





→ 8th ADVANCED TRAINING COURSE ON LAND REMOTE SENSING

10–14 September 2018 University of Leicester | United Kingdom

Forestry applications with Polarimetry and Interferometry (Practical)

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The initiative development of PolSARpro Software is a direct result of recommendations made during the POLinSAR 2003 Workshop held at ESA-ESRIN in January 2003.









The initiative development of result of recommendation Workshop held at ESA-

ro Software is a direct ring the POLinSAR 2003 anuary 2003.







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EXIT



Toolbox specifically designed to handle : Pol-SAR, Pol-InSAR, Pol-TomoSAR and Pol-TimeSAR data.

Educational Software offering a tool for selfeducation in the field of Polarimetric SAR data processing and analysis.

Developed to be accessible to : a wide range of users from novices to experts in the field of Pol-SAR, Pol-InSAR, Pol-TomoSAR, Pol-TimeSAR.

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282





Windows 10

More than 1740 different Pol-SAR, Pol-InSAR, Pol-TomSAR and Pol-TimeSAR functionalities.

> Each element of the Software (*a function*) can be extracted and incorporated individually into users' own processing software.

PolSARpro v5.2 Software is made available following the: Open Source Software Development (OSSD) approach, and follows the: GNU General Public License v2 – June 1991.

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+3000 registered users
+70 foreign countries

International Collaborative Project (4 Agencies, 15 Research Centres, 14 Universities)









Contributors 2017

Tsinghua University, China



University of Mining and Technology, China



National Space Science Center, CAS, China



Fudan University, China

Institute of Technology



Wuhan University, China



Satellite Surveying and Mapping **Application Center, China**



Xidian University, China



Harbin Institute of Technology China



Universidade Federal de Alagoas, Brazil

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R

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Khajeh Nasir Toosi University of Technology, Iran

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PolSARpro v5.2 Software offers the possibility to handle and convert polarimetric data from a range of well established CURRENT polarimetric airborne platforms.

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PolSARpro v5.2 Software offers the possibility to handle and convert polarimetric data from a range of well established PAST polarimetric spaceborne platforms.

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PolSARpro v5.2 Software offers the possibility to handle and convert polarimetric data from a range of well established CURRENT polarimetric spaceborne platforms.

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PolSARpro v5.2 Software offers the possibility to handle and convert polarimetric data from a range of well established **CURRENT** polarimetric spaceborne platforms.

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External Softwares



ESA - SNAP



ESA SNAP toolbox bridge





Polarimetric SAR Data Processing



- S1 toolbox (split, deburst, merge ...)
- Geocoding toolbox
- Terrain correction
- Interferometric toolbox (co-registration, flat Earth estimation ...

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Software – General Presentation

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Based on the OpenGL technology : open and process large image (20000 x 20000)

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SATIM Map Algebra





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SATIM Map Algebra





Display N BMP Images

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PolSARpro Calculator v1.0	
Op #1 (Op#1) Op#2 Operand #1 File Mat S / M File Mat S / M 2x2 mat STO RCL MC	Operator : File C (file) + value C (file) - value C (file) + value C (file) - value C (file) + (file) C (file) - (file) C (file) - value C (file) - value C (file) + (file) C (file) - (file) C (file) - value C (file) - value C (file) + value C (file) - value C (file) - value C (file) - value C (file) + value C (file) - value C (file) - value C (file) - value C . real (.) C . imag (.) C . abs (.) C . conj (.) C . cos (.) C . sin (.) C . tan (.) C . conj (.) C . squt (.) C . (.)^2 C . (.)^2 (?) OK C . log (1.1) C . ln (1.1) C . 10^2 (.) C . (.) > (?) C . 10log (1.1) C . 20log (1.1) C . (.) < (?) C . (.) > (?)
Input File Data Format Init Row End Row Init Col End Col OK	Operator : Sinclair Matrix : S2 C [S] + value C [S] - value C [S] * value C [S] / value C [S] + value C [S] - value C [S] / value C [S] / value C [S] + value C [S] - value C [S] / value C [S] / value C [S] + (File) C [S] - value C [S] / value C [S] / value C [S] + [S'] C [S] - value C [S] / value OK C [S] + [S'] C [S] + [mat] C [S] / value OK C [S] / [S] * C [U] t.*[S] * [U] C OK C .conj[S] C . tr[S] C .det[S] C .inv [S] C .eig1[S] C .eig2[S] C .eig1[G] C .eig2[G]
Input Value Type Input Value Complex Value Float Value N x N Matrix Complex Complex Float Hermitian OK	Operator : Hermitian Matrix : C2, C3, C4, T2, T3, T4 C [M] + value C [M] - value C [M] / value C [M] + (file) C [M] - (file) C [M] .* (file) C [M] .* (file) C [M] .+ (file) C [M] (file) C [M] .* (file) C [M] .* (file) C [M] .+ (file) C [M] (file) C [M] .* (file) C [M] .* (file) C [M] .+ (file) C [M] (file) C [M] .* (file) OK C [M] .+ (M') C [M] (file) C [U] .* (M] .* inv[U] OK C .coni [M] C .tr [M] C .det [M] C tr (inv [mat] .* [M]) C .eig1 [M] C .eig2 [M] C .eig3 [M] C .eig4 [M]
m11 +i m12 +i m13 +i m14 +i m21 +i m22 +i m23 +i m24 +i Load m31 +i m32 +i m33 +i m34 +i Save m41 +i m42 +i m43 +i m44 +i Save Output Value	Operator : Complex / Hermitian / Float / Special Unitary NxN Matrix O [mat] + value C [mat] - value C [mat] / value O [mat] .+ [mat'] C [mat] [mat'] C [mat] ./ [mat'] O [mat] .+ [mat'] C [mat] [mat'] O [mat] ./ [mat'] O . det [mat] O . tr [mat] O . conj [mat] O . inv [mat] O . eig1 [mat] O . eig2 [mat] O . eig3 [mat] O . eig4 [mat]

