GB-SAR technology and its deployment

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GB-SAR (Ground Based Synthetic Aperture Radar) is one kind of Synthetic Aperture Radar (SAR), whose platform is fixed on the ground surface. GB-SAR is useful for monitoring slow varying phenomena such as ground deformation due to landslide and volcanic activities. One GB-SAR system can monitor wide area with high resolution, therefore we do not have to select discrete positions to be measured, which is common for conventional methods such as GPS and strain meter. GB-SAR technology has been developed since 1980s, where most pf the system employed a vector network analyzer (VNA) as a transmitter and a receiver. Then in 1990, commercial systems have been deployed, which can acquire much faster than VNAs. These GB-SAR systems used a liner rail to move a radar unit with a pair of transmitting and receiving antennas. Recently, multiple fixed antennas can also be used for realize GB-SAR systems.

Frequency allocation is an important problem in practical use of GB-SAR. In European Union, 17GHz has been used for GB-SAR, and the same frequency is widely used also in Japan. GB-SAR information changes dependent on the operation frequency. Different frequencies should be studied for useful use of GB-SAR.

Compared to space borne SAR systems, GB-SAR normally images near range targets. Therefore, SAR processing algorithm used in space borne SAR systems cannot be used, and generally the SR processing of GB-SAR data required relatively larger computation for the size of the data sets. In order process the data faster, we are proposing a method to use fractional Fourier transformation. Then in order to obtain higher resolution, we are using CS (Compressive Sensing) approaches.

Even though the targets are located relatively short range, for example, a few hundred meters to 1km, we found that the atmospheric effect is very strong in interferometric analysis. Atmospheric correction is quite important for accurate measurement in SAR interferometry.

Tohoku University is operating 3 sets of GB-SAR systems using 17GHz. One of the systems is fixed at Arato-zawa landslide site located in Miyagi prefecture since November 2011. Interferometric SAR images are obtained in real time and transferred to the university through internet. This is a social demonstration of real time warning system, which is a collaboration of Tohoku University and Kurihara city. This type of observation is strongly required in Japan. We are now planning to use it for observation of volcanic activities.

Then we are now testing GB-SAR for vibration observation of bridges and other social infrastructures and buildings.

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