

Rice mapping with polarimetric SAR Data using Sentinel-1

Toolbox

Objectives:

How to process RADARSAT-2 polarimetric products; Derive Polarimetric decompositions for rice identification; Rice mapping using unsuperivised polarimetric classification and supervised wishart classification.

Data:

The sample data used in this exercise was a subset from one RADARSAT-2 Fine quad-pol image acquired on June 27, 2012.

Pass	Asending
Product	Single Look Complex (SLC)
Incidence angle mid swath	38.89
Resolution	8.1*7.6 (R*A)
Location	Jiangsu, China

Software:

The Sentinel-1 Toolbox and SNAP, open source software for scientific learning, research and exploitation of the large archives of ESA Sentinel and heritage missions.

Tutorial:

Open the Data:

Use the **Open Product button** in the top toolbar and browse for the location of the sample data.

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View the product:

In the Products View you will see the opened product. Within the product bands you will see four polarizations:

- HH
- HV
- VH
- VV

For each polarization, there will be the complex data **i and q bands** and virtual bands for **intensity**.



View a band:

To view the HH band, double-click on the Intensity_HH band. Zoom in using the mouse wheel and pan by clicking and dragging the left mouse button.



Calibrating the Data

To properly work with the SAR data, the data should first be calibrated. Calibration radiometrically corrects a SAR image so that the pixel values truly represent the radar backscatter of the reflecting surface. Calibration is essential for quantitative use of SAR data.

From the SAR Processing menu, go to the Radiometric menu and select Calibrate.



For polarimetric processing the data must be **complex**. In the Processing Parameters tab, check mark the **Save as a complex** output.

Calibration	Calibration
I/O Parameters Processing Parameters	I/O Parameters Processing Parameters
Source Product source: [1] subset_0_of_RS2-SLC-FQ20W-ASC-27-Jun-2012_10 Target Product Name:	Source Bands:
subset_0_of_BS2-SLC-FQ20W-ASC-27-Jun-2012_10_Calib Save as: BEAM-DINAP Directory: F:\test Ø Open in SENTINEL-1 TOOLBOX	EBVISAI Auxiliary File:
Eun. Qose	Create beta0 virtual band

Polarimetric Matrix Generation

All the polarimetric tools work with either Coherency or Covariance matrices as input.

From the **SAR Processing** menu, go to the **Polarimetric** menu and select **Polarimetric Matrix Generation**.



In the **Processing Parameters** tab, select a **T3** matrix to convert the Quad Pol product into a Coherency matrix T3. Press **Run** to begin processing.

Processing Parameters
rix: 13
Run Close

When the processing completes, a new product will be added to the Products View. You will notice the new bands produced correspond to the elements of the T3 matrix.



Polarimetric Speckle Filtering

To clean up some of the speckle inherent in SAR images, you can apply a speckle filter. For full polarimetric data, speckle filters must take advantage of all bands and preserve the complex information.

Select Polarimetric Speckle Filter from the Polarimetric menu.



In the **Processing Parameters** tab, select the **Refined Lee** speckle filter, window size **7×7**. Press **Run** to begin processing.

Polarimetric Speckle Filter	Polarimetric Speckle Filter File Help
I/O Parameters Source Product source: [3] subset_0_of_ES2=SLC=FQ20W-ASC=27=Jum=2012_10_Cali	I/O Parameters Speckle Filter Humber of Losi: 1 Window Size: 7x7
Run Close	Run Close

Open the T11 band in both the T3 product and in new speckle filtered T3 product to compare before and after images. The resulting image will have less speckle but also appear more blurred.





Polarimetric Decompositions

Polarimetric decompositions allow the separation of different scattering contributions and can be used to extract information about the scattering process. From the **SAR Processing** menu, go to the **Polarimetric** menu and select **Polarimetric Decomposition**.



In the **Processing Parameters** tab, select the **Freeman-Durden Decomposition and H-A-Alpha decomposition, window size are both 5×5**. Press **Run** to begin processing.

