SAR Image Localization and Target Recognition Research Based on the Azimuth Circle Adjustment

GuangYang[1, 2], Xiaojuan Wang[2], Dejun Li[2], BaiZhang[1], Kun Gao
1 Northeast Institute of Geography and Agricultural Ecology
Chinese Academy of Sciences, Changchun
CHINA, 130012
2. Special Profession Department
Aviation University of Air Force
Changchun
CHINA 130022

Abstract: - According to the work mechanism of space synthetic aperture radar (SAR), this text introduced the localization algorithms of SAR image and the method of system error adjustment. On the basis of the concept of the azimuth circle and the combination of the north direction coordinate system of geography, carries on the adjustment to the localization data, so increased the SAR image localization accuracy at large scale, combines the simulated data and the image of Radarsat satellite, validate the localization algorithm and the adjustment method. The results had indicated that this algorithm might enable the localization accuracy of Radarsat image to achieve 400-600m, if the establishment of earth model might more accurate, the ground station could provide the more precise orbital data, the localization accuracy may further enhance. After the studying localization, summarizes to the research evolvement and the development uptrend of the goal pretreatment, the automatic detection and the recognition aspect in the SAR imagery, table the proposal for the future SAR image's recognition and the localization research.

Key-Words: - ITSM, Process Model, Framework, ITIL, UML

1 Introduction

Synthetic aperture radar technology is playing the influential role day by day, which by its entire day, all-weather and certain penetrability operating performance, in the domains of topographical survey; forest early warning, ocean monitoring as well as military remote sensing. In the application of SAR satellite imagery, the ground object has the precise pixel position on the image, in the following application of image; we must carry on the precise localization to the image in order to guarantee the geometry adjustment precision and the military precise attack effect. At the same time, any localization algorithm has the system error; which will affect the scope of the localization algorithm in the practical application. For the enhancement of localization accuracy, guarantees the application quality, it is necessary to carry on the adjustment to the localization result, reduces the error[1].

At present, for the SAR image goal's localization, we may use of the known geography information in the image formation region, such as some known ground control point's position, the relief map data, as well as some artificial or the natural features reference point, carries on the localization through interpolation extraction algorithms; we may also determines the goal's location using relative position relations of the pixel and the reference point[2,3]. But, in most situations, it is difficult to find the appropriate reference point, especially in the applications of ocean monitoring and military attack. In 1982, Curlander et al, who advanced the localization theory to the image by using the earth model equation, the SAR Doppler equation, the SAR slant range equation, and has completed the automatic correction geography code post-processing system of SAR image in 1989[4, 5].

The SAR image's characteristic decided its universality, simultaneously increased processing and the recognition complexity of the SAR imagery also. It does not look like the optical image to be such clear and intuitive, easy to examine the edge. The SAR image not only has the characteristic of the optical image geometry, meanwhile has the important electromagnetic signature. Not only distill the geometry characteristic of the target,but also distill the three dimensional elevation information and the velocity of movement information. These information's extraction not only needs more system mathematics knowledge, moreover needs more

system electromagnetic theory knowledge, thus, the image understanding difficulty has been increased. The recognition research to SAR imagery mainly concentrates to the automatic detection and the automatic diagnosis method study, This paper has researched the localization method to the SAR image at the basic of massive literature search's, which has advanced the SAR image localization method by using simulated data of the ideal point targets, and carry on the adjustment to the localization result combining the Earth model. We has confirmed the localization algorithm and the adjustment plan, which may cause the localization accuracy enhancement at large scale by researching and analyzing the simulated data's, it is possible to control the error to 400-600 meters. After the studying localization, summarizes to the research evolvement and the development uptrend of the goal pretreatment, the automatic detection and the recognition aspect in the SAR imagery, table the proposal for the future SAR image's recognition and the localization research.

2 Localization and Adjustment Algorithm of SAR Image Based on the Earth Model and Azimuth Circle

The target point position's accurate degree is weighed through the localization accuracy in the SAR image, the localization of SAR image is also the post-processing foundation of the space borne SAR. This paper advanced one kind of target precision localization and the adjustment plan which may cause the large scale enhancement of the localization accuracy.

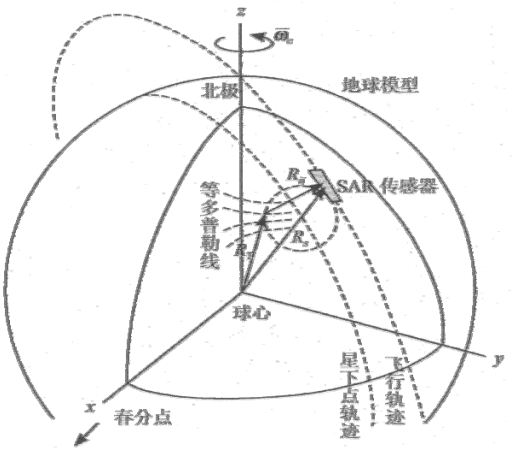

Fig1 the position relational graph of the satellite and target point under inertial coordinate system

The intersection that the Doppler center frequency equation and the earth model equation in the ground, which confirmed the point of intersection between the Doppler lines and the slant range equation, which is the ground position of the target point, as shown in Figure 1.

