DATA PROCESSING FRAME FOR AIRBORNE SAR PROTOTYPE DEVELOPMENT

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1. INTRODUCTION

The National Institute of Aerospace Technology (INTA) from Spain has a program for Synthetic Aperture Radar (SAR) Research and Development. The Radar laboratory is in charged of technology acquisition, lines of interest definition, collaboration in remote sensing projects and in general supporting Spain needs in this area.

Airborne SAR prototypes with increasing complexity are built, improving performance and including new capabilities. Data processing developments in different fields are required to cover needs in characterization/validation of complete systems, on board system configuration and operation, product generation, improvements, etc. A frame for handling all this data processing needs has been developed and it is in permanent updating.

2. HIGH LEVEL FRAMEWORK

The frame has to manage and implement data processing at all the stages of prototype development. Before flight, performance assessment, software to implement new functionalities and radar data analysis has to be done. On flight, radar operation, data characterization/validation, data conditioning, SAR imaging, performance analysis have to be carried out. The software for all these tasks has to be developed and tested within the same framework.

The complete environment is formed by a group of 64bits computers and common storage equipments, where data and software are accessible to all the developers.The software is made up of different tools that combined support data processing for all the SAR prototype development stages and new software development and validation. It includes:

- Design of data take campaigns, including on ground support equipment used by performance assessment, and SAR image analysis.
- Performance assessment, based on system specification, preflight tests and point target simulation. These tools are connected to product generation and SAR image analysis to assess complete system performances. Point target simulation is useful for software validation and characterization in development and for supporting in campaign designs.
- System configuration performs interface tasks between on board SAR system and on ground data processing. This includes radar configuration generation, imaging and analysis configuration and folder structure for data, products, reports, etc.
- Sensor data analysis includes radar data (including preflight data) and positioning and attitude data.
- Product generation that includes preprocessing for each prototype.
- SAR Image analysis includes IRF analysis and extended targets analysis.

The framework intends to include as many areas as possible within the same philosophy of work and with similar interfaces, in this way development and validation of SAR systems is less time consuming to reach the same goals.

3. DATA PROCESSING AREAS

Design of data take campaigns
This area includes on ground reflector distribution. That distribution is simulated with the point target simulation tool, SLC image is generated and point target analysis tool can be used in order to define a group of values for radar configuration, data processing and product validation. A tool to obtain reflector positions in slant geometry images from ground data locations and sensor track is implemented. The output can be introduced in the image analysis tool to perform automatic analysis for a group of data takes.

Performance Estimation
Assessment for performances can be done from requirements based on antenna pattern models, and system location capabilities[2]. Based on pre-flight test data, a nominal/ideal reference function can be generated to analyse IRF in range dimension. The point target raw data simulation considers flat terrain and on ground reflectors can be simulated for different geometries.

System Configuration
This software generates groups of parameters for complete system operation, checking is implemented in parameter generation. It includes radar parameters (frequency and timing parameters), platform parameters, processing parameters and validation parameters.

Sensor data analysis
Radar signal characterization obtains statistics related to time and frequency domains to get measurements of offset, bandwidth, dynamic range, etc. This area includes position and attitude data analysis for data take validation purposes.

Product generation
Preprocessing includes data conditioning (offset, digital real-iq, etc), extraction of data for motion compensation (sensor position, velocity, squint, ideal track, LOS shifts, phase errors, etc), Doppler Centroid calculation. First motion compensation is included within preprocessing group. Imaging includes complex image generation based on Chirp Scaling algorithm [4], speckle reduction, side lobe control, autofocus, geolocation, interferometric processing, etc.

Image Analysis
Tools for radiometric and geometric point target analysis (resolution, PSLR, ISLR, phase, distances, angles, etc) and for extended target analysis (statistics, number of equivalent looks, radiometric resolution, etc) are implemented [1][3].

4. CONCLUSIONS AND FUTURE DEVELOPMENTS

The framework has been useful for a group of few people. To be useful for the new bigger group involves to improve graphical user interface, procedures and user manuals.

New developments are related to new prototypes features, interferometry, polarimetry, multi-band, real time data takes and imaging, etc. Therefore, future developments are focused on mission design, imaging with variant Doppler Centroid, motion compensation, generation of interferometric and polarimetric products, image analysis for new products, etc.

5. REFERENCES

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