Polarimetric Decomposition File Help I/O Parameters Processing Parameters Decomposition: FreesaurDurden Decomposition FreesaurDurden Processoriton FreesaurDurden Processoriton Fre	Polarimetic Decomposition ************************************
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When the processing completes, you can view all three bands in an RGB colour view by right-clicking on the product name and selecting **Open RGB Image View** from the popup menu.



Freeman RGB (R=double bounce G=volume B=surface)



Cloude RGB (R=entropy G=Anisotropy B=alpha)

Unsupervised polarimetric classification

From the **SAR Processing** menu, go to the **Polarimetric** menu and select **Unsupervised polarimetric classification**.



In the **Processing Parameters** tab, select the **H-Alpha Wishart and Freeman-Durden Wishart**. Press **Run** to begin processing.

Polarimetric Classification File Help	Polarimetric Classification
I/O Parameters Classification: Freeman-Durdan Wishart Window Size: Initial Humber of Classes: H Alpha Wishart Hindow Size: Tinal Humber of Classes: H Alpha Wishart Threshold for Mixed Category: 0.5 Run	I/O Parameters Classification: # Alpha Wishart Window Size: Kaz Iteration: # Alpha Wishart Doal Pol Freeman-Durden Wishart Resear-Durden Wishart Run Close

Double-click on the class results to open it.



H-Alpha Wishart



Freeman Wishart

Supervised polarimetric classification

Select areas as training data sets using the **Create a new geometry container** and other drawing tools on the right hand side of the tool box.



Create a new geometry container, name it and draw it in the image using the drawing tools.

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Select **Supervised Classification Training** from the **Polarimetric** menu, then highlight the training geometries and click on "OK" to start the training. The center for the coherency matrices of the pixels in each user identified class is computed and save in a text file in user specified directory.





From the **SAR Processing** menu, go to the **Polarimetric** menu and select **Supervised Wishart Classification**.



In the **Processing Parameters** tab, select the training geometries txt file, window size 5×5 . Press **Run** to begin processing.

Supervised Wisha	art Classification
File Help	
I/O Parameters Pr	ocessing Parameters
Training Data Set:	F:\training_cluster_centers0.txt
Window Size:	5
	<u>Run</u> <u>C</u> lose
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Crops mapping with polarimetric SAR Data using GF-3 data Objectives:

How to process GF-3 polarimetric products using PolSARpro 6.0

Polarimetric decompositions of GF-3 data for Crops identification

Crops mapping using unsuperivised polarimetric classification and supervised wishart classification

Data: The sample data used in this exercise was a subset from one GF-3 quad-pol image acquired on July 6, 2017

Product	Single Look Complex (SLC)
Incidence angle mid swath	41.18
Nominal Resolution	8
Location	Guangxi, China
Center Frequency	5.40

Software: PolSARpro 6.0

Tutorial:

We choose the environment: Environment----Single Data Set (Pol-SAR),

then choosing GF-3 data file folder.

Selected and click "Save&Exit", Will pop up one Warning: Choose "No".



import data: import----Spaceborne Sensors----GaoFen-3(GF-3)

open file GF3_MYN_QPSI_004764_E110.5_N25.9_20170706_L1A_AHV_L10002463697.meta.xml



Read head file: Click

Import four polarizations S11\S12\S21\S22 corresponding to HH\HV\VH\VV







Extract PolSAR images, and choose Full Resolution. out data format Choose Sinclair Element.