The target localization of SAR image must choose the fixed coordinate system first, and the coordinate system is the inertial coordinate system, which may use the geocentric coordinate's model to replace. Under this coordinate system, any target point RT in the ground satisfies the earth model equation:

$$\frac{x_t^2 + y_t^2}{(R_e + h)} + \frac{z_t^2}{R_P^2} = 1 \tag{1}$$

And

$$h = h(x_t, y_t, z_t) \tag{2}$$

For the point, h is the ground elevation value, R_e is the Earth radius, and f is the smoothness factor. At the same time, the target point R_T rotates along with Earth's rotation, its speed is:

$$V_T = W_e \times R_T \tag{3}$$

The height H of SAR platform maintains certain height, according to shown in Figure 2, know using the three-cornered relation:

$$R_{i,j} = \frac{H}{\cos\theta} \tag{4}$$

And θ is the pronate angle from the platform to the target point.

The position $R_s = (x_s, y_s, z_s)$ of satellite and the speed V_s are the functions of the satellite's flight time, which may obtain by the orbital data which provided by satellite. The relations are between it and the target point slant range.

$$R_{i,j}^2 = (R_T - R_S) \bullet (R_T - R_S) \tag{5}$$

The Doppler frequency shift of the antenna beam through the target point is f_D. The relation between f_D, the satellite position, and the target point position is:

$$f_D = -\frac{2}{\lambda R}(\mathrm{R_T}\text{-}\mathrm{R_S}) \bullet (\mathrm{V_T}\text{-}\mathrm{V_S}) \tag{6}$$

So long as assigns each pixel slant range R_{ij} and the Doppler center frequency f_D on the SAR image, settle equation (1),(5),(6),associated then obtains each goal correspondence position R_T.

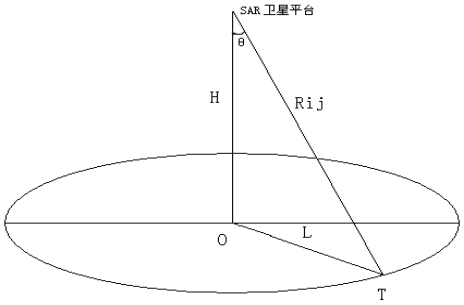

Fig2 the location relational graph between the satellite platform and target

By $R_T(x_t, y_t, z_t)$ and the earth's core model may know:

$$\begin{cases} x_t = R_e \cos\alpha \bullet \cos\beta \\ y_t = R_e \cos\alpha \bullet \sin\beta \\ z_t = R_e \sin\alpha \end{cases} \tag{7}$$

And α, β is the earth's core latitude and longitude of the target point.

By counter-triangle formula may know:

$$\begin{cases} \alpha = \arcsin\dfrac{z_t}{R_e} \\ \beta = \arcsin\dfrac{y_t}{R_e \cos\alpha} \end{cases} \tag{8}$$

By the earth's core model may know[6,7]:

$$\begin{cases} \beta = \gamma \\ \tan\alpha = (1-e^2)\tan\Phi \end{cases} \tag{9}$$

According to the coordinate transformation, we can obtain the geographic coordinate of the target point:

$$\begin{cases} \gamma = \beta \\ \Phi = \arctan\dfrac{\tan\alpha}{(1-e^2)} \end{cases} \tag{10}$$

And γ is the geographic longitude of the target point, Φ is the geographic latitude of the target point.

According to localization algorithm studies [4] of space borne synthetic aperture radar image parse in the paper, the projection of satellite platform's central point's on SAR image was confirmed to the center of circle in the azimuth circle. L which is the distance from the actual target point to the center of circle O in the azimuth circle, is obtained according to the photograph position of the reality target point T, that is, the distance L between T and O should be equal to the distance L' from T' to O', therefore T with T' should be in the same circularity arc which the centre of a circle is O, and the radius is L, as shown in Figure 4.

And

$$L = h \times \tan\theta \tag{11}$$

h is this spot the ground elevation value of the point;θ is the probate angle from the platform to the target point.

In the SAR image, the ground image mapped on the plane negative from the spherical surface position, according to the imaging characteristic of SAR image, we may measure the distance between two points directly in the picture, the distance is termed plan distance. We can demarcate the longitude and latitude of the conjectural target point T' and O to the transit instrument. Make sure the location of the center of circle O in the photograph utilizing the geometry theory, measure the distance L between O and T in the photograph, and make out the direction line of just north on the photograph or the transit instrument separately. Measure the nip angle θ_1 between OT and the direction line of just north in the photograph, and measure the nip angle θ_2 between OT' and the direction line of just north in the transit instrument, In case of the nip angle between OT and OT' in the earth's core coordinate is θ.

