Pseudo Full-Polarimetric SAR Signal Derivation

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Abstract **– This paper proposes the method of deriving pseudo full-polarimetric SAR signal using data of TerraSAR-X. Pseudo full-polarimetric means artificial data by using two sets of dual-polarization data that was observed in the past. We examined this method for reference reflectors and residential areas.**

Index Term **– pseudo full-polarimetric, TerraSAR-X, dual-polarization**

Ⅰ. INTRODUCTION

In recent years, the need for remote sensing by satellite has been growing as one of disaster measurements.

As one of the observation methods by remote sensing, there is a full-polarimetric observation that performs observation using the polarization of the electromagnetic wave. The advantage of this observation method, due to observation with all the polarization state of the target, it is possible to perform various analysis. But, because number of observations is much less than the dual-polarization observation, full-polarimetric data have not been fully used.

In this paper, we describe the method to create a pseudo full-polarimetric data using from two sets of dual-polarization observation data of TerraSAR-X. In order to improve the accuracy of the pseudo-data, we perform the analysis by focusing on the characteristics of the amplitude and phase data of the radar.

Ⅱ. DERIVING PSEUDO FULL-POLARIMETRIC SIGNAL

A. Method

We have created a pseudo-data by using the data of the date and time of two sets. Here, 'H' means horizontal polarization and 'V' means vertical polarization. HH, HV, VV shows a combination linear polarization respectively and these are represented in the order of reception and transmission.

The data that have been observed in the date and time A areHH_A, VV_A, and data that has been observed in the date and time B are HH_B, HV_B. Index Ps represents pseudo data.

Time A :	HH_A	HV_{PsA}	VV_A
Time B :	HH_B	HV_B	VV_{PsB}

$$HV_{PsA} = \frac{HH_A}{HH_B} \times HV_B \quad (1)$$

$$VV_{PsB} = \frac{HH_B}{HH_A} \times VV_A \quad (2)$$

As the feature of this method, it cannot be applied to natural objects, such as plants because deriving pseudo full-polarimetric is assumed that the position of the observed object does not change over time

B. Used Data

We analyzed using dual polarization and full-polarimetric data of TerraSAR-X. Tab.1 shows details of used data.

Tab.1 Details of used data of TerraSAR-X

Date	Polarization
2010. 4.18	[HH HV VH VV]
2011. 9.17	[HH VV]
2011. 10.9	[HH HV]

Ⅲ. RESULTS

We selected four residential areas . We extracted the amplitude characteristics of ratio of HH data of period of two set. Next, we checked whether the selected area contains pixels that are suitable for creating pseudo data. Third, we created pseudo full polarimetric data using only the pixels that are suitable for pseudo data creation. The areas where the amplitude ratio of the pixels become $\left|\frac{HH_A}{HH_B}\right|$=1 or $\left|\frac{HH_A}{HH_B}\right| \fallingdotseq 1$ are suitable for forming pseudo full-polarimetric data because of the feature of this method.

Fig.1 Verification Areas(Aerial)
(Left:Area Ⅰ Midst:AreaⅡ Right:AreaⅢ)

Ⅳ. RESULTS VERIFICATION

We created a pseudo data by screening the data in the amplitude information. Fig.1 shows images of residential areas treated here. We created pseudo data by using the data of the portion surrounded by the red dotted line. Fig.2 shows histogram of phase and amplitude of $\frac{HH_A}{HH_B}$ respectively. In Fig.2, colors mean Black;more than 0.08%, Red;0.06~0.08%、Green;0.04～0.06%. We set the threshold as shown in Fig.2. We created the pseudo data by using only pixels between the values of amplitude; $0.7 \leqq \left|\frac{HH_A}{HH_B}\right| \leqq 1.3$.

Fig.3~Fig.5 show polarization signatures of the residential area obtained from actual full-polarimetric data and pseudo full –polarimetric one, respectively. As shown in Fig.3~Fig.5, we can see the form of the signature of the two is very similar. From these results, we found that there is a possibility of creating a pseudo full-polarimetric data with high accuracy by screening pixels.

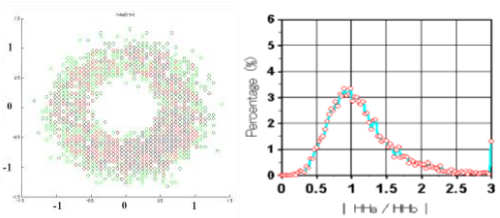

Fig. 2 Histogram (Left; phase dimension of $\frac{HH_A}{HH_B}$, Right; amplitude of $\frac{HH_A}{HH_B}$)

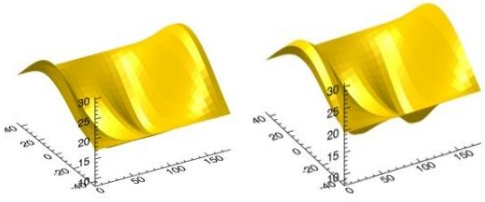

Fig. 3 Signature of Residential area Ⅰ
(Left; actual Right; pseudo)

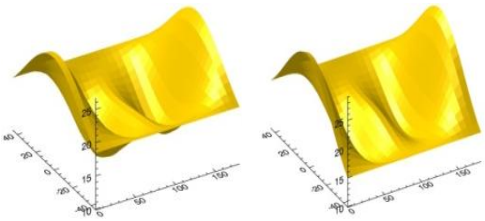

Fig.4 Signature of Residential areaⅡ
(Left; actual Right; pseudo)

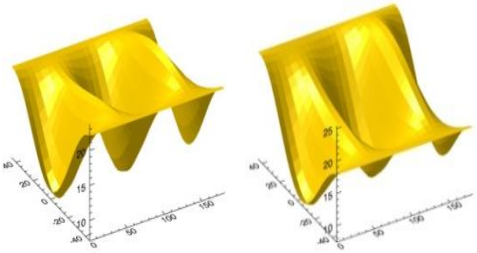

Fig.5 Signature of Residential areaⅢ
(Left; actual Right; pseudo)

Ⅴ. CONCLUSION

We proposed a method to create a full-polarimetric data artificially from two sets of dual-polarization data. In the wide area such as residential area, we consider raising the accuracy of the pseudo data by screening the data by the amplitude information that radar data have. Therefore, there is a possibility that the accuracy of the pseudo data is further improved by screening data by phase as well as amplitude.

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