DEVELOPEMENT OF AN EFFICIENT SCAN SAR PRCESSOR USING INTEGRATED SPECAN ALGORITHMS

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1. INTRODUCTION

Most of currently operational Synthetic Aperture Radar (SAR) satellites include the Scanning SAR (ScanSAR) mode for extended remote sensing applications. The extended swath provided by the ScanSAR mode can make up for the disadvantage of normal satellite SAR operation, such as limited coverage areas and short revisiting times. Therefore the ScanSAR mode is desired, especially when reduced resolution is acceptable in order to achieve global monitoring and continuous observation capabilities.

ScanSAR processing is distinguished from conventional full aperture SAR processing techniques such as RDA or chirp scaling algorithm due to its unique burst most operation. Although the SPECAN algorithm is known to be the most efficient processing technique for processing continuous mode data, its merit is highlighted when applied for ScanSAR mode data. The SPECAN is convenient to implement on each burst signal from different sub-swath and combine together later on.
However, the simplicity and efficiency of the algorithms inherently accompany degradation of the SAR image quality. This may not be a considerable issue for medium-to-low resolution ScanSAR mode but the estimation processes for DC(Doppler Centroid), Doppler rate parameter and PRF values over wide range intervals are highly complicated and elevates difficulties of producing high quality SAR images. Hence it is not straightforward to implement a high performance processor that works with diverse ScanSAR data of arbitrary mission parameters including sub-swath number, PRF, yaw steering and so on.
In this paper we demonstrate a general SAR processor that works for both Strip and ScanSAR data. It is verified that the quality of the ScanSAR products are comparable with the conventional stripmap mode images except the intrinsic reduction of the resolution.

The SPECAN technique treats raw data in bursts and thus provides a good efficiency in terms of processing burden. However, a simple adoption of the SPECAN technique results in low resolution due to the linear RCMC and irregular sample spacing in the azimuth direction. We attempt to process ScanSAR data over Korean peninsula taken by Radarsat-1 operating in ScanSAR with 4 sub-beams. We adopt a modified SPECAN algorithm as a means to enhance ScanSAR image quality. The imperfection of the SPECAN algorithm results in undesirable scalloping effects. We demonstrate that modification of the Doppler parameter estimation process can remove these scalloping effects. Sub-swath images processed from separate mode beams are combined to match with each other with high geometric correlations. All of these processes are separately implemented in C++ code modules so that, in addition to the improved efficiency, they can be easily upgraded and adopted by general SAR processors later on. Other processing algorithms based on the SPECAN technique are also described and compared with the modified algorithm through image quality evaluation process.

2. SIMULATION

When the conventional SPECAN algorithm is applied, the deramping for DC correction is performed by a simple FFT and the undesirable scalloping effects are evident in the acquired quick look image. Hence a descalloping procedure is added to remove these but the result is not impressive since the accuracy of the Doppler parameter correction is strictly limited and the scalloping is still clearly visible. In order to compensate for this, a chirp scales Z transform technique is applied and the impact is demonstrated by the descalloped image shown in Fig. 1.

All the processing algorithms are encoded in C++ modules and adopted for a general SAR processor. The user can easily choose the type of SAR product and after the CEOS data is retrieved for analysis, the processor attempts to find the best algorithm that fits to the selected SAR raw data.

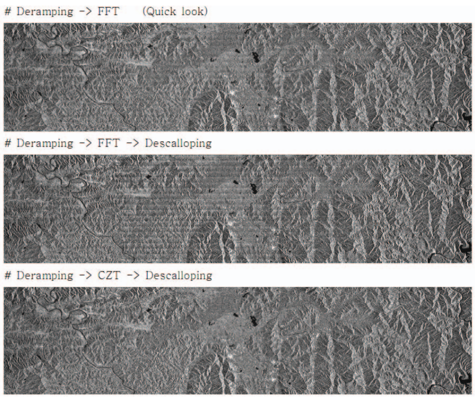

Figure 1 Descalloping procedure by modified SPECAN algorithm

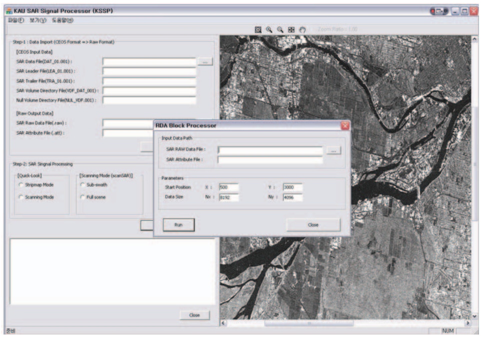

Figure 2 Operation of the modular SAR processor with efficient C++ coding

3. REFERENCES

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