Combined Use of L-band, C-band, and X-band SAR Images for Monitoring the Dynamic Process of an Artificial Island—the Hong Kong International Airport

Peifeng Ma, Hui Lin, Hengxing Lan, and Jie Chen
(The Chinese University of Hong Kong, China)

To overcome the shortage of space, the Hong Kong government has been reclaiming lands along the seafront, which will introduce continuous ground settlement since the beginning of reclamation. The Hong Kong International Airport, 75% of which was reclaimed from the sea, is one of the largest artificial islands in the world (Jiang & Lin, 2010). Figure 1 presents the fill allocation in the airport platform. Chek Lap Kok and Lam Chau (the white color regions in Figure 1) are two original islands located in the sea. The surrounding areas are reclaimed using different fill types.

Since the beginning of reclamation, the ground and facilities may be subject to various movements caused by unconsolidated subsurface soil layers, penetration of seawater, tidal load, the impacting force of the landing airplanes, and etc. The revelation of its dynamic process and driving forces requires multidisciplinary knowledge of geology, hydrology, meteorology, structural engineering, and etc. To this end, this paper jointly exploits L-band ALOS/PalSAR, C-band ENVISAT/ASAR, and X-band TerraSAR-X data to monitor the deformation of the airport from 2007 to 2011. The multidimensional SAR tomography technique (Fornaro, Reale, & Serafino, 2009; Lombardini, 2005; Xiao Xiang & Bamler, 2010) is employed to extract linear deformation velocity of single persistent scatterers (PSs). The results are shown in Figure 2. The deformation results are evaluated using leveling survey data of benchmarks obtained from the Hong Kong Airport Authority and height results are validated using LiDAR data obtained from the Civil Engineering and Development Department. We can observe that the number of detected PSs using high resolution TerraSAR-X data increases dramatically compared with that using medium resolution ALOS/PalSAR and ENVISAT/ASAR data. The derived linear deformation velocity maps using ALOS/PalSAR, ENVISAT/ASAR, and TerraSAR-X data show a good agreement in spatial dimension notwithstanding different looking angles. The result using TerraSAR-X data confirms that two original islands remain stable during this period, while other positions are experiencing different levels of settlement.
Figure 2. Linear deformation velocity maps using ALOS/PalSAR (a), ENVISAT/ASAR (b), and TerraSAR-X (c) data, blue points represent movements away from sensors. (d) is the digital elevation model map using TerraSAR-X data, red points represent higher positions.

Reference