Then

$$\theta = \theta_1 - \theta_2 \tag{12}$$

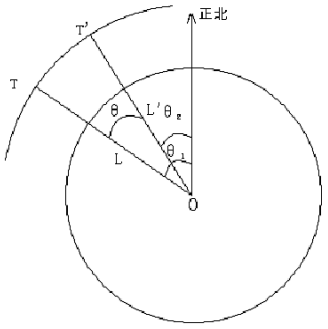

Fig3 the position relational graph between the target point and measuring point In azimuth circle

If θ < 0, then conjectural point is deflexion far from the direction line of just north than the real point; If θ > 0, then conjectural point is deflexion near from the direction line of just north than the real point;.

As shown in Figure 3, in the plane of ΔOTT

$$TT^{'} = (2L^2 - 2L^2 \cos\theta) \tag{13}$$

It's known from Fig3,in $\triangle O_2TT'$,

$$\cos(O_2TT') = \frac{R_e^2 + R_e^2 - TT'^2}{2R_e^2} R_e \tag{14}$$

After determining of $arc\cos(O_2TT')$, because of TT' is section of a circular arc in the spherical surface and the geocentric distance is R_e, we can acquire by fan-shaped arc length formula:

$$TT' = R_e \times arc\cos(O_2TT') \tag{15}$$

So long as has determined the azimuth nip angle θ and the distance L of the target dot, and the adjustment process has nothing to do with the satellite platform and the radar parameter, we may discover that we can carry on the adjustment to the precision of goal from the above inferential process, therefore, the adjustment plan has the strong compatibility.

3 Application of the Resolution Localization Adjustment Project

According to the actual GPS localization data, we will apply this algorithm to compare the localization result to the first-level SAR image in Beijing area. We selected six experimental spot randomly, There into, includes SiTong bridge, MuXi terra, the country trade bridge, the east exit of north road in east three link, the center island of the lake in south side of Summer Palace, the center island of the lake in east side of Summer Palace. The measurement result and adjustment data see Table 1 and Table 2.

According to the localization result analysis we can know that, this algorithm localization accuracy achieves between 400m--600m. After the adjustment, longitude measured deviation average value: -0.000037°; Latitude measured deviation average value: 0.000011°

According to the computed result we may see that: In the situation of no any external influence, this algorithm has been controlled the accuracy after the decimal point fifth, its ground error is 400-600 meters, which will conform to the military position error request basically and has the high localization accuracy and has the practical application value.

4 Error Analysis of the Resolution Localization Adjustment Project

The spaceborne SAR imaging mechanism is complex somewhat compared to the aircraft-borne SAR imaging process. Because the satellite is in near circular orbit, the distance is different between the satellite and the ground at different position, moreover the SAR image is the side-looking radar image imaging, if considered again the wave complication of the ground, the erroneous source is various which affects the localization accuracy and the adjustment precision of the point target of SAR[8].

4.1 Error Analysis of Target Localization Algorithm

According to the localization principle of SAR image, we may know that, it is different for each kind of error to the localization influence, satellite track measuring error including orbital direction error, radial direction orbital direction error and cross orbital error. The measuring error mainly causes the localization error of the location, the measuring error of the radial direction along orbital direction track measuring error along orbital direction, for the localization accuracy of the distance and location, the distance is primarily. There into, the first two errors constitute the main error source which the orbital surveys, but cross orbital position measuring error cross orthogonal the radial direction orbital measuring error, its influence very small [9].

For the localization of target in the earth's surface, usually uses the ellipsoid mathematics earth model of revolution to replace the genuine geoids. The different ellipsoid of revolution, the ellipsoid parameter is various, the actual target height is not dissimilar in observes belt. Because SAR image information reflects is that back direction dispersion intensity, therefore, the hypsography is one of the main error sources which affects SAR image quality and position precision [10].

Table 1 The localization result of the point target

Table 2 The localization result adjustment data table of the point target

Target point	Real longitude	Real latitude	Survey longitude	Survey latitude	Longitude deviation	Latitude deviation
SiTong Bridge	116.314800	39.965305	116.314388	39.965185	-0.000412	-0.000120
MuXi Terra	116.328770	39.905677	116.328077	39.905405	-0.000693	-0.000272
Country trade bridge	116.454900	39.931828	116.455127	39.931983	0.000227	0.000155
East exit north road in east three link	116.455070	39.939508	116.455299	39.939784	0.000229	0.000276
Centre island of the lake in south side of Summer Palace	116.265460	39.984460	116.265140	39.984435	-0.000320	-0.000025
Centre island of the lake in east side of Summer Palace	116.269604	39.989802	116.269693	39.989823	0.000089	0.000021

