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# Investigation of atmospheric effects in MIMO type 79 GHz GB-SAR interferometric monitoring

Yuta Izumi[(1)], Ryuma Saito [(2)], Jun Fujiwara [(3)], and Motoyuki Sato [(2)]
(1) Muroran Institute of Technology, Muroran, Japan; e-mail: yizumi@mmm.muroran-it.ac.jp
(2) Tohoku University, Sendai, Japan; e-mail: ryuma.saito.e7@tohoku.ac.jp, motoyuki.sato.b3@tohoku.ac.jp
(3) Antenna Giken Co., Ltd., Saitama, Japan; e-mail: fujiwara@antenna-giken.co.jp

Ground-based synthetic aperture radar (GB-SAR) is a powerful radar remote sensing tool for near-real-time environmental monitoring. Thanks to its near-real-time capability, it has been studied and applied to many applications such as minefield, volcano, glacier, and landslide monitoring. The possibly occurred phase errors should be compensated to obtain the displacement images with high precision. In particular, the temporal change of atmospheric refractivity causes phase disturbances in the GB-SAR interferometric observation, resulting in deteriorating deformation estimation accuracy. However, a comprehensive understanding of the received radar signal echo under various weather situations is still lacking, especially for W-band GB-SAR. Recently, the low-cost 79 GHz (W-band) multi-input multi-output (MIMO) type frequency-modulated continuous waver (FMCW) radar system has been commercialized for automotive sensing use. Although such a commercialized MIMO radar system was originally developed for short-range target detection, it may be applied to long-range target monitoring, especially for interferometric applications.

In this background, we address using low-cost MIMO type FMCW radar in 79 GHz as the environmental remote sensing application, especially for long-range target deformation monitoring and investigating the signal behavior under various weather conditions. For this purpose, we have employed a 79 GHz MIMO type GB-SAR system using a commercial tip (TI AWR2243) and performed a continuous field measurement with a maximum range of 140m in Sendai, as shown in Fig. 1. In addition to 79 GHz radar measurement, the 17 GHz GB-SAR measurement was simultaneously performed for comparison purpose. Experimental results revealed a significant APS effect for 79 GHz radar and suggested employing an appropriate compensation method to bring error close to GB-SAR operating lower frequency band.

**Figure 1.** Long-range MIMO type GB-SAR observation during snow in Sendai, Japan.