opt.bin : Classification binary output file.
- M-MD_S-MD / class_coh_opt.bmp : Classification bitmap output file.

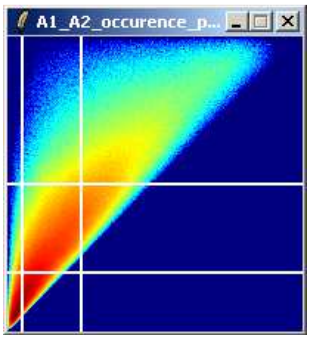
- M-MD_S-MD / A1.bin, A2.bin: A1 and A2 binary output file.

8-bits and 24-bits Output Bitmap Files

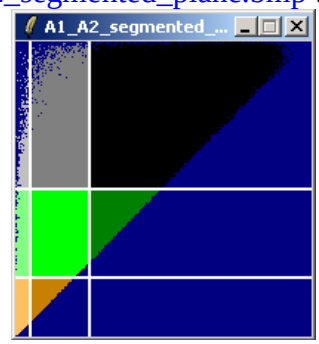
- M-MD_S-MD / coh_opt_RGB.bmp : This 24-bits color-coded image represents the joint information associated to the optimal coherencies and reveals particular behaviors of different types of natural medium under examination. White areas indicate targets showing high coherence independently of the polarization. Green zones reveal the presence of a single dominant coherent mechanism within the resolution cell. Secondary coherences, associated to the red and blue channels have significantly lower values. Dark green color characterizes scattering features dominated by a single mechanism but with a very low coherence.

- M-MD_S-MD / seg_A1.bmp, seg_A2.bmp : Segmented A1 and A2 files.

- M-MD_S-MD / A1_A2_occurence_plane.bmp :



- M-MD_S-MD / A1_A2_segmented_plane.bmp :



Wishart – Optimal Coherences Unsupervised Classification:

The optimal coherence classification results are used to provide an adequate initialisation to a segmentation merging polarimetric and interferometric analysis results. The classification algorithm processes the different canonical scattering mechanisms separately. Pixels belonging to one of the typical scattering type are first segmented using the results of the interferometric coherence set identification. The resulting clusters are used to initialise a kmean unsupervised segmentation procedure based on the Wishart distribution of the (6×6) polarimetric interferometric coherency matrix T6.

In this way, pixels are segmented according to their polarimetric and interferometric features. Clusters resulting from the ML segmentation are assigned a colour indicating their average coherence, ranging from dark for low coherence to light for high coherence.

Globally, polarimetric interferometric characteristics are efficiently segmented into compact clusters corresponding to scatterers with similar polarimetric and interferometric characteristics. The joint use of polarimetric and interferometric data permits to segment the corresponding sparsely vegetated zones or clear-cuts and provides a final mapping with significantly increased information content.

Opt Coh File Optimal Coherence segmentation procedure output file.

- M-MD_S-MD / class_coh_opt.bin

% of Pixels switching Class The segmentation termination criterion consists of a logical combination of two conditions

The iterative k-mean clustering procedure is stopped if :

Maximum Number of Iterations

- A sufficiently low percentage of pixels switch class from one iteration to the other.
- The number of iterations reaches a maximum value

Numerical values are automatically set to default values and may be modified.

Scattering Mechanism Mask:

Single
Double
Volume

Select the different canonical scattering mechanisms to be processed separately by the classification procedure.
The Scattering Mechanism Mask input files are:

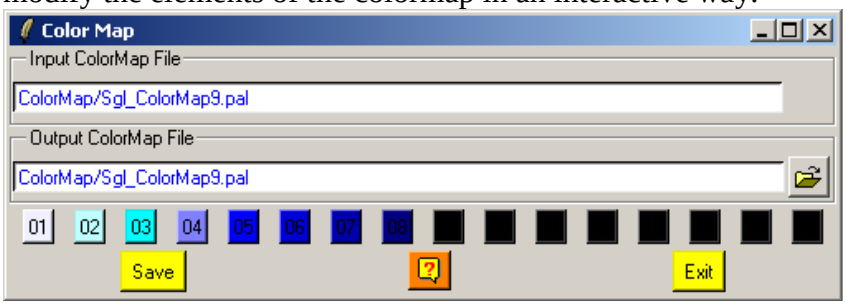
- M-MD_S-MD / sgl_class.bin
- M-MD_S-MD / dbl_class.bin
- M-MD_S-MD / vol_class.bin

