System and applications of airborne SAR

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The Pi-SAR is a dual-frequency airborne polarimetric and interferometric synthetic aperture radar(SAR). The frequencies of the system are X-band (9.55GHz) and L-band. X-band SAR has been developed by NICT, and L-band SAR by JAXA. The two SAR systems are jointly equipped with the Gulfstream-II jet-aircraft and operated simultaneously or independently. The resolution for X-band radar has 1.5m and that for the L-band has 3m. The polarimetry function is possessed for both X-band and L-band system. In addition, the X-band has two antennas and has an interferometric function with 2.3 m baseline aiming at a three-dimensional observation. All of the data are sampled in 8-bit quantization or each I and Q signals. Three high-data-rate recorders achieve more than 10 km swath with full functions: dual frequency, polarimetry, interferometry, and full-resolution. Quick-look processor is also boarding.

Experiments and observation using this SAR system has been carried out in Japanese territory since 1995. Calibration experiments had been carried out with corner-reflectors and polarimetric active calibrators at the sand dune area. Also, in the spaceborne SAR calibration and validation experiments, such as SRTM/X-SAR(X-band) in 2000 and ALOS/PALSAR(L-band) in 2006, Pi-SAR had contributed toestimate topographic mesurements and polarimetric measurements of the test sites. In 2007, NICT is going to join the validation experiments of German newly launched TerraSAR satellite (X-band) by using the Pi-SAR.

Observations applied for various areas in Japan have been carried out two or three times in every year usually. NICT and JAXA are jointlyprovide the Pi-SAR observation oppotunities for the scientists of environments, forestry, agriculture, hydrology, geology, oceanography and so on. During 2003-2006, NICT and JAXA raise the application of research in aresearch announcement scheme. More than 30 scientsis gave applications and jointhe experiments and publish the research results. We had quasi-monthly observation applied to volcanic disasters in 2000. Volcano Usu has began to erupt on end of March 2000, and volcano of the Miyake-jima also activated on the end of June. Detail shapes and sizes of the craters were detected clearly for Usu volcano, and thick volcanic ashes covered over forests were discriminated from thin accumulation. The huge caldera appeared on the top of the Miyake-jima on July 8, 2000 was observed clearly by the Pi-SAR and sizes and depth are measured by its data. In 2004, widley disaster monitoring had been carried out by Pi-SAR after the earthquake in Niigata-Chuetsu.

In 2000, we had a chance to carry out the joint experiment of two airborne imaging radars: Pi-SAR and AIRSAR developed by Jet Propulsion Laboratory (JPL) during their PacRim2 campaign. We were aiming at the technical and application objectives for the experiment. Former objective includes cross comparison of the capabilities between two systems. As latter objective, various applications such as forestry, vegetation, urban environment, volcano, and oceanography using four bands full-polarimetry are possible to investigate using combination of Pi-SAR and AIRSAR data. Topographic mapping derived from interferometry of both systems are compared to investigate the errors by influence of penetration depth. Ground-based experiments for this purpose were carried out at the same time in many area of Japan by the cooperation of many Japanese scientists. All Pi-SAR(X-band) data unti now has been archived in NICT, and most of their prossesed data can be serve to the scientist on the requests.

From 2006, the new system succeeding the Pi-SAR has been developed. The design concept of the radar system is aiming at more practical for dissaster monitoring. The system will be completed in 2008.