

Development of X-band airborne polarimetric and interferometric SAR with sub-meter spatial resolution

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In these days, some new spaceborne synthetic aperture radar (SAR) systems were launched. There are two ways of developing; the ways to higher spatial resolution and polarimetric functions. In the L-band, the PALSAR on the ALOS has higher spatial resolution than the JERS-1 SAR. In the X-band, the TerraSAR-X and the COSMO-SkyMed system are achieved the spatial resolution of some meters. The National Institute of Informations and Communications Technology (NICT) has been operating the airborne dual-frequency polarimetric SAR system in the X-band; Pi-SAR, with the Japan Aerospace Exploration Agency (JAXA) since 1987. However, the spatial resolution of the Pi-SAR in the X-band (1.5m) is coarser than these newly launched X-band SARs. The airborne SAR system is useful to investigate the ability of remote sensors, because of the large freedom to select the observation conditions.

To investigate the worth of SAR with the higher spatial resolution, in 2006 the NICT started the development of the new airborne SAR in the X-band with sub-meter spatial resolution; Pi-SAR2. The maximum band width of 500MHz brings the spatial resolution of 0.3m in slant-range. The chirp pulse is generated by the 12bit D/A converter with system clock of 1.6GHz. The Pi-SAR2 has three receiving sub-systems connected to the three antennas in two antenna units. The main antenna unit includes the vertically and horizontally polarized antenna for the polarimetric function. In the sub antenna unit, the vertically polarized antenna is installed for the cross-track interferometry. The receiving signal is digitalized at the sampling rate of 1.6GHz and recorded by the digital recording system with recording rate of 200MB/sec/ch. The width of antenna beam is 3 and 35 degrees in azimuth and elevation, respectively. The Pi-SAR2 is able to add one more receiving-subsystem to achieve more functions like the along-track interferometry, the MTI and the Pol-In-SAR.

The platform of Pi-SAR2 is the gulfstream-II business jet. The two antenna units are installed under the inner-wing. The baseline length of the cross-track interferometry is about 2.5m. To archive the spatial resolution of 0.3m, the position of platform has to be measured accurately. The Pi-SAR2 uses the POS AV systems with the GPS receiver to correct the position and attitude data of the platform. The antenna beams are able to steer in yaw-axis between 9degrees to cancel the drift angle of the platform. By using the yaw-steering mechanism, the Pi-SAR2 is able to the observation with the sliding spotlight SAR. The antenna beams are able to steer in elevation to direct the boresight of antenna to the target exactly.

The operation of the Pi-SAR2 started in December 2008 and the calibration and validation of the system is in progress. The worth of SAR with the higher spatial resolution may be investigated by using the Pi-SAR2. Moreover, the problems linking to the higher spatial resolution may also appear. The Pi-SAR2 will be a useful tool to investigate the effect of SAR with higher spatial resolution.