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Reduction of Azimuth Uncertainties in SAR Images Using Selective Restoration

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Abstract— A framework is proposed for reduction of azimuth uncertainty space borne strip map synthetic aperture radar (SAR) images. In this paper, the azimuth uncertainty in SAR images is identified by using a local average SAR image, system parameter, and a distinct metric derived from azimuth antenna pattern. The distinct metric helps isolate targets lying at locations of uncertainty. The method for restoration of uncertainty regions is selected on the basis of the size of uncertainty regions. A compressive imaging technique is engaged to bring back isolated ambiguity regions (smaller regions of interrelated pixels), clustered regions (relatively bigger regions of interrelated pixels) are filled by using exemplar-based in-painting. The recreation results on a real Terra SAR-X data set established that the proposed method can effectively remove azimuth uncertainties and enhance SAR image quality.

Index Terms— Azimuth Antenna Pattern (AAP). Repetition Frequency, Signal to Noise (SNR), Synthetic Aperture Radar (SAR), Image processing.

1 INTRODUCTION

Synthetic Aperture Radar (SAR) is a powerful and well recognized microwave remote sensing, technique which enables high resolution measurements of the Earth's surface independent of weather conditions and sunlight illumination. The radar system is coherent and transmits frequency modulated, high energy pulses (chirps) at a high pulse repetition frequency (PRF), typically greater than 1 kHz for space-borne systems. The direction of energy transmission is called range while the flight direction is defined as azimuth. The back scattered echoes are received, down converted and stored after analog/digital-conversion. Due to the use of a small antenna length in azimuth, every point on the ground is illuminated by thousands of pulses. The basic SAR image formation consists of a compression of the chirp signal followed by the azimuth processing which corresponds to the formation of a long synthetic aperture. This is probable since the SAR system preserves the phase information and all received echoes in azimuth can be coherently combined after a proper phase correction. Since the length of the synthetic aperture increases with the range distance, the resulting azimuth resolution has become free on the range distance. The hypothetical value for the azimuth intention is equal to the half of the antenna length in azimuth. This will permit a high resolution imaging for space-borne SAR systems. Typical azimuth antenna the sizes for space borne SAR systems in civil applications are from 5 to 14 meters. Since the first space borne SAR system has been launched in 1978, a vast technological and application related development has been achieved. Space borne SAR systems represent today one of the most difficult remote sensing, imaging instruments in a technological sense and this poses a great challenge for the development of new idea, techniques and mechanisms for future SAR systems. In this paper, we propose a novel framework to mitigate azimuth ambiguities in space borne strip map SAR images. The locations of azimuth ambiguities are determined by Using Hyper spectral filtering. All pixels at ambiguity locations are replaced with zeros, and these pixels are restored by employing emerging compressive sensing, or exemplar-based in-painting depending on the size of the ambiguity region.

The approach used in this paper for ambiguity filtering is based on the concept of selective filtering. Essentially, in the frequency domain we select the region of the signal spectrum less affected by aliasing, i.e., the region where the nulls of the folded AAP are located (in fact, the spectrum of the scene reflected is weighted by the AAP of the sensor, so that where the folded AAP presents a null, the spectrum of the ambiguity will be null, whatever the original shape of reflected spectrum). In a way similar to that of [6], we obtain the transfer function (TF) of the filter using the theory of Wiener filtering, as shown in the following sub-section. Once the TF of the filter is available, we propose a filtering approach based on the generation of "ghost maps"

2 RELATED WORK

Antonio Criminisi, Patrick Pérez, and Kentaro Toyama [1] described, the objective is to replace the hole that is lefted in a visually reasonable way. This has been verified for textures. It repeats the two dimensional patterns. Texture creation based algorithms for generating large image regions from sample textures. In-painting techniques are used for filling the small region gaps. Similar patches do not exist in it. The accurate color values are calculated using exemplar-based production. Selected object has been replaced by a visually reasonable background that minimizes the appearance of the source region. Preservation of edge sharpness, no dependency on image segmentation, balanced region filling to avoid artifacts. Speed, efficiency and accuracy are gained in the synthesis of texture. It can't get accurate results. It does not produce the expected outcome. It is suitable for only small regions. Textures are added in order to fill the lost patches of images. In-painting that is another algorithm used for filling larger regions.