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/ PolSARpro Simulator (c) Dr Mark L. Williams	
PolSARproSim	
Cutput Master Directory	
C:/DEV_PolSARpro_v3.0_track0	🗀 E 🖻
Output Slave Directory	
C:/DEV_PolSARpro_v3.0_track1	🖬 🖬 🖻
Geometric Configuration Platform Altitude (m) 3000. Horizontal Baseline Incidence Angle (deg) 45. Vertical Baseline (e(m) 10.0 m) 1.0
System Configuration Centre Frequency (GHz) 1.30 Azimuth Resolution Slant Range Resolu	(m) <u>1.5</u> tion (m) <u>1.06066</u>
Ground Surface Configuration Surface Properties (Smoothest = 0 Roughest = 1 Ground Moisture Content (Driest = 0 Wettest = 1 Azimuth Ground Slope (%) 2.0 Range Ground Sl	10) 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Forest Configuration Tree Species Hedge (0) Pine (1, 2, 3) Deciduous (4) Tree Height (m) 18.0 Forest Stand Density (stems Forest Stand Circular Area (Ha) 0.282745	4 AV
Random Number Generator 35961 Final Image Number of Rows 105 Final Image Nur Configuration File C:/DEV_PolSARpro_v3.0_track0/pspsim_config	Save Config
Bun 7	Fxit









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PolSARpro - Bio SOFTWARE





PolSARpro - Bio SOFTWARE





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PolSARpro - Bio SOFTWARE




BIOMASS MISSION

BIOMASS mission : 7th ESA Earth Explorer (2021)



Biomass will provide global maps of the amount of carbon stored in the world's forests and how this changes over time.

Further our knowledge of the role forests play in the carbon cycle.

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PolSARpro-Bio

The new scientific toolbox for ESA & third party fully polarimetric SAR missions

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PolSARpro - Bio will offer the possibility to handle and convert polarimetric data of **FUTURE** polarimetric spaceborne platforms.

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PolSARpro - Bio will offer the possibility to handle and convert polarimetric data of **FUTURE** polarimetric spaceborne platforms.

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New functionalities











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Pol-TomoSAR processor





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PolSARpro v5.2 SOFTWARE



http://earth.esa.int/web/polsarpro



The Web Site provides

- Details of the project
- Access to the tutorial and software
- Information about status of the development
- Demonstration Sample Datasets

ESA validated, tested and vetted releases

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PolSARpro v5.2 SOFTWARE



https://earth.esa.int/web/polsarpro



https://www.ietr.fr/polsarpro



 Permanent updates (bugg fixed, new functionalities ...)
Beta version releases (not ESA validated)

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PolSARpro v5.2 SOFTWARE





PolSARpro - v5.2 : Linux *light* version





PolSARpro - v5.2 *complete* version





December 2018



October 2018



PolSARpro - Bio : Distribution will start from January 2019

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Forestry Applications with Pol-InSAR *Practical*

1st part : Simulated Pol-InSAR datasets



2nd part : Airborne Pol-InSAR datasets (ESAR - DLR)



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AfriSAR campaign / Gabon

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Forestry Applications with Pol-InSAR *Practical*