Target point	Survey longitude	Survey latitude	Adjustment longitude	Adjustment latitude	Longitude deviation after adjustment,	Latitude deviation after adjustment,
SiTong Bridge	116.314388	39.965185	116.314623	39.965209	-0.000177	-0.000096
MuXi terra	116.328077	39.905405	116.328689	39.905598	-0.000081	-0.000079
Country trade bridge	116.455127	39.931983	116.454963	39.932003	0.000063	0.000175
East exit north road in east three link	116.455299	39.939784	116.455158	39.939600	0.000088	0.000092
Centre island of the lake in south side of Summer Palace	116.265140	39.984435	116.265292	39.984387	-0.000168	-0.000073
Centre island of the lake in east side of Summer Palace	116.269693	39.989823	116.269657	39.989851	0.000053	0.000049

Besides the above factors, the Doppler center frequency is also the main parameter which in the localization computational process. The Doppler center frequency has something to the satellite orbit, the radar angle of view, the antenna direction, earth rotation factors and so on. In the different slant range, the Doppler center frequency also differs. At present, the Doppler parameter may obtains through clutter locking and the self-focusing technology, this kind of technology may enormous enhance the estimate precision of Doppler parameter. Therefore, Doppler center frequency error influences the localization accuracy very small [11].

4.2 The Goal Adjustment Error Analysis

The factors which influence the adjustment precision are large, except the error of using the approximate localization material, but also its own error, below carries on the analysis to the algorithm error.

First, the observed value are excessively many in the algorithm, the personal error is inevitable in the measuring process leads;

Second, the correspondence known ground control point of geographic coordinate, which is composed by many pixel spots in the image, therefore, in the actual use, it is unable to judge pixel position precisely.

Once more, the earth model is the emerging scientific research topic, its availability still in discussion. In fact, any earth model is an approximate description to Earth, even if it is the 25th degree earth model equation precise, a 50 meter radius error in the big ground also causes 150 meter pixel localization error. Its localization error is 2 to 3 times for the model error, and has not considered the elevation difference in the algorithm, these disturbance factor will affect to the result.

Finally, we will use the average radius of Earth Re when judgment the arc TT', the value of Re has the change along with the earth surface condition, which has the big disturbance to the result.

5 Target RECOGNITION Research In SAR Image

The domestic and foreign scholars have done a great many work in the SAR image's feature extraction and the target recognition aspect, the early work have mainly concentrated in pretreatment aspects of the noise control. The SAR image that obtained by the imaging radar is the reflection of the object to the radar wave diffusion properties. Because the imaging radar emissive the pure concerned waves, when this kind of signal illuminate goal, the goal stochastic scattered signal and transmitting message's interference has the speckle noise, and causes the pixel grey level of the imagery to change fiercely, namely in the even goal surface, some pixels assumes the luminescent spot, some assume the dim spot, blurred the image fine structure, causes the image explanatory ability to reduce [12]. Therefore, before the automatic detection to the SAR imagery, we must carry on denoising processing. The elimination speckle noise uses the air zone filtering algorithm, like average value filter method, median filter method, Frost filter method, LEE filter method and GammaMAP filter method and so on. Liu Yongchang, Zhang Ping and Yan Weidong proposed small wave packet territory value law elimination synthetic aperture radar image speckle noise method [13] in the general method foundation; Qu Xiaorong proposed the multi-criterion misalignment threshold value speckle noise based on the median value filter processes before the auto-adapted weighting and the algorithm of restrain stripe interferential making use of the Harr wavelet, has obtained very meaningful research results [14]; T.R.Crimmins proposed that geometry spot filter [15], J.S.Lee proposes partial filter method[16]; Zhaohui Zeng, S.fukuda, E.P.Simoncelli and so on realize SAR image denoising using the wavelet transformation [16]. Wan Peng, Wang Jianguo et al. proposed a method that suppresses the SAR image coherent spot noise and distills the weak reflection terrain feature edge, uses the smallest error criterion to calculate the theory division threshold value of the SAR image, through iterates gradually obtains its reasonable size, obtains its edge [17] using the shape operator function in the division image. In a word, domestic and foreign study in the SAR image's pretreatment aspect obtains progressed greatly, the image denoising level had the very big enhancement, foundation for the further realized of the goal recognition.

