

RADARSAT-2 Polarimetric Products Simulated from CV-580 Data

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ACRONYMS AND ABBREVIATIONS

CD	Compact Disk
ENVI	Environment for Visualizing Images
ERDAS	Earth Resources Data Analysis System
FQ	Fine Quad polarization
GeoTIFF	Geographic Tagged Image File Format
HH	Horizontal transmit, horizontal receive polarization
HV	Horizontal transmit, Vertical receive polarization
LUT	Look-Up Table
MDA	MacDonald, Dettwiler and Associates Ltd.
NESZ	Noise-Equivalent Sigma-Zero
PCI	Parallel Cascade Identification
RSI	Radarsat International
SAR	Synthetic Aperture Radar
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SLC	Single-Look Complex
SQ	Standard Quad polarization
VH	Vertical transmit, Horizontal receive polarization
VV	Vertical transmit, Vertical receive polarization
XML	EXtensible Markup Language



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1 INTRODUCTION

Simulated RADARSAT-2 products are required prior to launch for a variety of purposes including testing image analysis software and guiding applications development. While RADARSAT-1 data is ideal for simulating heritage products other approaches are required to simulate new products available from RADARSAT-2, namely dual-polarized, polarimetric and ultrafine products.

MacDonald, Dettwiler and Associates Ltd. (MDA) has simulated RADARSAT-2 dual-polarized and polarimetric Single-Look Complex (SLC) products from the Environment Canada Convair 580 airborne polarimetric Synthetic Aperture Radar (SAR). These simulated products have the same resolution, pixel spacing and noise level as real products and are presented in the RADARSAT-2 product format. Samples of dual-polarized (HH, HV) and polarimetric products simulated from CV-580 data acquired over Quebec City are provided on the accompanying Compact Disk (CD).

The simulation is limited to the following RADARSAT-2 modes:

- Dual polarisation (HH, HV or VV, VH): Standard, Fine and Wide modes
- Polarimetric (HH, HV, VH, VV): Standard Quad (SQ) and Fine Quad (FQ) modes

On the CD a separate directory is provided for each sample product.

This document provides a brief description of the simulation process and how real products will differ from simulated products. The RADARSAT-2 product format is defined in the RADARSAT-2 Product Format Definition document which is also provided on the CD.

Further information on RADARSAT-2 is available from <http://www.radarsat2.info/> or by contacting Gordon Staples at Radarsat International (RSI) (gstaples@rsi.ca).



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2 SIMULATION PROCESS

The input to the simulation is calibrated, single-look complex CV-580 polarimetric data. All four channels (HH, HV, VH, VV) are processed for fully-polarized products but only two channels (HH, HV or VV, VH) are processed for dual-polarized products.

The simulation process involves the following steps:

1. Simulating RADARSAT-2 data from CV-580 data. This involves:
 - a) Adding zero mean complex Gaussian noise to increase the Noise-Equivalent Sigma-Zero (NESZ) to RADARSAT-2 levels.
 - b) Filtering in the slant range and azimuth directions, to achieve the desired resolution and spectral shape while preserving polarimetric information.
 - c) Interpolating in the slant range and azimuth directions to the desired sample spacing.
 - d) Scaling real and imaginary components to 16-bit signed integers.
2. Converting the simulated data to the RADARSAT-2 product format. This involves:
 - a) Converting image data to Geographic Tagged Image File Format (GeoTIFF) format
 - b) Generating the eXtensible Markup Language (XML) header file
 - c) Generating Look-Up Tables (LUT) in XML for σ_0 , γ_0 and β_0

The RADARSAT-2 XML header file contains information on the sensor, processing parameters and geographic location of the scene. The simulation parameters along with the CV-580 header provide information for populating only a small number of the many fields in the XML header. For example, the CV-580 header does not provide any information on the geographic location of the scene.



To populate the remaining header fields the XML header is based on example headers generated by the RADARSAT-2 processor from simulated raw data. While these headers do not represent the actual CV-580 all header fields are populated with sensible values. Example headers were generated for each product of interest.

The GeoTIFF image format can be read and displayed by many image analysis packages (e.g., ENVI, PCI, ERDAS). The XML files can be viewed by any text editor or Internet browser. The procedure for applying LUTs to retrieve calibrated values is explained in the RADARSAT-2 Product Format Definition document.

3 DIFFERENCES TO A RADARSAT-2 PRODUCT

There remain a number of differences between the simulated RADARSAT-2 products and a real product:

- The data calibration quality is determined by the CV-580 calibration system and not the RADARSAT-2 calibration system.
- The NESZ is assumed constant over both the input and output images. In practice the NESZ varies over the swath being lower at the centre of the swath and higher at swath edges. This variation is caused by the antenna pattern of the sensor and varies from beam to beam.
- Information provided in the XML header is not entirely related to the simulated image. The reason for this is that not all information is available in the CV-580 header files.
- Users will be able to order RADARSAT-2 data with different LUTs applied depending on the application (e.g., land, ice, etc.). This variety of LUTs is not provided by the simulator, rather one standard LUT is used.
- The simulated products do not represent a particular beam. The airborne CV-580 covers a wide range of incidence angles, far exceeding the incidence angle range of the RADARSAT-2 beams.
- CV-580 coverage is limited compared to RADARSAT-2 coverage. The size of the simulation does not represent the size of a RADARSAT-2 product.
- The simulator provides RADARSAT-2 products according to the March 2003 format definition.



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