Visualization of three-dimensional SAR analysis data by stereo isogram map: Precise detection of surface ruptures of the 2016 Kumamoto earthquake sequence

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Advances in geodetic surveying technology make it possible to grasp the crustal deformation in a wide range from several cms to several meters. In particular, the observation by the spaceborne SAR enables high-resolution detection of crustal deformation using interferometric and three-dimensional analysis. These advances are bringing about a major change to the conventional field investigation method of surface ruptures associated with earthquakes. Here, I tried to visualize the 3D-SAR data of the 2016 Kumamoto earthquake sequence (Kobayashi, 2017) to detect the regional and local surficial deformations with high accuracy.

For visualization of 3D-SAR data to high-resolution and high-dynamic-range images, the stereo contour and relief mapping method is applied. The 3D data is divided into three components, the east-west, north-south, and vertical components, each consists of geographic coordinates and a single value. The isogram map having fine line interval up to the equivalent to the accuracy of data is generated from the data. For east-west and vertical components having the high accuracy, practically fine isogram at a line interval up to 1 cm are drown. Those isogram images are processed into anaglyph capable of stereoscopic viewing with a wide field of view.

In the visual interpretation using an anaglyph image at a line interval of 1 cm, both the main fault zones (Futagawa River, Idenokuchi and Takagi earthquake faults) accompanied by regional crustal deformation and numerous small ruptures scattered in a 50 km square area are observed in a single image. The interpretation results of small ruptures are generally consistent with that of Fijiwara et al. (2016) based on conventional InSAR images that spatial resolution is assumed to be one digit higher. It is easy to detect the ruptures with a displacement of east-west and north-south components of about 5 cm using the image. Furthermore, ruptures up to 2 cm in displacement are recognizable in the Kumamoto urban area where the gradient of regional deformation is small. In the field survey based on the 3D-image interpretation, I found those small ruptures and measured the displacements of guardrails, road curbs, and concrete structures.

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