Improvement of Airborne L-band-SAR (Pi-SAR-L2) Coherence by Pixel by Pixel Resampling

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1. Introduction

Although Airborne SAR is advantageous in terms of flexibility of flight path direction and observation scheduling, the deviation from the flight path linearity due to the perturbation by wind irregularity makes interferometry difficult. We have been working on a development of L band airplane SAR interferometric technique with an aim to use it for volcanic deformation monitoring. The most effective way to improve the coherence between 2 airborne observations is precise coregistration of the slave image against the master image. We here present a new method of precise coregistraion for airborne SAR interferometry using pixel by pixel resampling capability of RINC software package developed by Taku Ozawa at NIED. We demonstrate the usefulness of this technique utilizing airborne repeat path SAR data acquired by JAXA’ s airborne L-band SAR system (pi-sar-l2) over southern Kyushu volcanoes (Sakurajima volcano, Kirishima volcano and Unzen volcano) .

2. The classic coregistration method

Because the flight path of satellite is relatively smooth, the coregistration between master and slave images based on two dimensional quadratic function fitting is sufficient. Our interferometric process for airborne SAR started with the same technique. However, our preliminary tests suggested the insufficiency of this classic method for airborne SAR failing to faithfully follow high frequency component of pixel offset caused by irregularity of the airplane flight path due to the wind fluctuations especially in along-track direction.

3. Precise coregistration method using pixel by pixel matching technique

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To improve the effectiveness of coresistration, we employ an additional step to fit the two dimensional pixel offset field after the primary fitting using a quadratic function. In the process of the additional fitting for the the primary fitting residuals, we use an empirical smooth function fitting capability of Matlab software package. Thus we calculate the offset values between master and slave for every pixel of master image and then we carry out coregistration using pixel by pixel resampling capability of RINC software package. This additional procedure significantly improves the coherence as we see below.

3. Demonstration of Usefulness of New method using data over Kirishima volcano

We tested the usefulness of the new method for the repeat path SAR data acquired on 2014 and 2016 over the Kirishima volcano complex. The figure shows the comparison of the coherence between the results of classic and new methods. The area of good coherence increases significantly in the image derived by the new method in the right hand, where brighter colorization corresponds to better coherence. The improvement of the lower half of the image is obvious. Although there still remain stripes of worse coherence which run in the direction perpendicular to the azimuthal axis, the width of those stripes is reduced. This bad coherency seems to be caused by abrupt change of flight speed of the airplane. In this particular observation, our target is Iwoyama dome which is a nest of recent phreatic activity, and the coherence there is actually greatly improved by the new method resulting in better understanding of the ongoing inflation mechanism which will be reported elsewise. In the presentation, we will show the test results using other data sets and discuss the usefulness of the new methods.

Credits: We used RINC (Ver. 0. 36) developed by Dr. Taku Ozawa and Geospatial Information Authority of Japan height data for SAR interferometric processing. This study was supported by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan, under its Earthquake and Volcano Hazards Observation and Research Program.

Keywords: Airborne SAR, SAR Interferometry, Crustal Deformation

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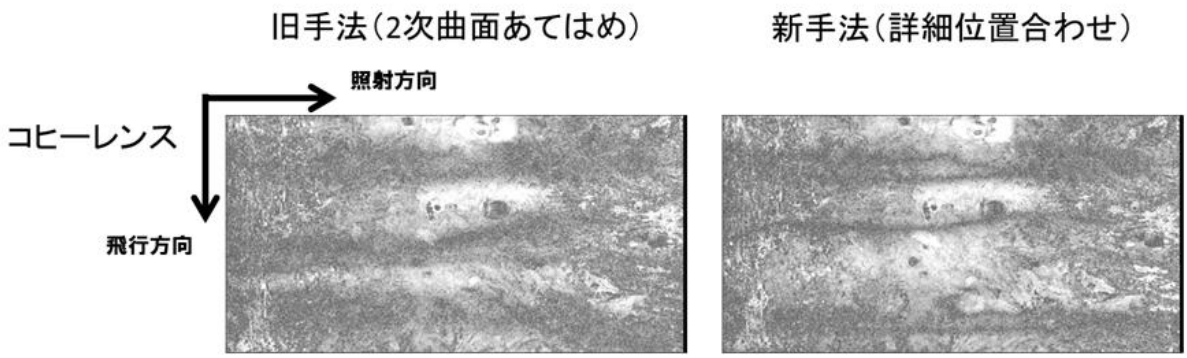

図　EW軌道データ（2014-2016）に対するリサンプル新旧手法の比較.
コヒーレンスは，明るいピクセルほど干渉性が高い．全体的に干渉性が上がっているが，特に，画像の下半分で改善が顕著である.

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