1st part : Simulated Pol-InSAR datasets



2nd part : Airborne Pol-InSAR datasets (ESAR - DLR)



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AfriSAR campaign / Gabon

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1 sur 44

140

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116

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0

1

4 * -

1.0

300

Save Config

Exit

SE. FULLEI - 2018

Final Image Number of Columns 141

Roughest = 10 1

Wettest = 10

Range Ground Slope (%)

Forest Stand Density (stems / Ha)

۲



Surface Properties

Forest Configuration Tree Species

Tree Height (m)

Configuration File

Run

Ground Moisture Content

Azimuth Ground Slope (%)

18.0

Random Number Generator

C:/DEV PolSARpro_v3.0_track0/pspsim_config

Final Image Number of Rows

Forest Stand Circular Area (Ha) 0.282745

(Smoothest = 0

[Driest = 0

105

2

Hedge (0) Pine (1,2,3) Deciduous (4)

35961

2.0



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PolSARproSim is a rapid, coherent, fully polarimetric and interferometric SAR simulation of forest.

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The SAR image is evaluated as a coherent sum of scattering events from small elements of the scene







Direct-Ground, Direct-Volume and Ground-Volume contributions are included, with both trees and short vegetation comprising Volume terms.



D\



Given the map of tree locations and dimensions a grid of points is used to sample the attenuation of the coherent wave in 3D



RANDOM HEDGE







Geometric configuration

Platform altitude :	3000m
Incidence angle:	45°
Horizontal Baseline :	10m
Vertical Baseline :	0m

System Configuration

Frequency :	1.5 GHz
Azimuth resolution :	1.3811 m
Range resolution :	0.6905 m

VIT EALLY ILETING

Ground Surface Configuration

Surface properties :	0 (smoothest)
Ground moisture Content :	0 (driest)
Azimuth / Range ground slope	e : 0 %

Forest configuration

Tree Species :	0 (hedge)
Tree Height:	10m
Forest stand density :	0.2
Forest Stand Circular Area :	1 Ha









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MAIN MENU - ENVIRONMENT



Input Master Directory: <u>My_Data_Directory / Pol-InSAR_PolSARproSIM_forest / master</u>

Input Slave Directory:

My_Data_Directory / Pol-InSAR_PolSARproSIM_forest / slave

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PROCESS DATA





PROCESS DATA





ELEMENTS



🦞 Polarimetric SAR Data Processing and Educational Tool v5.1 - Menu	×-
CE CSA PolSARpro The Polarimetric SAR Data Processing and Educational Tool	
T3 S Environment Convert Process Display Calibration Utilities Tools Configuration Help T	Quit .

🖉 Data 🖡	Processing: Sinc	dair Elements				×
Input Dir	ectory					
C:/My_Da	ita_Directory/Pol	-InSAR_PolSAR	proSIM_forest/master			
- Output D	irectory					
C:/My_Da	ita_Directory/Pol	-InSAR_PolSAR	proSIM_forest/master	_		
Init Ro	w 1	End Row	301 Init Col	1	End Col	301
S11		C III	(A11 (dB) = 111	(dB)	C Phase	₩ BMP
S21	⊂ A21	C 121	C A21 (dB) = 121	(dB)	Phase	₩ BMP
\$12	○ A12	C 112	I A12 (dB) = 112	(dB)	C Phase	🗭 BMP
S22	C A22	C 122	⊂ A22 (dB) = 122	(dB)	Phase	R BMP
Pauli	C Cmplx	Mod	20log10(Mod)	(dB)	C Phase	₩ BMP
Span	C Linear	🖲 De	ciBel = 10log(Span)			🗭 ВМР
	Selec	- All		F	laval	
	Jelec	2.250		-	ICSCI	
	Run				Exit	

Do it Yourself: Select some elements, set the parameters and view the corresponding BMP files (*select BMP*).

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ELEMENTS





100 % v s21_pha.bmp (833.7 ko)

px▼

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100 % v s22_pha.bmp (833.7 ko)

px •

ELEMENTS







HH-VV

span

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PROCESS DATA









🖉 Interferogram Est	mation		-	×	
- Input Master Directory					
C:/My_Data_Directory/	Pol-InSAR_PolSARpro	SIM_forest/master		-	
- Input Slave Directory		_			
C:/My_Data_Directory/	Pol-InSAR_PolSARpro	SIM_forest/slave		_	
- Output Master-Slave [Directory				
C:/My_Data_Directory/	Pol-InSAR_PolSARpro	oSIM_forest/master_sla	ive /		
Init Row 1	End Row	301 Init Col	1 End Col	301	
- Image 1				-	
С НН С НУ	CW CHH	+W C HH ·W	CLL CLR	C BB	
Image 2					
⊂нн €н∨	C W C HH	+W ⊂ HH ·W	CIL CLB	C BB	
T Averag	ging	Row	Col		
Run			Exit		

Do it Yourself: Select polarization channels and view the corresponding BMP files.

