Airborne remote sensing in active fault research

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Aerial photograph interpretation at 1:40,000 to 1:20,000 scales has introduced to geomorphology since 1960s, which brought significant progress in active research in Japan. Tectonic Geomorphologists intensively observed aerial photographs and recognized active faults throughout Japan. As a result, "Active fault in Japan" was published by University of Tokyo Press in 1980, and revised in 1991. In 1980s, it was said that "the era of active fault discovery is over". However, several active faults have been newly discovered since the 1990s after the introduction of 1:10,000 aerial photographs, seismic reflection, and excavation studies to active fault research.

Since the onset of the 21st century, new active fault studies have started to combine aerial photography and LiDAR. Suzuki et al., 2003 conducted LiDAR measurements along the Itoigawa-Shizuoka Tectonic Line for the first time, and confirmed the technique’s efficiency in identifying small-scale tectonic landforms. They then produced detailed digital elevation models (DEMs) using old aerial photographs taken before artificial modification. Moreover, they took aerial photographs at 1:10,000 scale originally along the whole fault line with POS-IMU measurements. The purpose was to enable detection of co-seismic displacement with future earthquakes.

Recently, Suzuki et al., 2015 presented an innovative LiDAR study in which the uplift distribution caused by the 2013 Kamishiro fault earthquake was revealed. Moreover, they conducted to take aerial photographs again for the focal region, and crustal deformation was photogrammetrically measured by comparing aerial photos before and after the earthquake. The results indicated that the severely damaged Horinouchi area was remarkably uplifted and dislocated to the west due to low-angle reverse faulting.

For the 2017 Kumamoto Earthquake, satellite SAR is appreciated because it revealed co-seismic surface deformation in the wide area. However, airborne LiDAR data have significantly contributed to the detection of local surface deformation. Therefore, it is essential to upgrade crustal deformation analysis methods to combine airborne LiDAR, satellite SAR, and aerial photogrammetry.

Keywords: LiDAR, Aerial photograh, active fault