D:/龙计划/GF3_MYN_QPSI_004764_E110.5_N25.9_20170706_L1A_AHV_L10002463 /

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Symmetrisation (S12 = S21) 2x2 Complex Scattering Matrix S2

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End Row

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End Col

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Exit

Covariance Elements C [C2] C [C3] C [C4]

data conversion: Converting S2 to T3

Output Directory

Input Data Format | - Output Data Format -

Sinclair Elements

Coherency Elements

Init Row 1

Full Resolution
 Sub Sampling

C Multi Look

🧣 Data File Conversion					×
Input Directory					
D:/龙计划/sub_GF3					
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Init Row 1 End Ro	w 3000	Init Col	1	End Col	2000
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Full Resolution					
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Input Data Format 2x2 Cor	nplex Scattering M	latrix S2	_		
— Output Data Format					
C [S2]>>[S2]	○[\$2]>>[12]			
C [S2]>>(s11,s21)	C [\$2]>>(s22, s12)		C [S2]>>(s11	, s22)
C [S2]>>(L·HV)	C [\$2]>>(R - HV)		C [S2]>> (pi4))
C [\$2]>>(I11,I21)	C [\$2]>>(122, 112)	(C [\$2]>>(I11,	122)
C [S2]>>[C2]-pp1	C [\$2]>>[C2]·pp2		C [S2]>>[C2]	- pp3
<pre>C [S2]>>[C2]-LHV</pre>	C [\$2]>>[C2]·RHV		C [S2]>>[C2]	- pi4
C [S2]>>[C3]	C [S2]>>[C4]			
	C [\$2]>>[T4]			
Run	2			Exit	

Generate an RGB image for displaying a color composite image

Select: Display—>Create RGB File—>RGB Color Composition 1—>Run

🧣 Create RGB File	×
- Input Directory	
D:/龙计划/sub_GF3/T3	- 🖻
- Output Directory	
D:/龙计划/sub_GF3/T3	- 🖻
Init Row 1 End Row 3000 Init Col 1 End Col	2000
 Pauli Composition [S11+S22] [S12+S21] [S11-S22] Sinclair Composition [S11] [(S12+S21)/2] [S22] Combine Blue File Green File Red File 	
- BLUE Input Data File	
S11+S22	- 2
GREEN Input Data File	_
IS12+S21	—
RED Input Data File	
S11-S22	- 🖻
Color Channel Contrast Enhancement	
✓ Automatic MinMax ✓ Independant C Common	
Blue Channel Red Channel Green Channel	
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- Output RGB File	
D:/龙计划/sub_GF3/T3/PauliRGB.bmp	_
Run 🖸 Exit	

To clean up some of the speckle inherent in SAR images, you can apply a speckle filter. For full polarimetric data, speckle filters must take advantage of all bands and preserve the complex information.

Next, the matrix T3 element is filtered.

Select: Process—>Polarimetric Speckle Filter—>Lee Refined Filter

Lee Refined Filter, the reason for choosing this filter is that it can retain the polarization information well under the influence of removing speckle filters.

Speckle Filter			×	
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D. Mart 201300_CH 5_CCC				
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C [S2] >> [T3]	C [S2] >> [C3]	€ [S2]>>[T4]	C [S2]>> [C4]	
Number of Looks 1 Window Size Row 7 Window Size Col 1				
📕 System Noise Filtering (HV / VH)				
Run			Exit	

滤波前和滤波后的 RGB 合成图对比





Polarimetric Decompositions

Polarimetric decompositions allow the separation of different scattering contributions and can be used to extract information about the scattering process. From Process menu, elect Polarimetric Decomposition.

For example H/A/Alpha Polarimetric Decomposition





Unsupervised polarimetric classification

 $H/A/Alpha\ Classification: choose\ Process -> Polarimetric\ Segmentation --> H/A/Alpha\ Classification$





Supervised polarimetric classification

In the supervised classification method, we choose Supervised Wishart Classification method for practice.



Click Graphic Editor, and you need to open a BMP file in order to make Classification Training. Then, you can edit Classification Training areas. This step is very important in supervised classification and will affect the final classification result. What's more, you click Run training process.

Five types of land objects were selected as follows:water, urban, forest, cropland and bamboo forest.

🦸 Data Processing: Wishart Supervised Class	sification	×			
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Set File D:/龙计划/sub_GF3_LEE/T3/wishart_training_cluster_centers.bin GF3_LEE/T3/wishart_training_cluster_centers.bin					
Run	2	Exit			