Zhimin ZHANG and Zhen-song WANG R [2] presented azimuth ambiguities of synthetic aperture radar by using three filters. Defeat the azimuth uncertainties of synthetic aperture radar (SAR).We can get a reaction nearly liberated of the first ambiguity. This technique is based on the random time domain model of the echo signal. Matched filter used by image recreation of SAR, other two filters is used to get responses which have the responses of the first ambiguities. This technique which help to improve quality of SAR image and pulse repetition frequency (PRF) in SAR.

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Xiao-Ming Li, Susanne Lehner, and Thomas Bruns [3], Calibrated ASAR images is used as the only source of input without needing previous information from an ocean wave model (WAM) as the standard method used in weather centers. To get integral ocean wave parameters such as Significant Wave Height (SWH), Mean Wave Period, and Wave Height of waves with period greater than 12 s from synthetic aperture radar (SAR) images over sea surface and weather.

Wen-Qin Wang [4], it offers several compensation than satellites because it was not controlled by orbital mechanics and fuel utilization. The high return frequency, high motion, and robust capability that we have desperately wanted are still complicated to get for present space borne and airborne sensors. It is complicated to get high azimuth motion and at the same time wide swath and high frequency for conservative space borne on high SAR. By using this technique with reflector antenna and digital beam forming on getting is future for High Resolution and Wide Swath (HRWS) remote sensing,. System design, signal model, imaging scheme, system performance, and echo suppression is investigated. This method with reflector antenna can operate flexibility and reconfigurability which enable a satisfactory HRWS remote sensing, performance and ability. This method helps radar platforms and for remote sensing, applications due to their receptive and determined the satellites and airplanes.

Andrea Monti Guarnieri [5] Restraint of strong azimuth ambiguity in single complex synthetic aperture radar images, to be used for detecting products and interferometric survey. Band-pass filter is used to select that portion of the azimuth spectrum that is less tending by deformation, the one that corresponds to the zeros in the virtual azimuth antenna pattern. The filter is used for removing strong ambiguities.

3 PROPOSED WORK

The approach used in this paper is ambiguity filtering; it is based on the concept of selective filtering. Essentially, in the frequency domain we select the region of the signal spectrum less affected by aliasing, i.e., the region where the nulls of the folded AAP are located (in fact, the spectrum of the scene reflected is weighted by the AAP of the sensor, so that where the folded AAP presents a null, the spectrum of the ambiguity will be null, whatever the original shape of reflected spectrum). In a way similar to that of, we obtain the transfer function (TF) of the filter using the theory of Wiener filtering, as shown in the following sub-section. Once the TF of the filter is available, we propose a filtering approach based on the generation of “ghost maps”, which are then used to get the final filtered image, where only the areas affected by the ambiguities are substituted with their filtered version, as detailed in this Section.

3.1 Discrete wavelet transform

This transform add image or signal mode for discrete wavelet and wavelet packet transforms. The adding modes indicate that the various ways is used for handling the problem of border deformation in signal and image analysis. The difficulty is highly underdetermined as the number of known elements is M and the number of unknowns is N with M>>N. If Sw0 is the sparse representation in wavelet domain can be given as

$$Y = \varphi \Psi TSw0 = \Theta Sw0 \qquad (1)$$

Where Ψ is the wavelet transform matrix = φ Ψ T is called the measurement matrix. The problem is to find Sw0 from y if the measurement matrix is known. Once Sw0 is known, S can be found by taking the inverse Ψ transform.

3.2 Hyper Spectral filtering

The growth of hyper spectral sensors and software to analyze the resulting image data. The “hyper” in hyper spectral which indicate “over” as in “too many” and large number of calculated wavelength bands. Hyper spectral images are spectrally over determining, which represents that the spectral content is to identified and distinguished spectrally only one of its kind materials. Hyper spectral images provide the approaching for most correct and complete information mining than possible with any other type of remotely sensed data. Hyper spectral imaging is a technique that is processing multiple narrow-band images above a spectral range and enabling complete analysis and determining of objects. This method is sometimes indicate to as multispectral imaging important to extend classical point-based spectroscopy with imaging, while enlarged classical color imaging with more haunted data.

