Backscattering Characteristics Extracted by POL&IN-SAR

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Abstract
Backscattering characteristics of earth surface targets, such as urban targets, forest, ice, glacier and snow are being studied. POL&IN-SAR techniques will be applied. In study of urban targets, polarization orientation angle shifts are used.

Keywords: POL&IN-SAR, urban targets, forest, ice, glacier, snow, polarization orientation angle shofts.

1. INTRODUCTION

Interferometric SAR (IN-SAR) technique has demonstrated its capabilities of measuring 3-D surface terrain and small displacement fields [1]. In addition, interferometric coherence reflects temporal and local change of targets. Polarimetric SAR (POL-SAR) technique has been applied for target decomposition and terrain/land-use classification [2], [3]. Recently, polarimetric and interferometric SAR (POL&IN-SAR) technique has been proposed to extract canopy height and vegetation structure. Objective of this research is to consider POL&IN-SAR technique as a tool for extracting backscattering characteristics of forest, ice sheets, glacier, snow and urban targets (built-up areas, farmland, manmade objects and so on).

2. STUDY AREAS AND DATA

2.1. Sarawak, Malaysia

Our study site of rainforest, Lambir Hill National Park is located in this area, where deciduous and broadleaf trees are about 60 m height and 80 m height crane is used for canopy observation. This study site contains topographic relief. Polarimetric data was acquired in cycle 10 and 11 in 2007. POL-SAR and POL&IN-SAR technique will be applied to analyze the data.

2.2. Greenland

Our previous study of Antarctica showed that an IN-SAR technique could be a useful tool for mapping of ice sheet movement and glacier flow [4]. Our original idea in study is to apply POL&IN-SAR technique to Antarctica, but unfortunately there is no plan of polarimetric acquisition by PALSAR over Antarctica. Our study area was change for Greenland. Study interests are on ice, glacier and snow. Polarimetric data was acquired over Greenland in cycle 10 and 11 in 2007. In case of JERS-1 SAR, baseline estimation was a serious problem to generate interferograms. However, as for PALSAR reliable interferograms are expected due to an accurate baseline from highly accurate orbit information.

2.3. Gifu, Japan

Gifu is a study site of urban targets containing built-up areas, farmland, rivers, manmade objects and so on. Polarimetric data was acquired in cycle 10 and 11 in 2007. POL-SAR and POL&IN-SAR technique will be applied to analyze the data.

3. DATA ANALYSIS

3.1. Sarawak, Malaysia

Figure 1 shows PALSAR polarimetirc image of Sarawak in March 2007. A white box in the image presents a location of 80 m height crane in Lambir Hill National Park. According to baseline information by JAXA, a perpendicular baseline of an interferogram from March and

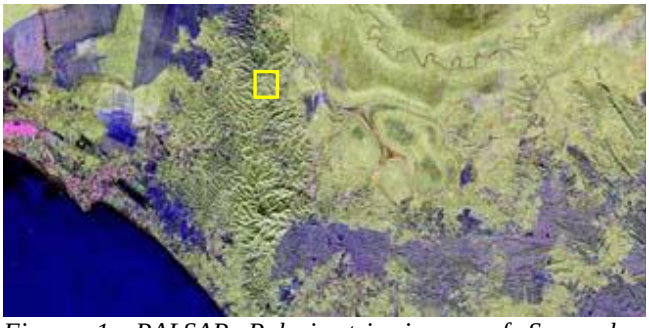


Figure 1. PALSAR Polarimetric image of Sarawak, Malaysia in March 2007. Blue color corresponds to |HH+VV|, red to |HH-VV| and green to |HV|. Azimuth is the right to the left, and range is the bottom to the top.

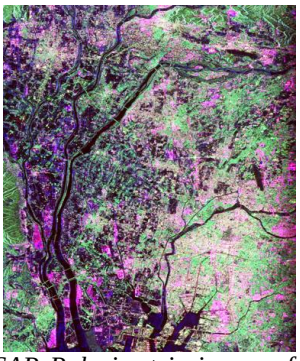


Figure 2. PALSAR Polarimetric image of Gifu, Japan in March 2007. Blue color corresponds to |HH+VV|, red to |HH-VV| and green to |HV|. Azimuth is the bottom to the top, and range is the left to the right.

April data is about 300 m. Good quality interferograms are expected. POL-SAR and POL&IN-SAR analysis will be followed in future.

3.2. Greenland

Data selection among a lot of scenes over Greenland in the period of March to April 207 for POL&IN-SAR analysis will start soon.

3.3. Gifu, Japan

Figure 2 shows PALSAR polarimetirc image of Gifu in March 2007. Interests in this site are urban targets. Recently polarization orientation angle shifts in built-up areas has been studied. The polarization orientation angle shift by the building and/or house wall is [5]

$$\tan\theta = -\tan\alpha/\cos\phi \cdot \qquad (1)$$

where α is the rotation angel of the vertical wall from the azimuth direction (more strictly, the perpendicular direction to the radar incidence), and ϕ is the radar look angle as shown in Figure 3.

Figure 4 (a) shows the polarization orientation angle image of the same area of Figure 1. Most of the area is built-up areas, and is so flat that polarization orientation angles should be zero if they are dominated by only topography. However, Figure 4 (a) shows a wide variation of them. The reason is that building and/or house walls don't always face to radar. Figure 4 (b) shows classification results by the alpha-entropy method [2]. Dipole classes appear in built-up areas and forest on hill surfaces. In this study polarization orientation angle shifts will be used to develop a polarimetric decomposition in urban areas.

4. CONCLUSION AND FUTURE WORKS

PALSAR data analysis has just started for three study sites, Sarawak, Malaysia, Greenland, and Gifu, Japan.

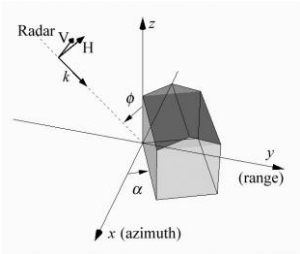
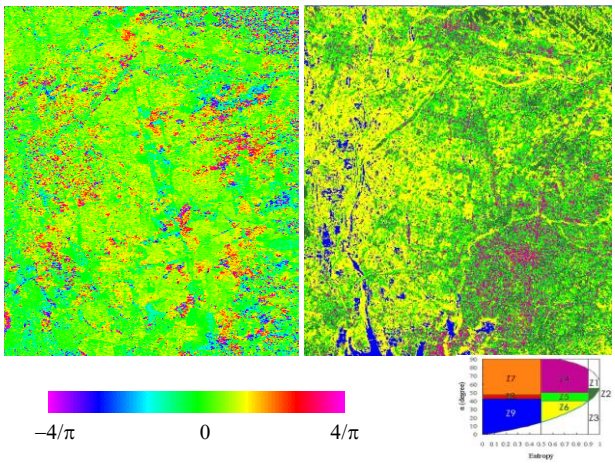


Figure 3. Schematic diagram of the radar imaging geometry to relate the orientation angle to a wall angle.



(a) *(b)*

Figure 4. (a) Polarization orientation angles and (b) alpha-entropy classification map of PALSAR data of Gifu, Japan.

Intensive works will follow using POL&IN-SAR techniques and polarization orientation angle shifts.

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