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Genetic algorithm-based displacement extraction technique for LiDAR dataset

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Owing to recent progress of aerial survey with laser transmitting device, we can easily obtain detailed digital elevation model represented by point cloud data. This model is applicable to many purposes such as active fault detection, quantification of bluff lines, and extraction of ground displacement caused by an earthquake.

Although some methods for seismic displacement extraction from point cloud data have been proposed, we need more robust and powerful method in terms of noise immunity. In this study, we propose a new method based on the RBF (Radial Basis Function) interpolation and the GA (Genetic Algorithm) for the seismic dis-placement detection and then conduct a series of inquests including the parameter setting, the evaluation of noise resistance, and the comparison among four optimization techniques: GA, L-BFGS-B, Nelder-Mead, and COBYLA.

The results of considerations revealed that: (1) the size of unit for pattern matching should be set to 24 m square for the point cloud divided into 1 m grid; (2) the proposed method stably detect the correct dis-placement even under ill-posed condition; (3) the combination of the RBF and the GA is well suited for this problem because the objective function appearing in this study possesses extreme multimodality, suggesting that we should not use the optimization method based on gradient information.

Keywords: genetic algorithm, interpolation, LiDAR, displacement, optimization