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🖉 Interferogram Estimation	
Input Master Directory	
C:/My_Data_Directory/Pol-InSAR_PolSARproSI	IM_forest/master
- Input Slave Directory	
C:/My_Data_Directory/Pol-InSAR_PolSARproSI	ilM_forest/slave
Output Master-Slave Directory	
C:/My_Data_Directory/Pol-InSAR_PolSARproSI	ilM_fd_est/master_slave / 🔤
Init Row 1 End Row 3	301 Init Col 1 End Col 301
- Image 1-	
СНН • НУ С W С НН + V	W CHH-W CLL CLR CRB
Image 2	
СНН €НV СW СНН+V	W CHH-W CLL CLR CRB
T Averaging	Bow Col
	Linear L
Run	Exit
Ø WARNING	X
CREA C:/My_Data_Directory/Pol	ATE THE DIRECTORY ? oHnSAR_PolSARproSIM_forest/master_stave
Yes	No Cancel

Note: The Output Directory is automatically set to: MasterDir_SlaveDir

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* | | |

px▼

100 % v interferogram_LL_LL.b.

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<u>(HH-VV) (HH-VV)</u>

px▼ 100 % ▼ interferogram_HHmVV...

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ΉH+VV) (HH+VV)

px • 100 % • interferogram_HHpVV_....

RR RR*

px▼ 100 % ▼ interferogram_RR_RR.b.

PROCESS DATA





FLAT EARTH REMOVAL





Do it Yourself:

Enter Flat Earth file name, set the parameters and run the function.

Note:

The Input Slave Directory is automatically set to: SlaveDir_FER

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PROCESS DATA











Do it Yourself: Select polarization channels view the corresponding BMP files.

Note:

The Output Directory is automatically set to: MasterDir_SlaveDir_FER

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PROCESS DATA





COHERENCE ESTIMATION





17 Complex Coherence Estimation				
Input Master Directory				
C:/My_Data_Dire	ectory/Pol-InSAR	_PolSARproSIM_forest/ma	aster	
- Input Slave Dire	ectory			
C:/My_Data_Dire	ectory/Pol-InSAR	_PolSARproSIM_forest/sla	we_FER	
- Output Master-9	alave Directory			
C:/My_Data_Dire	ectory/Pol-InSAR	_PolSARproSIM_forest/ma	aster_slave_FER	
Init Row	1 End	Row 301 Init	Col 1	End Col 301
- Complex Coher	ences		_	
-Linear-	- Circular	Pauli	Optimal	
🖾 нн	I LL	HH+W THV+	VH 🔽 SVD	L. MinMax
I HV	I▼ LR	F HH W T HH	AV* ☐ PD	□ L. Diff
ΓW	I⊏ BB	_	IT NR	
- Numerical Ra	dius	Loci MinMa	x	a Diff
Thela1	Theta3	Num Points	thus	n Points
- Box Car Win	dow	BMP	-	
Row 7	Col 7	- Averaging	Row	Col Col
Run		Hid		Exit

Do it Yourself:

Select polarization channels (*linear, circular, pauli, SVD*), set the parameters (*Box Car = 7x7*) and view the corresponding BMP files (*select BMP*).

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COHERENCE ESTIMATION







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COHERENCE ESTIMATION





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COHERENCE ESTIMATION





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CE CSA PolSARpro The Polarimetric SAR Data Processing and Educational Tool	
T3 S Environment Convert Process Display Calibration Utilities Tools Configuration Education Help T	Quit .
In MENSION FINOLEDONES	
	m

301

+

Esit

2º

End Col

HH

Polarimetric Channel

Weighting Coherence Fraction Factor

Ground Phase Centre HH - V

Coherence Amplitude Inversion Procedure Ground Phase Estimation & RVOG Inversion Procedure



Do it Yourself:

Output Master - Slave Director

DEM Differencing Algorithm

Median Window Size

Top Phase Centre

Run

Polarimetric Phase Centre Height Estimation

Coherence Amplitude Inversion Procedure

C:/My_Data_Directory/Pol-InSAR_PolSARproSIM

Ground Phase Estimation and RVOG Inversion Procedure

Init Row

2D Kz File

C:/My_Data_Directory/Pol-InSAR_PolSARproSIM_forest/master_slave_FEF

End Row

301

-

.

