Training Course for POLSARPRO

Training Course team

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Background

The development of the PolSARpro software was initiated in the frame of the ESA funded study, "Applications of Synthetic Aperture Radar Polarimetry" (AO/1-3949/01/I-LG). This study focused on the use of Polarimetric SAR (POLSAR) and Interferometric Polarimetric SAR (POLInSAR) techniques for the observation of land surfaces and sea ice.

PolSARpro v2.0 is developed under contract to ESA ("Development of a Polarimetric SAR Image Analysis Tool", ESA–ESRIN Contract no. 17863/03/I–LG) by a consortium comprising I.E.T.R at the University of Rennes 1, DLR-HR and the University of Adelaide. The initiative is a direct result of recommendations made at the Workshop on "Applications of SAR Polarimetry and Polarimetric Interferometry (POLINSAR 2003)" held in January 2003 at ESRIN, Frascati, Italy.

The objective of the current project is to provide a tool for self-education in the field of POLSAR data analysis at university level and a comprehensive suite of functions for the scientific exploitation of fully and partially polarimetric multi-data sets and the development of applications for such data.

A wide-ranging tutorial and comprehensive documentation provide a grounding in polarimetry and polarimetric interferometry necessary to stimulate research whilst the tools establish a foundation for the development of scientific applications that exploit polarimetric data and techniques.

PolSARpro is developed to be accessible to a wide range of users, from novices to experts in the field of Polarimetry and POLInSAR data processing. The tool is conceived as a flexible environment, with a friendly and intuitive graphical user interface (GUI) enabling the user to select a function, set its parameters and run the software.

The GUI, written in Tcl-Tk (80000 lines), manages around 120 widget windows that control 150 C routines performing well-established algorithms in the field of polarimetric radar signal processing. Due to its modular structure, each element of the software (a function) can be incorporated individually into users' own processing software, and users can easily add new functions and components, as their need arises.

PolSARpro v2.0 software will run on the following platforms: Windows 98+, Windows 2000, Windows NT 4.0, Windows XP, Linux I386, SOLARIS and Macintosh OS, and will be made available following the Open Source Software Development (OSSD) approach.

Currently in its development stage, PolSARpro v2.0 (source code and elements software packages) will be released gradually throughout 2004 and 2005 and made publicly available for free download from the ESA Web Portal (Earthnet) at: http://earth.esa.int/polsarpro.

Aim of the Training Course

The primary objective of this Training Course is to provide insights into the main functionalities of the PolSARpro v2.0 software, illustrated with demonstrations of the Tool.

The course is open to both novices and experts in the field of Polarimetry and POLInSAR data processing who wish to discover the functionalities offered by the PolSARpro v2.0 software.

This Training Course combines both a lecture/tutorial and a practical course in handling polarimetric data.

Training Course Organization

During the Training Course, the three following key topics will be considered:

- General presentation of the software
- PolSARpro – Single Data Set package
- PolSARpro – EO Scientific Investigator package.

In topics 2 and 3, selected key functionalities will be presented in the form of brief lectures, introducing the essential aspects of the widget handling. Participants are then encouraged to run a simple illustrating and demonstrating exercise in a classical workshop fashion.

The course will end with a practical course to illustrate a complete polarimetric data processing chain.

Training Course Programme

09h00 – 09h30 Topic 1: General Presentation of the PolSARpro Software

This first topic concerns the presentation of the software architectural design, environment interface, modular structure, directories organisation, data management, etc.

This first part is completed with a presentation of some key software functionalities:

- **Help** (The software is accompanied by detailed help files for each individual function which can be dynamically displayed)
- **Tutorial** (The software is accompanied by a tutorial, providing a substantial and balanced introduction to the basics, scattering concepts, systems, advanced concepts and typical applications of SAR Polarimetry (POLSAR) and SAR Polarimetric Interferometry (POLInSAR). This tutorial enables self-education in the field of Polarimetry and is illustrated with application examples showing the full range of functions offered by the tool in the *"Do it yourself"* sections)
- **Display** (The software offers the possibility to create and export images in an 8-bit or 24-bit dynamic range (Windows Bitmap and TIFF formats) for inclusion in reports, or export them to GIS software for comparison with other data. A basic Viewer (PV 3.0) is also available, which can be used to display and modify output results in common graphics formats such as Windows Bitmap)

- **Tools** (The software offers basic operating functions, e.g. IEEE format conversion, rotation, flip, transpose, complex FFT, etc. These functions may be applied directly to any binary raw data files)

09h30 – 11h00 **Topic 2: PolSARpro – Single Data Set Package**

The PolSARpro Full software interface comprises a large collection of well-established algorithms and tools designed for the analysis of single data set polarimetric SAR data (single channel) with specialized functionalities for in-depth analysis of fully and partially polarimetric data and the development of applications for such data.

During this second part, all the component functionalities of a complete polarimetric data processing chain are presented. Each topic is illustrated with a short demonstration exercise.

09h30 – 09h40 • **Environnement, Import raw binary data, Sub-area extraction**
09h40 – 09h50 • **Polarimetric data conversion**
09h50 – 10h00 • **Change of polarisation basis**
10h00 – 10h10 • **Speckle filetring, P.W.F**
10h10 – 10h20 • **Data processing: polarimetric elements representation**
10h20 – 10h30 • **Polarimetric decompositions and analysis**
10h30 – 10h40 • **Unsupervised Wishart - H / A / <u>a</u> classification**
10h40 – 10h50 • **Supervised polarimetric Wishart segmentation**
10h50 – 11h00 • **Optimal Polarimetric Contrast Enhancement (O.P.C.E)**

11h00 – 11h30 **Break**

11h30 – 12h00 **Topic 3: PolSARpro – EO Scientific Investigator Package**

The PolSARpro software has interfaces dedicated to processing data from specific spaceborne (Envisat ASAR, ALOS-PALSAR, RADARSAT2, TerraSAR, SIR-C) and airborne sensors (AIRSAR, Convair, EMISAR, ESAR, PISAR, RAMSES). This EO Scientific Investigator package proposes a 'recommended' (identical in all cases) processing chain summarizing essential functionalities in order to provide a first and simple qualitative analysis of the polarimetric data set.

During this third part, some of these processing functions are presented and illustrated with a demonstration exercise.

11h30 – 11h40 • **Speckle filter (BoxCar, JS Lee refined filter)**
11h40 – 11h50 • **H / A / <u>a</u> decomposition and analysis**
11h50 – 12h00 • **Unsupervised Wishart - H / A / <u>a</u> classification**

12h00 – 13h00 **Practical Course**

This laboratory course is based on a *"Do it yourself"* approach. A complete polarimetric data processing chain is proposed to the participants in order to illustrate and consolidate the Training Course.