

## Survey for tree root system GPR by synchronized with self-tracking total station

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A non-destructive inspection for imaging the exact root system of trees under the ground surface is important to assess the healthiness of trees or to evaluate the risk of collapse. The authors applied a GPR (Ground Penetrating Radar) survey to image the distribution of lateral root system in detail. The system used in the surveys was a cart type GPR that is able to synchronize GPR traces with accurate antenna positions obtained by a self-tracking total station using an active target mounted on the GPR antenna. Since the tracking rate of our total station is 2.5 times per a second, it has a nonnegligible delay to determine the position relative to the rate of GPR scanning. The delay causes positioning error that depends on the operation speed. We conducted an experiment to determine the relation between the operation speed and the error and the accuracy was improved by correcting the error using the relation. We applied the system to trees in three different surface conditions: The first case is a Quercus planted in a loam layer. The second case is a Platanus. The ground surface around the tree is paved and layer under pavement is a natural gravel layer. The last case is a Japanese black pine planted in sand near seashore. In all the cases, we could successfully image the detailed root distribution in the near-surface layer, and in the case of the Japanese black pine the horizontal root distribution was identified up to the depth of 1m.

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