CALIBRATION OF THE HIGH PERFORMANCE AIRBORNE SAR SYSTEM (Pi-SAR2)

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Abstract:

NICT (National Institute of Information and Communications Technology, Japan) have developed a high performance airborne SAR system (Pi-SAR2) since 2006, as a successor to the Pi-SAR (X-band). Pi-SAR2 system is installed to the Gulfstream II business jet. Two antenna radomes are mounted under the base of both wings. Table 1 shows the observation mode and the specifications of Pi-SAR2.

Table 1. Observation mode of Pi-SAR2

Observation mode	Mode 1	Mode 2	Mode3	Mode 0 (optional)
Bandwidth	500 MHz	300 MHz	150 MHz	500 MHz
method	Strip map	Strip map	Strip map	Sliding spotlight
Slant range resolution	0.3 m	0.5 m	1.0 m	0.3 m
Azimuth resolution	0.3 m (1look)	0.6 m (2looks)	0.6 m (2looks)	0.5～0.3 m (2looks)
Swath width	5～10 km	7～10 km	> 10 km	4 ～9 km
Azimuth length	-	-	-	3 ～7 km
NE σ^0	< -23 dB	< -27 dB	< -30 dB	< -25 dB

*In all modes, Pi-SAR2 acquires full polarimetric (HH/VV/HV/VH) and interferometric (VVs/HVs) data.
*Values are estimated with the airplane altitude of 12000 m and the ground speed of 220 m/s

Pi-SAR2 has polarimetric and interferometric functions with high spatial resolution of 0.3-0.6 m in along track (azimuth) direction and 0.3-0.5 m in cross track (slant-range) direction at X-band. High resolution in range direction is achieved by wide transmission bandwidth of 500 MHz. For optional experimental observation mode, sliding-spotlight beam steering of mechanical antenna movement in azimuth direction permits the high resolution in azimuth direction of 0.3 m with 2-looks. Noise equivalent backscattering coefficient (NEσ0) will be kept under -27 dB in slant-range distance of 5-10km between incidence angles from 20 to 60 degree at the platform altitude of 12000 m.

In this paper we report the ground based calibration experiment using active radar calibrators (ARC) and corner reflectors (CR) in conjunction with the Pi-SAR2 test flight.

The calibration experiments were carried out at the runway of the Taiki aerospace experiment field in Hokkaido, Japan in December 1-2, 2008. Two ARCs were used for measuring the azimuth antenna pattern and the polarimetric performance of the Pi-SAR2. We used 20 CRs (different shape and radar cross section) for radiometric and polarimetric calibrations (Fig.1).

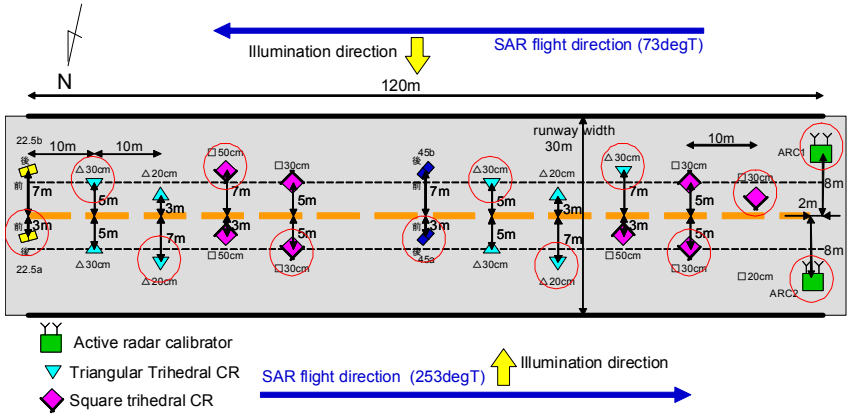

Fig. 1 Arrangement of ARCs and CRs on the runway

Fig. 2 shows Pi-SAR2 mode1 RGB power composite image (R:HH, G:HV, B:VV). Although the azimuth ambiguity images of the strong scattering from a tower are shown the center of the SAR image, the signal to ambiguity ratio (azimuth S/A) is over 40 dB in the SAR image.

Extended SAR images of the CRs on the runway are shown in the Fig. 3. Fig. 4 shows the up-sampled ground range and azimuth profiles of a CR (square trihedral) in the SAR image (HH-pol.). The spatial resolutions are 0.41m and 0.29m in the ground range and azimuth, respectively.