5.1 The Extraction Research Study of median line characteristic and textural property in SAR image

Analyse and extraction goal using the SAR image's recognition clues are the important method of the object detection and the recognition in the SAR image, but application textural property and line characteristic research are more in the SAR image's feature extraction. J.Chanussot proposes multiple source data fuzzy fusion boundary extraction operator[18]; TupinF et al. who is French Paris higher telecommunication Engineering college's, has proposed suits under the Baye frame to examine the linear feature the algorithm [19,20]; A.Lopes, E.Nezry, R.Touz et al. studied and proposed structure ratio operator that is suitable for the boundary, the line, spot extraction[21].In the concrete application, JinFei Wang's research realizes line characteristic automatic detection[21] through the Hough transformation; To distill exactly the rice paddy boundary information in the Radarsat SAR image, Shao Yun et al.who working in remote sensing institute has developed a two-dimensional eight direction filtering algorithm and has designed the optimized boundary extraction plan, applied it in the study "the SAR technology uses in the south paddy rice growing trend monitor and the land utilization investigation application demonstration", which might reduce the error of the paddy rice sown area computation in the application, further enhanced the paddy rice estimation precision [22]. Li Yan, Peng Shaolin, Liao Qifang et al. studies using the data of Canada radar satellite (RADARSAT) narrow wave scanning pattern (SNB), which has established radar remote sensing succession information paddy rice estimation model based on the RADARSATSNBSAR, carried on the wide range paddy rice evaluation taking Guangdong Province as the example [13]; France's Roger Fjortoft, Armand Lopes and Philippe Marthon proposed best multi-marginal check algorithm in SAR image, they proposed that in view of the SAR image's edge detector, this kind of detector under the stochastic multi-edge model by the smallest mean error judgment is most superior [14-16]; Yang Long, Zhou Zhimin, Huang Haifeng et al.who is in the University of National Defense and Science's, use two step examination operators in the line goal extraction aspect to examine the peripheral point, then use evolves the direction grouping law which from the phase grouping thought comes to form straight line characteristic method [17]; Wang Cheng, Wang Runsheng et al. has designed the corresponding straight line extraction algorithm in straight line extraction aspect in view of the SAR

image in coherent spot statistical property, first using the Canny operator and the Ratio operator obtains the peripheral point and the edge direction, then obtains the initial straight line chart according to the edge direction uniform principle, finally through high-level grouping method connect the straight line damage because of the noise [18]; Song Jianshe, Yuan Lihai, Chen Zhijiang and so on has designed goal center of gravity extraction algorithm in view of the linear object based on the goal edge detection's foundation, has design contour line tracing algorithm to the ring-like object, and has given to the computational method which including target zone, central point marking, the goal crosswise, longitudinal "diameter" and so on [4]; Wan Peng, Wang Jianguo, Zhao Zhiqin, Huang Shunji and so on proposed one kind of new synthetic aperture radar image object detection and recognition methods, this method according to the SAR image statistical distribution characteristic, unifies the characteristic of the permanent false warning examination algorithm and the wavelet transformation extraction in the SAR image [18]; Zhu Caiying and so on who is in People's Liberation Army Information engineering University's has proposed on one kind of new method that extract the radar image resident place's in view of the target of complex structure, this method selected three appropriate characteristic component synthesis colored textural property image based on the paragenesis matrix texture analysis's foundation, obtained the luminance component again through HIS transformation, using brightness threshold value division image distill resident [20]; Han Ping and so on has studied one kind of method about synthetic aperture radar target characteristic extraction and recognition based on KPCA (Kernel Principal Component Analysis) and SVM (Support Vector Machine) [21]; Wang Yunfeng and so on who is in University of Electronic Science and Technology of China's proposed fractal dimension feature extraction algorithm making use of the least squares method fitting space-like surface's, and has carried on feature extraction [22] using this algorithm to the SAR image.

In the path and the bridge extraction aspect, the domestic and foreign scholars have done massive work and have made the good extraction progress. Florence Tupin, Henri Maitre et al. who has study in the SAR image highway network's extraction, they first use the partial line feature detection operator extraction basic line segment, then completes the line segment organization through MRF [22, 23]; Li Sudan and so on proposed that one kind of two step algorithm which used to extract linear feature, specially distills highway network from the synthetic aperture radar (SAR) image which not having the surveillance [24]; Tang Zhiwei and so on first carries on the pretreatment to the SAR image, removes the obvious non-target area, strengthens to the goal recognition effect, then carries processing on view of bridge shape goal based on this, including direction ratio law and bilateral parameter lawwhen distinguishes in the SAR image when they identifies the bridge goal in the SAR imagery[23]. Because in the high resolution SAR image, the path in the spatial structure is one tall and slender, and width basic constant invariable homogeneity rangee. Therefore Xiao Zhi, Bao Guang Shu who is in South central University's has proposed that one kind algorithm which distills the urban road network from the high resolution SAR image, The concrete process is using fuzzy C average value cluster method which carries on the cluster analysis to the high resolution SAR image, separates the path class pixel from the primitive image, then carries on the refinement to the cluster result, simultaneously eliminates the short line segment using the track operator, distills the path middle line two value charts pixel value to take the image energy, applies the Snakes model examination path network. Through the actual SAR image confirmation, this algorithm may distill complex urban road network accurately[25].