4 SYSTEM DESIGN

A target O would impart I number of significant uncertainty image pairs on both the right and left sides. The ith ambiguous images on the right and left can be represented as GRi and GLi , respectively, shifted by Δai in azimuth direction and Δri in range direction. We classify azimuth ambiguities into two categories, namely clustered ambiguity and isolated ambiguity. Ambiguity connected pixels of the size greater than 50 pixels; we name them as clustered ambiguity, with all other ambiguity regions termed as isolated ambiguity. The pixels in ambiguity regions in SLC data are assumed to be unknown, and selective restoration mechanisms used to find the values of these pixels. The image will be separated into components, which are adapted to the different quality requirements. Each individual component is transferred into a format that allows making conclusions about the structure of the contents. This offers the option to distinguish between basic and more complex contents. The transformed data are weighted according to their meaning for the image contents and then eliminating the redundant information. We can restore the ambiguity region. However, if a scatter from a target is very weak and the ambiguous signal is quite strong, then may mark this location as possible ambiguity, as scatter from weak targets may be less than the variation of parameter from actual AAP at the location.

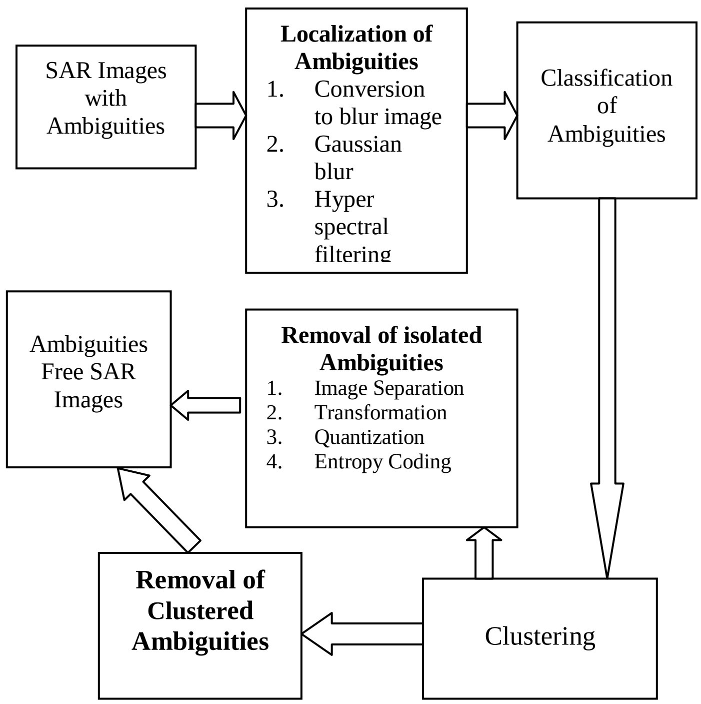

Fig.1. System Architecture

4.1 Localization of Uncertainties

Selecting a SAR image and check whether it is a colored image or not. If it is colored image you have to convert it into gray image. Using rgb2gray function, converting colored image into gray image. Select a Synthetic aperture image and impose in it Gaussian blur. A Gaussian smoothing is the blurring an image by Gaussian function. It is a widely used effect in graphics software, typically to reduce image noise and reduce unwanted information. Hyper spectral filtering is used in order to locate the ambiguity in Synthetic aperture radar images. Hyper spectral filtering is effective than Band pass filtering. It is more accurate to finding of ambiguity in SAR images. The visual effect of this blurring technique is a smooth, blur similar to that of viewing the image through a translucent screen. Select an image and impose in it Gaussian blur. Now the SAR image contain blur. It can be identified using Hyper Spectral filtering, which is more accurate and effective. Salt and pepper Noise is added. Gaussian filter is used for blurring an image. Now the resulting image is blurred image.