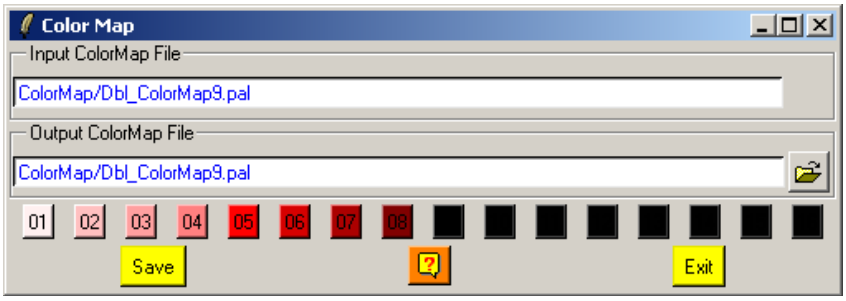
Merge All

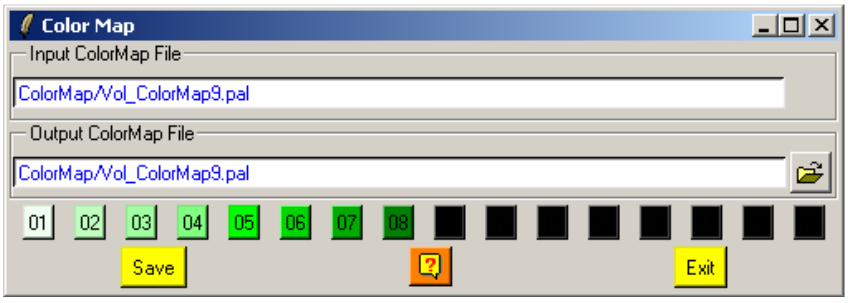
Merge the three classification results for each canonical scattering mechanism in one image.

Color Map 9

The colour coding of the bitmap output files is realized by the way of a 9-element dedicated colormap. Users have the possibility to modify the elements of the colormap in an interactive way.

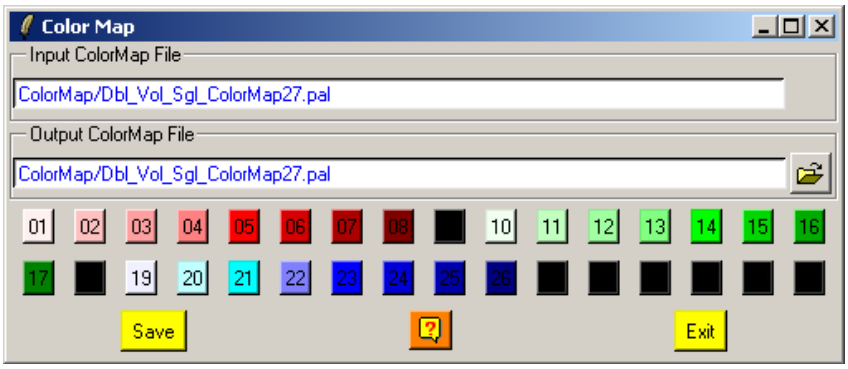






Color Map 27

The colour coding of the bitmap output files is realized by the way of a 27-element dedicated colormap. Users have the possibility to modify the elements of the colormap in an interactive way.



Output Files:

The classification output files are :

Single Scattering Mechanism

- M-MD_S-MD / wishart_coh_opt_sgl.bin : Classification binary output file.
- M-MD_S-MD / wishart_coh_opt_sgl.bmp : Classification bitmap output file.

Double Scattering Mechanism

- M-MD_S-MD / wishart_coh_opt_dbl.bin : Classification binary output file.
- M-MD_S-MD / wishart_coh_opt_dbl.bmp : Classification bitmap output file.

Volume Scattering Mechanism

- M-MD_S-MD / wishart_coh_opt_vol.bin : Classification binary output file.
- M-MD_S-MD / wishart_coh_opt_vol.bmp : Classification bitmap output file.

Merge All Scattering Mechanisms

- M-MD_S-MD / wishart_coh_opt.bin : Classification binary output file.
- M-MD_S-MD / wishart_coh_opt.bmp : Classification bitmap output file.

Other Scattering Mechanism

- M-MD_S-MD / wishart_coh_opt_xxx.bin : Classification binary output file.
- M-MD_S-MD / wishart_coh_opt_xxx.bmp : Classification bitmap output file.