5.2 The Research in the Aspect of image division and object detection of SAR image

The image division is divides the image into the region and the image object goal corresponds interesting, Obtains the picture target through the gray level latitude. Regarding the SAR image division, R.Cook proposes region fusion division method based on the moment characteristic; Y.Dong, B.C.Forster, P.A.Kelly and so on completes the radar image division using MRF [26]; C.Lemarechal has studied the SAR image division based on the morphology [26-27];R.W.Ives proposes SAR image pixel division method [27]; H.Derin proposes SAR division method and so on based on letter in reply number [28];Fu Kun,Kuang Gangyao who is in National University of Defense Technology give a complete algorithm about the high resolution, the list to polarize SAR the image target category [29].

At present the SAR image goal's examination and distinguishes which have received attention highly. Forepart, Because of the imagery distinguish rate is low, he early work mainly concentrates in the object detection aspect. Because the ships usual

existence massive angle reflection, the ships goal and the sea level have the strong contrast gradient. Valve division directly take image point brightness as characteristic division goal, therefore to SAR imagery processing, it is applied widely, moreover simple quickly. There are two methods examining the ships goal in the SAR images: One kind is the direct examination; Another kind is examining the contrail first, then seeks for the ships goal nearby the contrail. These two methods are suitable for the different situation, in the background noise is strong, but in ships goal quite small situation, because the trailing line is the very long line target, the characteristic is quite obvious, examines the contrail to be possible first to reduce the false warning in the examination ships goal. But the advantage of direct examining is that we may examine the static ships. T.Maria, J.K.Tunaley and so on examine flight path through Radon transformation [24, 30]; V.A. Nastassopoulos proposes most superior CFAR examination operator in the Weibull distributed foundation [30]; W.W.Irving proposes multi resolution object detection [31]; Leonid I.Perlovsky has studied object detection method based on neural network [24]; L.Benyoussef realizes and so on realized the object detection using the matched filter[32]. In the application aspect Norway national defense Research center started to be engaged in the SAR image the ships and the flight path examination aspect research from 1985 for the European State Agency, in 1992 they have completed use the ships and the flight path examination system about ERS-1 SAR data, inspect the specific sea area, the bay harbor. Along with the SAR image resolution's unceasing enhancement, using the SAR image possibly to realize the target recognition into.

The domestic scholar has also done the much works in the ships examination and the flight path recognition aspect, existing many ships target recognition's research work.aims at the in view of low resolution quite SAR image, In these low resolution SAR image, image resolution and ships' size basic quite, the ships goal may become a spot or the minority several spot composition strong goal approximately, the quite high contrast gradient in the sea level. Wang Shiqing proposed one kind algorithm SWDRM (Ship Wake Detection Algorithm based on Radon transformation and Morphologic image processing technology) by the Radon transformation and morphology imagery processing technology examination shipping agency contrail [33]; Zhou Hongjian proposed the application misalignment stretches the method enhancement ships goal, eliminates the spot using the morphology filter's method, after taking the valve value method examines the ship goal, counts the ship goal the length as well as the central place and so on important information, after examining the ship goal, the use curve scanning's method further examines flight path characteristic [34]. Along with the SAR technology mature and high resolution SAR image appearance, also no longer only uses the method which to the ships goal's examination the point target examines, but through ships goal small provincial characteristics analysis and extraction ships. Such as Zhong Jinsong, Zhu Minhui in view of ships object detection algorithm in the high resolution SAR image's, use the KSW double thresholds value division technology, its effect is better than the traditional examination method, is advantageous to the further target category and the recognition [33,34]; Tang Ziyue,Zhu Minhui and so on to propose one kind examination method based on neighbor picture element summation SAR sea level image ships contrail permanent false alarm rate [37]; Zou Huanxin and so on proposed one kind examination algorithm unifies the young Pood resolution analysis, the auto-adapted threshold value choice, the marginal check operator and the Radon transformation carries on the speckle noise to suppress with flight path [34]; Luo Qiang, Luo Li and so on proposed ships object detection method rests on the SAR image sea background and the ships type of target analysis, based on wavelet exchange satellite SAR sea image [35]. On the SAR image, the ships goal is clearly discernible, carries on the ships and the contrail examination has the broad application prospect. Along with the SAR technology to high way development and so on resolution, multipolarization, will carry on the ships and the contrail examination using the SAR image will have the bigger development opportunities.

5.3 The Recent Development Research of SAR Image

The United States Department of Defense Advanced studies Plan Bureau (DARPA) proposed the movement, the stationary target gain and the recognition (MSTAR) plans, the goal is the development of next generation SAR automatic target recognition system. This plan provides some military target and high resolution aviation SAR image to take the object of study, carries on under division of labor and cooperation's condition, many universities and the development facility participate in the research work, at present already obtained the important research results [24, 30]. Lincoln who is

in the American MIT laboratory holds the important status in the SAR goal's examination and the recognition, they provide ADTS (Advangced Detection Technology Sensor) the high resolution aircraft-borne SAR digital target information uses in the automatic object detection and the recognition research. Using these data, Quoc H.Pham and Chanin Nilubol complete the target recognition based on the hidden Markov model; Theera-Umpon proposed that solves in the SAR image using the morphology weight sharing neural network army vehicle's examination and the recognition question [24, 30].