4.2 Classification of Uncertainties

For identifying and tracking objects or ambiguity,We are using color map identification. It separate ambiguities and object. An "image histogram" is a type of histogram that acts as a graphical representation of the tonal distribution in a digital image. It plots the number of pixels for each tonal value. The histogram for a particular image will be able to judge the entire tonal distribution . SPECTRA is an applicaltion software to calculate optical behaviour of synchrtron radiation emitted from bending magnets.

4.3 Removal of isolated uncertainty

Let **S** be an $m \times n$ matrix representing the strip map SAR image. If y is a vector containing M ambiguous pixels of isolated ambiguities in **S**, then, by using the compressive imaging framework, it can be written as

$$\mathbf{y} = \mathbf{\Phi S} \qquad (2)$$

Where $\mathbf{\Phi}$ is an $M \times N$ the sampling matrix with $N = m \times n$. Each row of the sampling matrix contains only one “1” corresponding to pixel location in the SAR image. The image will be divided into various parts, which are adapted to the different requirements. Each part is transferred into a format, in order to get the structure of the contents. From this we can get which one is basic and more complex contents. The converted data are subjective according to their meaning for the image stuffing. We can eliminate the redundant information from the image.

4.4 Removal of clustered Uncertainty

Ambiguities are removed sequentially starting from the top-left corner of $\hat{\mathbf{S}}$ by applying exemplar-based in-painting technique. Exemplar-based in-painting employs a template window for filling the lost patches of images. The filling order is the core of exemplar-based in-painting. The global picture determines how to occupy space in the gap, the purpose of in-painting to regaining the affected region. The formation of the area surrounding Ω is continued into the gap, contour lines are drawn via the prolongation of those arriving $\partial\Omega$. The different regions inside Ω, as defined by the contour lines, are filled with color, matching those of $\partial\Omega$. The small regions are painted (e.g. little white spots) and “texture” is added.

5 DISCUSSION

The uncertainty of a concrete/metallic rectangular structure can be seen on both the left and right sides in azimuth directions. The left uncertainty appears on a uniform background. i.e., sea whereas the right ambiguity appears on populated areas. This is an example of distributed targets producing Uncertainty. The increase in the speckle noise due to BPF which would lead to lower SNR.

Three important features of the proposed Uncertainty reduction framework can be

1) The filtering technique decreases SNR, whereas the proposed technique does not deteriorate signal quality.

2) The strong and distributed uncertainty is not removed completely using the BPF technique, but the proposed framework can remove these ambiguities satisfactorily.

3) The band pass filtering technique results in blurring of the SAR image, whereas the proposed framework would not lose spatial resolution of the SAR image.

6 RESULTS

Our proposed technique restores only Uncertainty pixels within the SAR image. There is no change at all for all other locations. The filtering-based Uncertainty reduction techniques lower the SNR in a SAR image. However, in the proposed framework, SNR would be unchanged at the unambiguous locations. The increased interest of the research community in linear inverse problems would lead to highly efficient restoration algorithms in near future. We are confident that, exploiting latest research in these areas, the proposed framework would be a pragmatic and a computationally efficient option for mitigation of azimuth Uncertainty in space borne strip map images.

7 CONCLUSION

A framework based on selective restoration has been proposed for removal of azimuth uncertainties in space borne strip map SAR images. The azimuth uncertainties in strip map images are identified through a simple and efficient technique by employing a metric derived from AAP. The ambiguous locations are predicted by selecting either compressive imaging or exemplar-based in painting technique based on the size of the ambiguous region. The experimental results on real SAR have demonstrated that the proposed ambiguity mitigation framework is better compared to filtering-based reduction techniques. The proposed framework will be extended for uncertainty mitigation in space borne high-resolution spotlight/sliding spotlight SAR images in the future. The azimuth uncertainties in spotlight/sliding-spotlight SAR exhibits different behavior compared to space borne strip mode SARs. Therefore, AASR in spotlight/sliding-spotlight SAR images varies as a function of azimuth position, and new formulation for localization of ambiguities would be required to presume accordingly.

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