HIGH-RESOLUTION KU-BAND AIRBORNE SAR SYSTEM AND CCD FIELD TEST EXPERIMENT

Hideki Hasegawa[1], Yu Okada[1], Noboru Oishi[2], Masayoshi Tsuchida[2], Yosuke Nakano[1], Masafumi Iwamoto[1], Yoshihisa Hara[1]

[1]Kamakura works, Mitsubishi Electric Corporation, Japan ,
[2] Information Technology R&D Center, Mitsubishi Electric Corporation

ABSTRACT

Coherent change detection (CCD) technique is a kind of promising technique for current remote sensing system using RADAR, such as observation from unmanned aircraft observation system. Since a sensitivity of the target change depends on wavelength of radar system, higher frequency Synthetic Aperture Radar (SAR) is useful to detect a very slight change. On the other hand, detection of very slight change such as car track and collapse of resident area by using airborne high resolution SAR platform is very challenging due to very accurate flight pass control between before and after the change observation.

We have hence developed a Ku-band airborne SAR system, with a spatial resolution of 10cm, and have developed high accuracy navigation system and installed them on the airborne platform.

This paper presents the first results of CCD experiments. The experiments were carried on November 2007 in Nagoya area, using newly developed Ku-band SAR system curried on Gurfstream-II platform. We have conducted the experiments for 2 days and obtained 14 pass SAR images in total. We have achieved an accuracy of repeat pass separation as less than 10m and less than 3 degree of direction as a standard deviation. The CCD signal processing has been successfully implemented, and obtained with an average coherence of 0.6-0.9 in all images. As a result, a very slight change such as car track and trace of human activity can be detected. Detailed analysis result and discussion are presented in the paper.

1. 10CM SAR SYSTEM

To extract a very slight change information, high resolution(10cm) Ku-band SAR system has been developed, which is an improvement in the spatial resolution from the previous 30cm Ku-band SAR system[1]. This sensor features a single channel mono-static SAR system with a pulse bandwidth of 1.5GHz, enabling 10cm resolution. Figure. 1 shows an overview of Ku-band SAR system. The SAR system is carried on Gurfstream-II platform and system parameters are shown in Table. 1. In order to obtain higher coherence between several path observations, we have developed real-time navigation system using SBAS/GPS instrument, and obtained less than 10m tube in all 14 observations.

Figure.1 Overview of the Ku-Band SAR system

Table.1
Parameters of The High resolution Ku-band SAR system

Item	Parameters
Pulse bandwidth	1.5GHz
Center Frequency	16.45GHz (Ku band)
Power	300W
Off-nadir angle	60deg
Range resolution	10cm
Azimuth resolution	10cm
Beam width	9deg x 10deg
Polarization	HH
Platform	Gurfstream-II

2. RESULTS

Field test experiment was executed on November 2007 in Nagoya area, Japan. We have obtained 14 observation data in one field test area repeatedly. In 14 sequence observations, several targets, such as cars and human target, was set on the field, and extract features. Figure 1 shows one of examples with and without human target. Although the RCS of human in Ku-band is not so higher than noise equivalent sigma zero in this SAR system, we can extract slightly bright target as compared to the ground clutter, and detect radar-shadow behind the human target against the radar beam direction.

Using 14 observation data, we have attempted to extract a very slight change in the test field area. Owing to the very accurate platform repeat pass with an accuracy of less than 10m, we have succeeded to obtain a high coherence value with a typical value of 0.6-0.9, in all of the data combination analyzed in 14 observations. Figure 3 shows examples of coherence map before and after the car track. We can clearly detect the car track in both CCD images, and more detailed analysis result and discussion are presented in the paper.

3. REFERENCES

[1] Okada et al. "High-resolution Ku-band airborne SAR for DSM extraction," *IGARSS2007*.

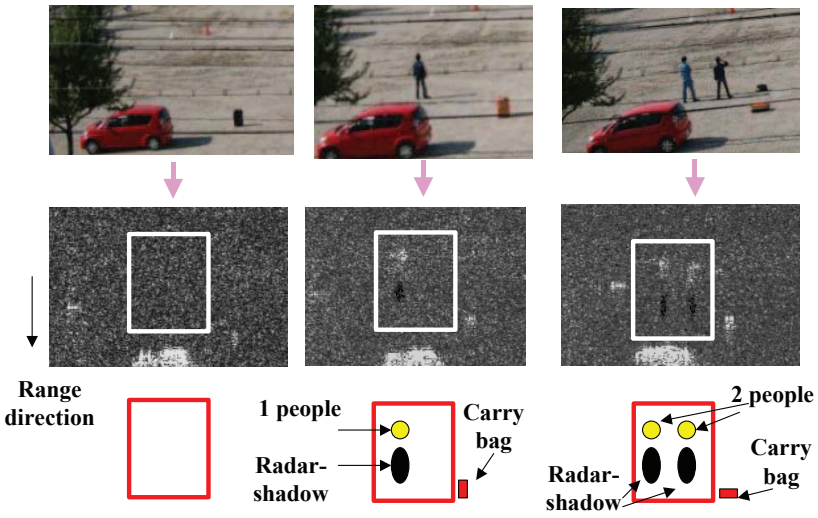

Figure.2 10cm SAR image of human target

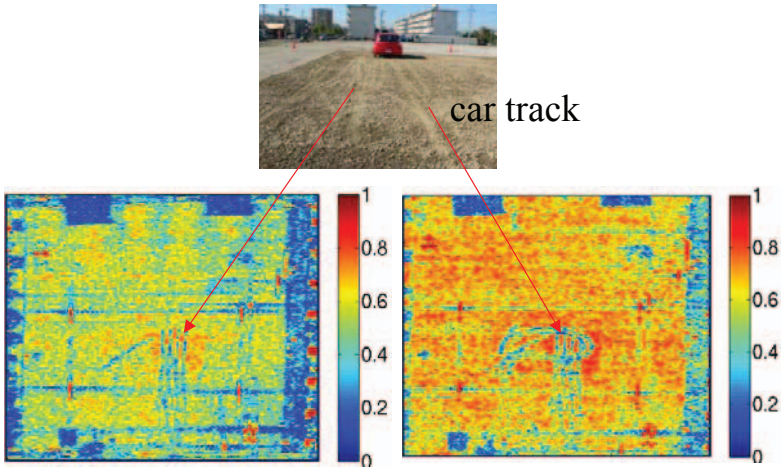

Figure.3 CCD image (coherence map) between before/after car track and human activities