Hist

Update List

st/slave/kz.bin

Init Col

Set the parameters (*Median Size = 21, Factor = 0.4*) and view the corresponding BMP files.

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-180

-5 m

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+180

+25 m



4 Height Estimation from Inversion Procedu	
Input Master - Slave Directory	
C:/My_Data_Directory/PoHnSAR_PoISARproSIM	_forest/master_slave_FER
- Output Master - Slave Directory	
C./My_Data_Directory/Pol-InSAR_PolSARproSIM	_forest/master_slave_FER
Init Row 1 End Row	301 Init Col 1 End Col 301
	Update List
F Polarimetric Phase Centre Height Estimation	Polanimetric Channel HH
DEM Differencing Algorithm	
Coherence Amplitude Inversion Procedure	
Ground Phase Estimation and RVOG Inversion	Procedure
Median Window Size 21 💌 🔺	Weighting Coherence Fraction Factor
Top Phase Centre HV 💌	Ground Phase Centre HH - VV
– 2D Kz File	
C:/My_Data_Directory/Pol-InSAR_PolSARproSIM	(_forest/slave/kz,bin
Pue	



Data Analysis - Data histograms

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MapAlgebra v1.1	
-1- RVOG_heig	hts.bmp (301×301
100	
<u>. 18</u>	
200	
zoom : 83 % value = -5.00	pixel : 145 12 < 8.83 < 25.00

🧳 Data Analysis : Statistics - Histog	ram		×
- Input Data File			
- Input Data Format			
C Complex	🖲 Float	C Integ	er
Show	_		4
🦳 🦳 Modulus 🦵 10log(Mod)	C 20log(Mod)	C Phase 🕟 Real	r Imag
Histogram Title		Histogram Label	
HISTOGRAM		Label	
— Minimum / Maximum Values [x-axis]—		4	
Min Automatic	Auto	Max Auto	MinMax
Clear Extract & Process	Plot	C box	loge
		Exit	

Do it Yourself: Step 1 : Select a BMP File

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sa





🥼 Data Analysis : Statistics - Histog	ram	_	×
- Input Data File			
C:/My_Data_Directory/Pol-InSAR_PolS	ARproSIM_forest/ma	aster_slave_FER/RV	0G_heights.bin 🗃
- Input Data Format	_		
C Complex	Float		C Integer
Show			
C Modulus C 10log(Mod)	C 20log(Mod)	C Phase G	Real C Imag
Histogram Title		- Histogram	Label
HISTOGRAM			Label
— Minimum / Maximum Values [x-axis]—			
R Automatic Min	Auto	Max Au	ita MinMax
Clear Extract & Process	Plot	r Tine	Eloze
		Exit	

Do it Yourself: Step 2 : Select an Input Binary Data File Select what to Show Enter the Histogram Title Enter the Histogram Label

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2 Polarimetric SAR Data Processing and Educational Tool v5.1 - Menu	
CESA PolSARpro The Polarimetric SAR Data Processing and Educational Tool	
T3 S Environment V Import V Convert V Process V Display V Calibration V Utilities V Tools V Configuration V Education V Help V	Quit .



Do it Yourself: Step 3 : Define the polygon area 1) *Right button* : Select area

- 2) Left button : Draw the polygon
- 3) Enter : Close the polygon
- 4) *Right button* : Save configuration

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🖉 Data Analysis : Statistics - Histo	gram		×
- Input Data File			
C:/My_Data_Directory/Pol-InSAR_Pol	SARproSIM_forest/m	aster_slave_FER/RV06	i_heights.bin 🗃 🗃
- Input Data Format			
C Complex	Float	r	Integer
- Show			4
🦷 Modulus 🦵 10log(Mod)	C 20log(Mod)	C Phase G R	eal C Imag
Histogram Title		Histogram La	bel
HISTOGRAM	(† †	La	abel
— Minimum / Maximum Values [x-axis]		4	
I Automatic Mir	n Auto	Max Auto	MinMax
Clear Extract & Process	Plot	r line	Elose
		Exit	

Do it Yourself: Step 3 : Extract and Process

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Do it Yourself: Step 4 : Plot the histogram