SAR ATR is automatic or a semiautomatic SAR image interpretation research important aspect, it has the important military significance, therefore, various countries take this aspect at present the research, typical including: America, Russia, France and Germany, Canada, Japan, Sweden, Italy, South Africa, the US is in international leading position [34]. US's SAR ATR research mainly has the Lincoln laboratory based on template's SAR the ATR system and MSTAR based on model SAR the ATR system.

In the research which the airport goal research aspect domestic does to the SAR image in are also very few, Sang Nong, Lu Peng, Zhang Tianxu and so on in view of the low signal-to-noise ratio radar image's characteristic, carry on the post-processing in the Radon transformation's foundation using the airport goal and the background radar imagery knowledge to the Radon transformation's result, with the aim of distilling in the radar image reliably airport goal [33]. But the airplane target recognition's research does not have the related report nearly in view of the SAR image.

5.4 The Main Matter and Forecast in the Study of Automatic Detection and the Recognition Research in the SAR Image

In the SAR image's use aspect, overseas has proposed that the characteristic structure understands and the target recognition direction to the automatic image develops, but the home is also in the goal extraction and the examination stage, are few to the goal automatic diagnosis research results.

SAR ATR which it's most difficult is the place which realizes to lie in promotes very difficultly the SAR ATR experimental result to the common actual situation. Although, may obtain immediately the sample from a specific image collection, but because the source image collection is in itself not the actual problem random sample, therefore, this sample is not stochastic essentially[35]. The domestic and foreign research also only limit to some algorithm to some specific SAR image denoising or the object detection, but distinguishes the research is also at the development phase. Analyzes the SAR image characteristic and the geography space mutual counterfeit relations, the solution false warning question, raises the SAR image resolution is realizes the automatic target recognition to be urgently needed the solution the question.

At present, the development of SAR image's has three directions: First, distills the recent information and the new characteristic using the radar remote sensing data, second applies the new theory, like based on paragenesis matrix, wavelet theory, fractal theory radar remote sensing image texture information extraction and based on fuzzy theory mix element decomposition and so on; Third, designs the new algorithm, how to achieve this goal, the way is infinitely varied, but generally and constructs the new algorithm two directions from the improvement classical algorithm to obtain.

6 Conclusions

From the above analysis, you can see that the slant range of SAR image - Doppler center of earth model localization algorithm suits the localization of SAR image in the spaceborne SAR ground datum processing system. Its localization accuracy is mainly decided by each kind of parameter measuring accuracy of system and the hypsography influence. The azimuth circle system error adjustment algorithm to be able to combine the localization algorithm with this paper well, increased the localization accuracy large scale, if uses the more precise position material as well as the entire precision earth model, the adjustment precision will further enhance.

Along with the day-by-day development of the observes technical about the radar to the place, facing SAR image data collection ability which grows unceasingly, how to carry on automatic or semiautomatic fast, the accurate interpretation to these images already more and more aroused people's interest and takes seriously. To SAR image goal automatic detection and recognition, although has conducted many research, but mostly is also restricted in the specific data and the sole method research, also has a long way to go to the universal application. Along with the artificial intelligence, fuzzy information processing, the wavelet analysis, the score Uygur method and so on will certainly to promote in the SAR image with the SAR image

research's union the goal automatic extraction research level enhancement.

