Development of the SAR Data Processing Package

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Abstract: This paper describes the SAR data processing S/W package it will be able to process the SAR image. This package constructs the several modules: SAR Image processing module, measuring module of surface displacement using differential interferometric SAR method, classification module using the POLSAR data, SAR Focusing module. In this paper, briefly describe the algorithm that is adopted to the functions, and module architecture.

Keywords: SAR Data processing, Focusing, POLSAR.

1. Introduction

The previous spatial image information became accomplished with the fragmentary processing technique which applies only a specific satellite image in specific objective, but that are many restriction to satisfy the requirement form the application field which is various to there. But, recently, several fusion approaches have been proposed in the multiple sensor fusion domain, and then these approaches could accomplished many new information which only a single sensor processing was not able to acquire.[1],[2],[3]

As a part of these efforts, out team is developing the single sensor (Hyper-spectral image, LIDAR data, SAR data) processing package as the base technique for integrated processing for multi-sensor spatial image. This paper describes the SAR data processing S/W package it will be able to process the SAR image as a part of "Integrated Processing Technology for Multi-sensor spatial imagery Information" project.

2. S/W Package

1) Introduction of "the Integrated Processing Technology for Multi-sensor spatial imagery Information"

Integrating spatial image information which is acquired by the various sensors (optical image, radar image, hyper-spectral image, and LIDAR data) and individual processor information, this project pursues technical development which creates new information to acquire to be impossible with the individual processor techniques. As a part of the development target, our team is planning to develop the individual sensor processing package in this year.

- Hyper-Spectral Image Processing system
  - Hyper-Spectral Image basic processing
  - Hyper-Spectral Image Compression
  - Hyper-Spectral Image Data processing
  - Hyper-Spectral Image classification algorithm
- LIDAR Data Processing system
  - LIDAR Data basic Processing
  - LIDAR 3D fast& optimal display
  - LIDAR data processing utility
- **SAR Data Processing system**
  - Image Processing
  - Differential Interferometric SAR processing
  - POLSAR Data Classification
  - SAR Focusing
- Ground Image Processing system
  - Short Distance Image Basic Processing
  - Spatial Image Information Processing in ground image
  - GPS/INS/DMI Tight-coupled Integration
- Multi-sensor fusion system
  - Core technique analysis
  - Core technique design

2) SAR Data Processing Module

This module describes the SAR Data Processing module among them.

(1) Focusing

Passing the following step, focusing module converts the raw data into the image data.

- Raw Data Correction: Bias removal, Gain imbalance correction, non-orthogonality correction
  - Bias removal: zero-bias calculation & bias remove
  - Gain imbalance correction: Correct and detect gain of I/Q signal amplifier
- Range Compression: it applies Inverse linear

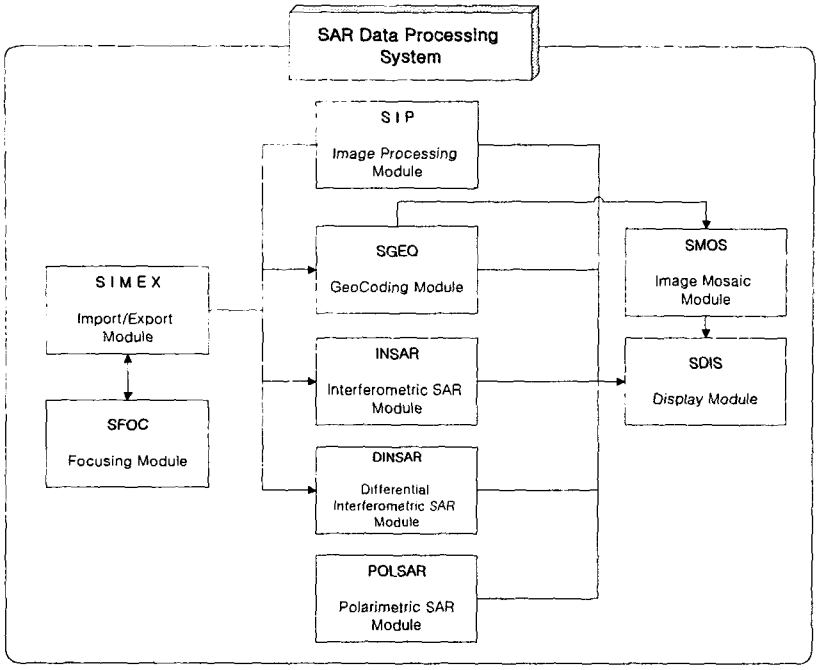

Fig. 1. SAR Data Processing System

FM chirp filter in sample data of range direction, and it reconstruct a signal.

- Doppler Parameter Estimation: For exact azimuth compression, calculate the Doppler parameter when image acquiring.
- Range Migration Correction: correct the migration of the range direction which it follows in satellite progress.
- Azimuth Compression: Using the Doppler parameter, it accomplishes the reconstructing filter with azimuth direction and matched filter.
- Multi-look Processing: it accomplishes the look filter for minimizing the speckle noise, synthesizes the a each result data with each other and generates the multi-look detected image

(2) Differential Interferometric SAR – Surface Displacement measure

Several methods have been proposed in DINSAR technique: 2-pass, 3-pass. Among them, we applied 2-pass DInSAR technique which used the one pair SAR Image and DEM data. We used DEM data and simulated interferogram for removing terrain phase.

