ACCURATE MEASUREMENT OF THREE-DIMENSIONAL SURFACE DEFORMATIONS BY ADVANCED INTERFEROMETRIC SAR TECHNIQUE

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Abstract: The interferometric synthetic aperture radar (InSAR) technique has demonstrated success in measuring Earth surface deformations [1-2] but is limited to measurement of deformations along the radar line-of-sight (LOS) direction. It is difficult to precisely determine 3-D surface deformation from LOS InSAR data alone, because SAR satellites have near-polar orbits. The 3-D deformation field by InSAR technique can be reconstructed using two interferograms generated from ascending and descending pairs and one or two azimuth pixel-offset tracking fields created by cross correlation of SAR images [3]. This method has difficulty in determining the north component of surface deformation due to the low sensitivity of the SAR pixel-offset tracking method.

Bechor and Zebker [4] have developed a multiple aperture SAR interferometry (MAI) technique that made a remarkable improvement in measuring along-track deformation. This method measures the along-track deformation from a MAI interferogram, which is created by the forward- and backward-looking interferograms using sub-aperture InSAR processing. This method is superior to the amplitude pixel offset method, and has an advantage that its atmospheric phase contributions are not very sensitive. Jung et al. [5] has proposed a further improved method, which enhances the coherence of MAI interferogram and correcting the phase contributions from the flat Earth and topographic effects caused by the following: 1) azimuth common band filtering; 2) multi-looking and phase filtering and 3) efficient corrections of the flat-Earth and topographic phases.

In this study, the three-dimensional deformations associated with the Father's day intrusion [6] and eruption of the Kilauea volcano and the 2010 Haiti Earthquake are measured in this study by an advanced InSAR technique, which is to integrate the InSAR and MAI techniques. ALOS PALSAR interferometric pairs acquired in the ascending and descending orbit pairs are used for both of them. The comparison between GPS and the advanced InSAR measurements is carried out.

REFERENCES

[1] D. Massonnet and K. L. Feigl, Radar interferometry and its application to changes in the earth's surface, *Rev. Geophys.*, 36(4), pp. 441-500, 1998.

[2] Z. Lu, O. Kwoun, R. Rykhus, Interferometric synthetic aperture radar (InSAR): Its past, present and future, *Photogramm. Eng. Remote Sens.*, 73(3), pp. 217-221, 2007.

[3] Y. Fialko, M. Simons, and D. Agnew, The complete (3-D) surface displacement field in the epicentral area of the 1999 Mw 7.1 Hector Mine earthquake, California, from space geodetic observations, *Geophys. Res. Lett.*, 28(16), pp. 2063-3066, 2001.

[4] N. B. D. Bechor, and H. A. Zebker, Measuring two-dimensional movements using a single InSAR pair, *Geophys. Res. Lett.*, 33, L16311, doi:10.1029/2006GL026883. 2006.

[5] H.-S. Jung, J.-S. Won, and S.-W. Kim, An improvement of the performance of multiple aperture SAR interferometry (MAI), *IEEE Trans. Geosci. Remote Sens.*, 47(8), pp. 2859-2869, 2009.

[6] H.-S. Jung, Z. Lu, J.-S. Won, M. P. Poland and A Miklius, Mapping Three-Dimensional Surface Deformation by Combining Multiple-Aperture Interferometry and Conventional Interferometry: Application to the June 2007 Eruption of Kilauea Volcano, Hawaii, *IEEE Geosci. Remote Sens. Lett.*, 8(1), pp. 34-38, 2011.