NASoftware Limited
Incorporating InfoSAR

Modular SAR Processor

Overview

The NASoftware SAR Processor provides a state of the art system for processing airborne SAR data. Its modular construction gives access to individual stages of the processing chain, allowing engineers to see the effect of algorithmic changes, or to replace individual stages by their own research/development algorithms.

The system will run in standalone mode and provides easy interfacing to your own application. It is back-end interfaced to the NASoftware InfoPACK SAR image undestanding package, so that complete user application processing chains can be constructed utilising the high level InfoPACKfacilities, and the effect of changes in the image formation stage immediately taken through to the processed images. The front end can be tailored to handle your specific input data.

A versatile and realistic SAR data simulator is also included, which enables arbitrary ground scenes to be constructed along with the corresponding single or multipass complex SAR data.

The processor is available in a number of versions:

Level 1

The level 1 processor handles broadside SAR data and includes the following basic stages:

Input: input routines are provided for a standard data format; additional input modules can be provided at extra cost, or can be interfaced readily by the user.

Output: single-look complex and detected amplitude.

Processing Stages:

- range compression
- azimuth compression
- iterated subaperture autofocus
- iterated signal-based autofocus and motion compensation

Each of these stages implements state of the art algorithms not (we believe) available elsewhere in any commercially-available software.

Level 2

This version add the following modules:

- curvature and range migration
- squint mode.

The curvature and range migration facilities improve image quality for ultra-high resolution SAR data. The squint facilities provide for data with up to 30 degrees squint.

Level 3

This level adds high fidelity spotlight mode facilities (broadside and squint)

Level 4

This level provides SARMTI: high quality detection of moving targets from the SAR data. For details of this new technology contact us. SARMTI is provided as a second standalone facility, and is currently available for broadside data only.

How To Order

To order, or to receive more information on our product range and availability, see us on the Web at http://www.nasoftware.co.uk, or contact:

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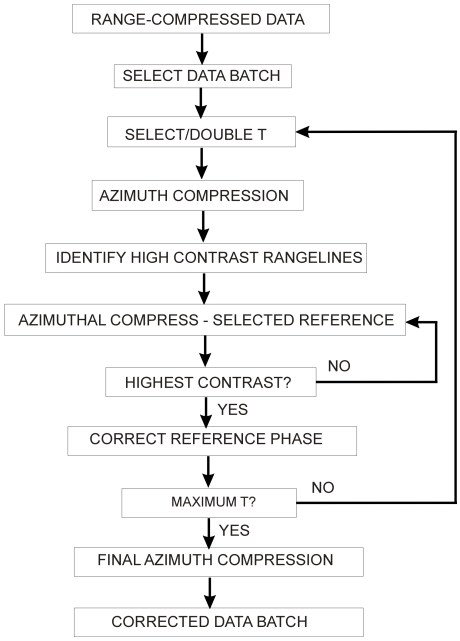
Technical Details

Level 1 Processor

The Level 1 processor provides optimal image formation facilities for broadside SAR data. After initial data input with optional range compression, the subsequent processing chain is shown below.



SAR Processor Level 1 Flow Diagram

The processing stages are as follows:

Range-compressed data
The flow diagram assumes that range compression has already taken place so that the phase history of individual scatterers is contained in the different rangelines.

Select data batch
SAR azimuthal compression is a batch processing operation that requires a batch that is longer than the total illuminated aperture. The length of the processed output is the difference between the batch length and the aperture. The first step, therefore is to select a suitable batch of data to process.

Select/double T
Unknown phase variations take place at characteristic time scales that determine the minimum length of data selected for autofocus and phase correction. Let us assume that a suitable minimum sample length T is sufficient to represent most of the shorter time scales in these phase fluctuations. Initially we wish to set the autofocus batch length to this time duration. However, the greatest accuracy in autofocus and phase correction is obtained when the autofocus sample length is equal to the total illuminated beam transit time. The NASoftware algorithm iterates the autofocus and phase correction process for successive doubling of the subaperture T until it matches the beam transit time. Thus the initial subaperture is selected to be some reasonable fraction of the maximum aperture, such as one quarter or one eighth.

Azimuth compression
The complete batch of SAR data now undergoes azimuthal compression using the nominal SAR parameters to define the reference.

Identify high contrast rangelines
The resultant SAR image is now tested to identify those rang lines that contain data with the maximum contrast. Though autofocus works on very weak variations in underlying RCS, it is significantly better for highly structured scenes with high contrast. Thus we identify these lines and confine our attention to these during the autofocus stage.

Azimuthal compress - selected reference
Autofocus processing now selects different references and tests the contrast of the output compressed image in the dominant contrast rangelines. An initial reference slope, corresponding to a change in the expected phase dependence on time, is selected, the dominant image lines are compressed and the contrast evaluated.

Choose Highest contrast?
The contrast for a given value of quadratic focus parameter is compared with previous values. If the contrast result is less than the highest value a new reference slope is selected and the process iterates (NO). If the contrast is a maximum then this value of the reference slope parameter is passed on as the best (YES).
Autofocus processing essentially comprises the two stages Azimuth compress - selected reference and Highest contrast? The signal-based phase correction comprises all of the outer loop.

Correct reference phase
The output from the autofocus loop is the optimum local value of the quadratic focus parameter. The correction to the local phase can then be derived as a double integral over the optimum local reference values. This process provides a continuous smooth phase correction that results in undistorted and focused SAR image output.

Maximum T?
As already noted, the autofocus and phase correction process can be iterated until the sample aperture is equal to the full illuminated aperture of the SAR. If this point has not been reached (NO) the process loops back to the Select/Double T stage and T is doubled. If the aperture has reached the maximum size (YES) then the corrected phase reference information is passed on to the final, azimuthal compression, stage.

Final azimuth compression
The entire original SAR data batch can now be corrected, using the phase corrections derived above, and final SAR compression can be applied. Note that the data has been phase corrected to match the nominal SAR reference, which is therefore used here.

Corrected data batch
The output of the final SAR compression stage should be both linear and well focused. Typical performance figures on real systems show that a defocus and distortion of less than 0.01% is achievable. Note that if there are severe variations on a short time scale the local focus performance may be degraded more than this. However, the long-term linearity should reach this value.