References

[1] Xiaokang Yuan. Spaceborne synthetic aperture radar introductory remarks [M].Beijing: Defense industry publishing house, 2003.
[2] General Staff Department. Military topography. People's Liberation Army Publishing house
[3] Military topographic interpretation. People's Liberation Army Publishing house
[4] Curlander J C.Location of Spaceborne SAR Imagery [J].IEEE Trans.On.Geoscience and Remote Sensing, 1982, GE-20(3):359-364
[5] JohnC.Curlander,Ronald Kwok, Shirley S.Pang.A Post processing System for Automated Rectification and Registration of Spaceborne SAR Imagery[J].INT.J.RemoteSensing,1987,8(4):621-638.
[6] QJ 1028A-95, Astronautics product commonly used coordinate system[S].
[7] QJ 907-85, Standard Earth parameter[S].
[8] Weijie Zhang. Spaceborne synthetic aperture radar image analysis localization algorithm research. Journal of Beijing Institute of Technology [J].Vo1, 25 NO.2 148-150.
[9] Xiufang Liu and so on. Spaceborne SAR image pointing accuracy analytical study. Journal of Remote Sensing. Vol10, NO.1:76
[10] T.R.Crimmins, Geometric filter for reducing speckle. Appl,Opt,1985,24(2):1438-1443.
[11] Jinfei Wang, Philip J.Howarth, Use of the Hough transform in automatic lineament detection, IEEE Trans. on Geosc. Remote Sensing,1990,28(7):561-566.
[12] S.Fukuda, H.Hirosawa, Suppression of speckle in synthetic aperture radar images, Int.J.Remote Sensing, 1998,19(3):507-519.
[13] Wan Peng,Wang Jianguo,Huang Shunji.. SAR image goal synthesis examination method [J]. Acta Electronica Sinica,2001,29(3):323-325.
[14] A.Loper,E.Nezry,R.Touzi, Structure detection and statistical adaptive speckle filtering in SAR images, Int.J.Remote Sensing,1993,14(9).
[15] Shao Yun,Tan Qulin,Xiao Jianhuan and so on. Radarsat the SAR image sails upstream the rice paddy boundary extraction research [J]. High Technology Letters,2002,(7):26-29.
[16] Li Yan,Peng Shaolin,Liao Qifang and so on. Radarsat SNB SAR data in big area paddy rice estimation applied research [J]. The geoscience progresses, 2003,18(1): 109-115
[17] Helmut Mayer. Automatic Object Extraction from Aerial Imagery—A Survey Focusing on Buildings. Computer Vision and Image Understanding,1999,74(2): 138–149.
[18] Aleksandra Vuckovic, Vlada Radivojevic, Andrew C.N. Chen, Dejan Popovic. Automatic recognition of alertness and drowsiness from EEG by an artificial neural network. Medical Engineering & Physics ,2002(24) :349–360.
[19] Eduardo Mosqueira-Rey, Vicente Moret-Bonillo, Intelligent interpretation of validation data, Expert Systems with Applications 2002 ,(23):189–205.
[20] Yang Long,Zhou Zhimin,Huang Haifeng. SAR image line feature extraction method study [J]. Modern Radar,2002,(1):50-53.
[21] Wang Cheng,Wang Runsheng. SAR image straight line extraction [J]. Acta Electronica Sinica, 2003,31(6):816-820.
[22] Wang Peng,Wang Jianguo,Zhao Zhiqing and so on. SAR image weak reflection terrain feature edge detection method[J]. Signal processing, 2000, 16(4): 317-323.
[23] Zhu Caiying,Lan Chaozhen,Jin Guowang. The texture image brightness threshold value law withdraws the SAR image resident place [J]. Chinese image graph journal , 2003,8(6):616-619.
[24] Han Ping,Wu Renbiao,Wang Zhaohua. Based on KPCA criterion SAR target characteristic extraction and recognition[J]. Journal of Electronics and Information Technology, 2003, 25(10): 1297-1301.
[25] Wang Yunfeng,Tang Zhiwei,Wang Jianguo,Huang Shunji. In SAR image bridge recognition methods research [J]. Systems engineering and electronic technology, 2001, 23(6): 76-78.
[26] Tang Zhiwei,Wang Yunfeng, Wang Jianguo. In synthetic aperture radar image bridge shape target identification [J]. Journal of Radio Sciences, 2000, 15(1): 41-44.
[27] Li Sudan,Wang Zhengzhi,Zhang Cui. SAR in image path's examination [J]. Journal of National University of Defense Technology, 2001, 23(1): 59-65.
[28] Xiao Zhiqiang,Bao Guangshu.. One kind withdraws the urban road network from the SAR image the method [J]. Acta Geodaetica et Cartographica Sinica ,2004,33(3):264-268.
[29] P.A.Kelly,H.Derin, Adaptive segmentation of speckled images using hierachical random field model, IEEE Trans.on ASSP, 1988, 36(10): 1628-1641.
[30] R.W.Ives,P.Eichel, Application of pixel segmentation to the low rate compression of

complex SAR imagery, IGARSS'98, 1998: 1064-1067.

[31] H.Derin, P.Kelly, Modeling and segmentation of speckled images using complex data, IEEE Trans.Geosci. Remote Sensing,1990,28(1):76-87.

[32] Fu Kun,Kuang Gangyao,Yu Wen xian. High resolution SAR image terrain feature sorting algorithm research [J]. Acta Electronica Sinica , 2001, 29(12A):1820-1823.

[33] Li Sudan,Zhang Cui,Wang Zhengzhi. In SAR image path examination method study [J]. Journal of Chinese Society of Astronautics , 2002, 23(1): 17-24.

[34] L.M.Novak,M.C.Burl,W.W.Irving, Optimal polarimetric processing for enhanced target detection, IEEE.Trans.on Aerospace and Electronic System,1993,29(1) 36-45.

[35] L.Benyoussef,Y.Delignon, An optimal matched filter for target detection in images distorted by noise,IGARSS'98,1998:1000-1003