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Configuration
Help



- 🗆 🗙

Quit

Cesa PolSARpro

Polarimetric SAR Data Process

The Polarimetric SAR Data Processing and Educational Tool

T3 S Environment Maport Convert Process Display Calibration Utilities Tools

🥼 Data Analysis : Statistics - Histor	gram	_	N	×
Input Data File			1	
C:/My_Data_Directory/Pol-InSAR_PolS	SARproSIM_forest/m	aster_slave_FE	R/RV0G_heig	ghts.bin 🗃 😹
- Input Data Format				
C Complex	🙃 Float		C Inter	ger
Show				4
🦳 Modulus 🦵 10log(Mod)	C 20log(Mod)	C Phase	Real	(Imag
Histogram Title		- Hist	ogram Label —	
- RVOG Heights			Label	
— Minimum / Maximum Values (x-axis)				
T Automatic Min	0	Max 🗍	15	MinMax
Clear Extract & Process	Plot	G line		Close
			Exit	



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Data Analysis : value - Profile	
Input Data File	
	Input Data Format
	- Pixel Values
	X Y +i
	Show
	C Modulus C 10log(Mod) C 20log(Mod)
	C Phase C Real Part C Imag part
	Range Length (pix) Value
	C X Range C Y Range C [X,Y] Range
Mouse Position	C Mesh C Surface C Mesh C C Mesh S
X 191 Y 1 Val 0.53	– Minimum / Maximum Values (y-axis)
Drientation	T Auto Min Max MinMax
	- Profile Title
Plot M W Close	
	(ral)
	Exit

Do it Yourself: Step 1 : Select a BMP File

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	June of Daylor Ferreral
	Complex Float CInteger
	Pixel Values
11.51	Shaw C Modulus C 10log(Mod) C 20log(Mod)
	Range Length (pix) Value
Have Davier	C X Range C Y Range C (X,Y) Range
X 191 Y 1 Val 0.53	Mesh C Surrace C Mesh L C Mesh S Minimum / Maximum Values (y-axis)
- Orientation	T Auto Min Max MinMax
	- Profile Title

Do it Yourself: Step 2 : Select a Input Binary Data File

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Do it Yourself: Step 2 : Select the row / col to define the profile 1) Zoom : mouse outside the rect Left button : Zoom in Right button : Zoom out 2) Move : mouse inside the rect

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🖉 Data Analysis : Value - Profile	
Input Data File	
C:/My_Data_Directory/Pol-InSAR_PolSARpros	SIM_forest/master_slave_FER/RV0G_heights.bin
	Input Data Format Complex Float C Integer Pixel Values X 152 Y 125 10.818792 +i Show C Modulus C 10log(Mod) C 20log(Mod) C Phase C Real Part C Imag part
	Range Length (pix) 30 Value 10.818792 Representation
Mouse Position	C Mesh C Sulface C Mesh C C Mesh S
X 152 Y 125 Val 10.76	— Minimum / Maximum Values (y-axis)
Orientation	🔽 Auto Min Auto Max Auto MinMax
	Profile Title
Plot Close	RANGE PROFILE
	Exit

Do it Yourself: Step 4 : Select the pixel (row / col) center of the profile

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Quit

×



Do it Yourself: Select what to show in 1D or 3D Fix range length (100pix in 1D, 30pix in 3D) Set min / max values **Plot**



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Forestry Applications with Pol-InSAR *Practical*





2nd part : Airborne Pol-InSAR datasets (ESAR - DLR)



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AfriSAR campaign / Gabon

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MAIN MENU - ENVIRONMENT



Input Master Directory: <u>My_Data_Directory / Pol-InSAR_Traunstein / master_slc</u>

Input Slave Directory:

My_Data_Directory / Pol-InSAR_Traunstein / slave_slc

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RAW INTERFEROGRAM





🖉 Interferogram Es	timation					×
- Input Master Directo	y -					
C:/My_Data_Directory	/Pol·InSAR_Trau	nstein/maste	er_slc			-
- Input Slave Directory						
C:/My_Data_Directory	/Pol-InSAR_Trau	nstein/slave,	_slc			-
- Output Master-Slave	Directory					
C:/My_Data_Directory	//Pol-InSAR_Trau	nstein/maste	e_slc_slave_slc)		
Init Row 1	End Row	1320	Init Col	1	End Col	1414
- Image 1	-					-
С НН Ф НУ	CW C	HH + W	C HH · W	СШ	C LR	C BB
Image 2						
⊂нн €н∨	CW C	HH + W	C HH · W	СШ	⊂ LR	C BB
T Aver	aging		Row	Col		
Bun					Exit	

Do it Yourself: Select polarization channels and view the corresponding BMP files.

Note:

The Output Directory is automatically set to: MasterDir_SlaveDir

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RAW INTERFEROGRAM





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FLAT EARTH REMOVAL





Do it Yourself:

Enter Flat Earth file name, set the parameters and run the function.