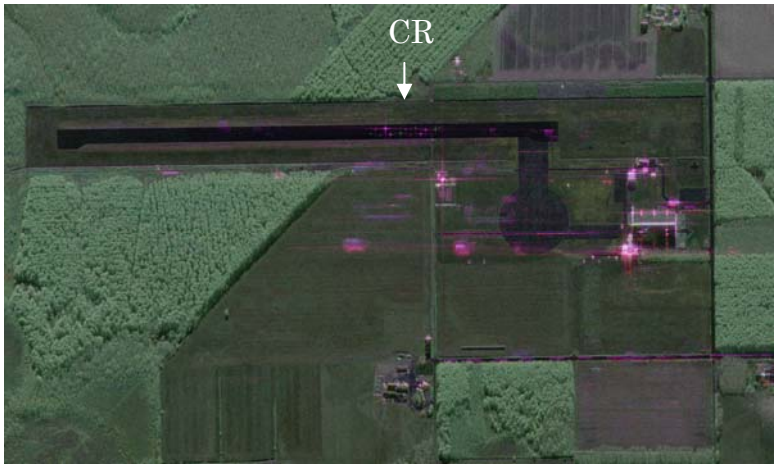

Fig. 2 Pi-SAR2 mode1 RGB power composite image (R:HH, G:HV, B:VV)('08/12/1). Image area is 1.5km x 0.9km

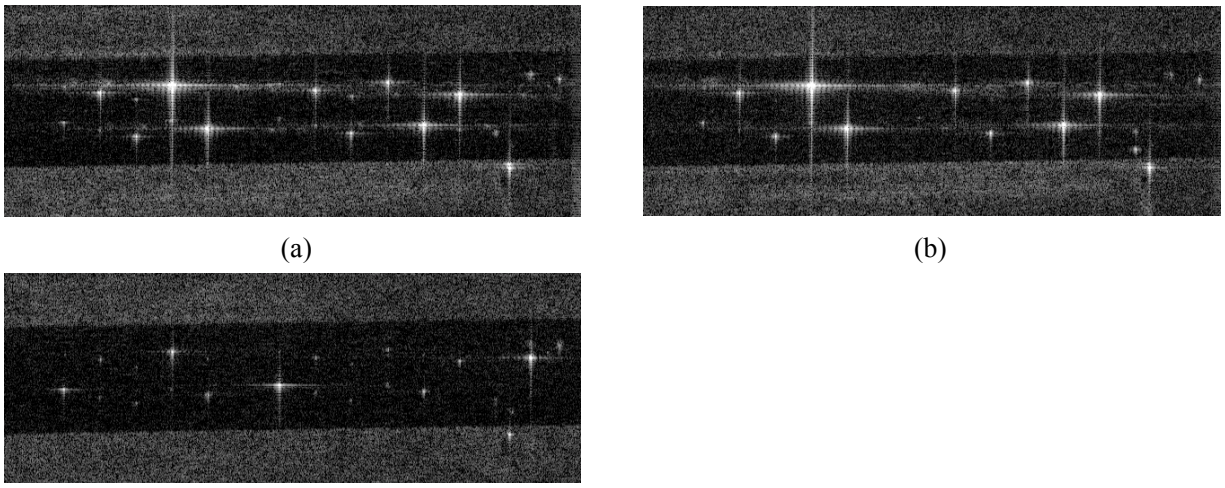

Fig. 3 Pi-SAR2 mode1 image (a: HH, b: VV, c: HV)('08/12/1). Image size is 160m x 60m. Pixel spacing is 0.25m x 0.25m.

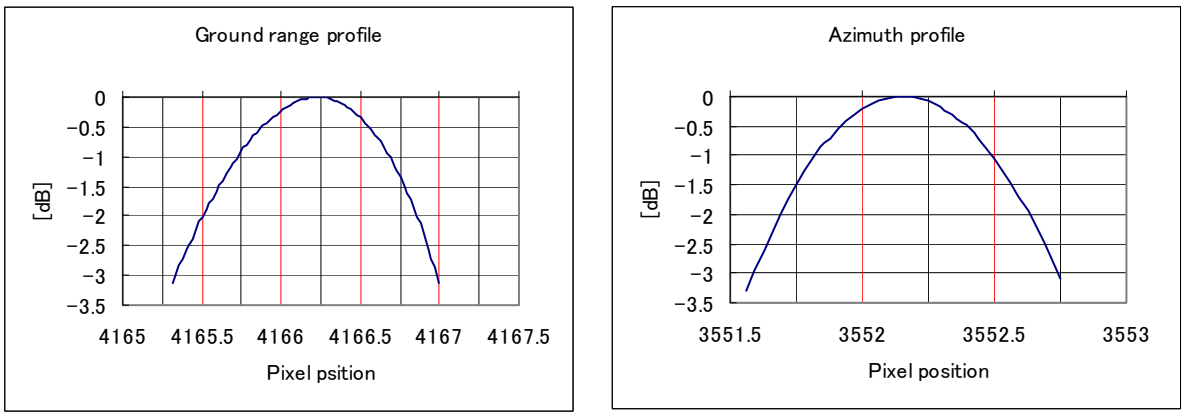

Fig. 4 Up-sampled range profile (left) and azimuth profile (right) of a CR (50cm-square). Pixel spacing is 0.25m x 0.25m.