- Multi-look amplitude image generation: convert single look complex image to multi-looked image
- Radar coordinate DEM generation: convert the DEM image to the image of radar-coordinates.
- Image Matching: match between the multi-looked master image and simulated SAR image.
- Radar DEM resample: resample the DEM image using the matching result.
- Interferogram simulation: simulate the interferogram.
- Differential interferogram generation: extract the residual phase from real interferogram and simulated interferogram.
- Slave orbit refinement: refine the slave orbit from residual phase.

(3) POLSAR Data Processing

- Data Preprocessing : POLSAR Data synthesizing, POLSAR Data Conversion, Polarization Signature
- Unsupervised classification: Polarimetric SAR Data unsupervised classification which analyzes the surface scattering mechanism analysis – polarimetric entropy, anisotropy, alpha angle.
- Supervised classification: Polarimetric SAR Data supervised classification which uses the Wishart classification method.

(4) SAR Image Processor

- Radiometric Correction: Beta-Nought, Sigma-Nought Image generation
- Slant range to Ground Range Conversion: SLC Image with Slant range conversion to ground range image
- Despeckling: Filtering the speckle noise
- Simulation image generation: simulate the ERS image with the CEOS header information.

(5) GeoCode

- Geocode: Generate a map projected SAR image based on only orbit information
- Orthorectify: Generate a rigorous geocoded SAR image with a DEM information and GCP

(6) Interferometric SAR

- Co-registration: co-registration about the ERS pair (Master and Slave)
- Interferogram generation: generate the interferogram image from the co-registered ERS pair.
- Phase Unwrapping: unwrap the interferogram phase
- DEM generation: extract the DEM information from the phase unwrapped image.

(7) Import/Export

- Import: Imports the common interior form(Image/signal data, meta data, auxiliary data) from the SAR (ERS-1/2, JERS-1, RADARSAT-1, ENVISAT) CEOS format.
- Export: Exports the common inter form to geotiff file.

(8) Display

The Module which supports various functions: Zoom In/Out, Panning, Quick Image Enhancement.

It supports the result image of common interior type data, geotiff, Interferometric SAR, Differential Interferometric SAR, POLSAR with input data, and supports the interface function which extracts a coordinate from the image, inputs and is able to store the coordinate value.

- Data Display: High capacity SAR image display
- Display control: Zoom In/Out, Panning,
- Quick Enhancement: Image Quick enhancement

3. Conclusions

This paper described the SAR data processing S/W package it will be able to process the SAR image. The package is in the process of development advancing, and will be applied with the seed it will be able to process each individual sensors and multi-sensor. In the future, the research about the fusion of the form which is various will be continued.

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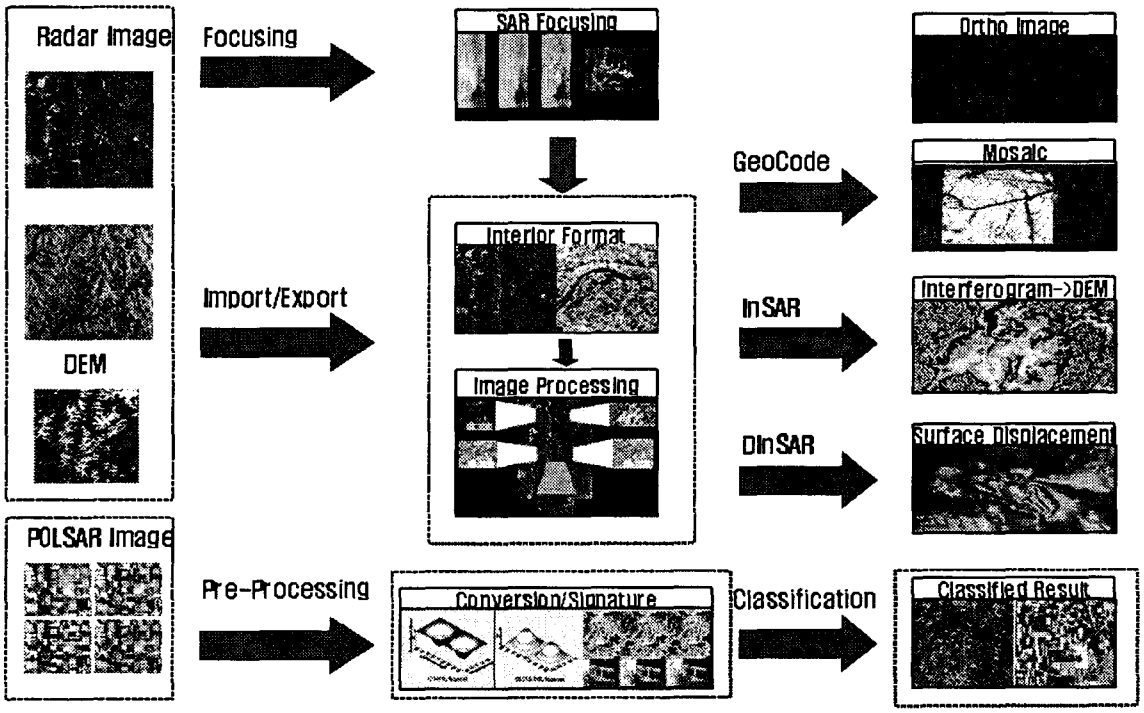

Fig. 2. SAR Data Processing Package outline