Note:

The Input Slave Directory is automatically set to: SlaveDir_FER

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RAW INTERFEROGRAM





🖉 Interferogram Estimation									
Input Master Directory									
C:/My_Data_Directory/Pol-InSAR_Traunstein/master_slc									
- Input Slave Directory	,								
C:/My_Data_Directory/Pol-InSAR_Traunstein/slave_slc_FER									
- Output Master-Slave	Directory								
C:/My_Data_Director	//Pol-InSAR_Trau	nstein/maste	r_slc_slave_slc_	FER	/				
Init Bow 1	End Row	1320	Init Col	1	End Col	1414			
- Image 1-	-					-			
С НН Ф НУ	CW C	HH + W	C HH W	CL	C LR	C BB			
Image 2				-					
⊂нн €н∨	CW C	HH + W	C HH · W	СШ	⊂ LR	C BB			
T Averaging			Row Col						
Bun		12			Exit				

Do it Yourself: Select polarization channels and view the corresponding BMP files.

Note:

The Output Directory is automatically set to: MasterDir_SlaveDir

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RAW INTERFEROGRAM





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CONVERT (S2 >> T6) + MULTILOOK Cesa

🥼 Polarimetric SAR Data Processing and Educational Tool v5,1 - Menu	- E X
CE CSA PolSARpro The Polarimetric SAR Data Processing and Educational Tool	
T3 S Environment V Import V Convert V Process V Display V Calibration V Utilities V Tools V Configuration V Education V Help V	Quit .







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CONVERT (S2 >> T6) + MULTILOOK Cesa



Do it Yourself: Select Multi Look : Row = 6 and Col = 2 Select Output Data Format : 2 x [S2] >> [T6]

→ 8t Note:

10-14 The Output Directory is automatically set to: MasterDir_SlaveDir_FER_MLK / T6

CONVERT (S2 >> T6) + MULTILOOK Cesa







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px▼ 100% ▼ PauliRGB_T2.bmp (1.7 Mo)









🖉 Speckle Fill	ter					-	X
- Input Master-S	ilave Direc	tory		-			
C:/My_Data_Di	rectory/Po	HnSAR_Trauns	tein/master	_slc_slave_s	lc_FER_M	LK/T6	-
			_		-		
							_
- Output Master	-Slave Dire	ectory					-
C:/My_Data_Di	rectory/Po	HnSAR_Trauns	te n/master	_slc_slave_s	lc_FER_M	LK_LEE	T6 🗃
Init Row	1	End Row	220	Init Col	1	End Col	707
		LEE	Refined S	peckle Filter	1.	_	
Number of Lo	ooks 📑	3 Wind	ow Size Ro	w 3	Wind	dow Size Col	1
E	lün					Exit	
-				7		_	

Do it Yourself: Set the parameters : Num Looks = 3 ; Window Size = 3.

Note:

The Output Directory is automatically set to: MasterDir_SlaveDir_FER_MLK_LEE

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DISPLAY DATA





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Coefficients (6x6)	X
Traunstein/master_slc_slave_slc_	FER_MLK_LEE/T6
Traunstein/master_slc_slave_slc_	
Row 220 Init Col	1 End Col 707
□ Ro13 = (HH1 , W1)	□ Ro23 = (HV1, VV1)
□ Ro46 = (HH2, W2)	□ Ro56 = (HV2, VV2)
F Ro15=(HH1,HV2)	□ Ro16 = (HH1, W2)
✓ Fo25 = (HV1, HV2)	E Ro26 = (HV1, VV2)
Ro35 = (VV1 , HV2)	₩ 1036 = (W1, W2)
dow Size : Bow 5 Col	5 Select All Beset
on one . How of Ou	
	Exit
	Coefficients (bx6) Traunstein/master_slc_slave_slc_ Traunstein/master_slc_slave_slc_ Row 220 Init Col Ro13 = (HH1 , VV1) Ro46 = (HH2 , VV2) Ro46 = (HH2 , VV2) Ro35 = (HV1 , HV2) Ro35 = (VV1 , HV2) Ro35 = (VV1 , HV2) Row Size : Row 5 Col

Do it Yourself: Select the correlation coefficients, set the parameters (*Box Car = 5x5*) and view the corresponding BMP files.

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CORRELATION ESTIMATION



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p×▼ 100% ▼ cmplx_coh_LL_mod.bmp (1.4 Mo)

Sa

CORRELATION ESTIMATION







COHERENCE ESTIMATION





Complex Coherence Estimation				
- Input Master-S	lave Directory			
C:/My_Data_Dir	ectory/Pol-InSAF	R_Traunstein/master_slc_slave_slc_	FER_MLK_LEE/T6	
- Output Master-	Slave Directory			
C:/My_Data_Dir	ectory/Pol-InSAF	{_Traunstein/master_slc_slave_slc_	FER_MLK_LEE / T6 🖻	
Init Row	1 End	d Row 220 Init Col	1 End Col 707	
- Complex Coher	rences			
Linear	Circular	Pauli	Optimal	
Г⊽ НН	RL	I HH + W I HV + VH	🔽 SVD. 🥅 L. MinMax	
I HV	I LR	HH W THUW*	T PD T L Diff	
₩ ¥	RB BB		IT NR	
- Numerical B	adius	- Loci MinMax	- Losi Diff	
Thelat	Thete3	Num Points	Num Prints	
(nead) 1	meas [Incarity cards	International and a second sec	
-Box Car Wir	ndow	BMP		
Row 7	Col 7	Averaging Ro	aw Cal	
Run		Hist	Exit	
			_	

Do it Yourself:

Select polarization channels (*linear*, *circular*, *pauli*, *SVD*), set the parameters (*Box Car* = 7x7) and view the corresponding BMP files (*select BMP*).

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COHERENCE ESTIMATION





COHERENCE ESTIMATION











Quit



2 Exit

*

B

Do it Yourself:

HV

•

Hist

n/kz-phi-mlk/kz.bir

Top Phase Centre

Run

C:/My_Data_Directory/Pol-InSAR_Traunst

2D Kz File

Set the parameters (Median Size = 21, Factor = 0.4) and view the corresponding **BMP** files. 2D Kz File : DataDirectory / kz-phi-mlk / kz.bin

HH - VV

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Ground Phase Centre (HH - VA







→ 8th ADVANCED TRAINING COURSE ON L





DISPLAY DATA





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DISPLAY DATA





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HEIGHT ESTIMATION - HISTOGRAM







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HEIGHT ESTIMATION - PROFILE





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Forestry Applications with Pol-InSAR *Practical*



2nd part : Airborne Pol-InSAR datasets (ESAR - DLR)



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ESA AfriSAR CAMPAIGN

ESA AfriSAR Airborne Campaign Lope National Park, Gabon

ONERA (2015) - DLR (2016)

Tropical forests of Gabon

P-Band (*Biomass Mission*) Single baseline = 80m

Courtesy of Dr Maryam Pourshamsi

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ESA AfriSAR CAMPAIGN

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MAIN MENU - ENVIRONMENT

Input Master Directory:

My_Data_Directory / Pol-InSAR_AfriSAR / master_slc_slave_slc_FER_MLK

Input Slave Directory:

My_Data_Directory / Pol-InSAR_AfriSAR / master_slc_slave_slc_FER_MLK

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DO IT YOURSELF

${\cal Q}$ -Polarimetric SAR Data Processing and Educational Tool v5.1 - Menu		_ = = ×
CESA PolSARpro The Polarimetric SAR Data Processing and Educational Tool		
T3 S Environment) Import Convert) Process) Display Calibration) Utilities	Tools Configuration Education Help	Quit .
Height Estimation from Inversion Procedures		
Input Master - Slave Directory	INVERSION PROCEDORES	
C:/My_Data_Directory/Pol-InSAR_AfriSAR/master_slc_slave_slc_FER_MLK/T6	DEM Differencing Algorithm	

342

•

Exit

2

End Col

HH

Coherence Amplitude Inversion Procedure / тб 📄 Ground Phase Estimation & **RVOG Inversion Procedure** Ŧ

Do it Yourself:

Output Master - Slave Directory

DEM Differencing Algorithm

Median Window Size

Top Phase Centre

2D Kz File

C:/My_Data_Dir

Run

1

Polarimetric Phase Centre Height Estimation

Coherence Amplitude Inversion Procedure

Ground Phase Estimation and RVOG Inversion Procedure

Init Row

C:/My_Data_Directory/Pol-InSAR_AfriSAR/master_slc_slave_slc_FER_MLK

End Row

◄▲

Hist

•

ctory/Pol-InSAR_AfriSAR/master_slc_slave_slc_FER_MLK/kz_ML.bin

572

Update List

Init Col

Weighting Coherence Fraction Factor

Ground Phase Centre HH + VV

Set the parameters (*Median Size = 3, Factor = 2*) and view the corresponding BMP files. 2D Kz File: DataDirectory / Pol-InSAR_AfriSAR / master_slc_slave_slc_FER_MLK / kz_ML.bin