Ground penetrating radar (GPR)

- Information extraction from ground penetrating radar systems -

The deployment of ground-penetrating radar systems has been growing over the last years. Using this technique, the shallow underground can be investigated without any mechanical excavation to detect any anomaly or to investigate the condition of subsurface elements. With the proviso not to disturb existing infrastructure, efficiently looking into its nearby underground is of special importance.

In order to process the GPR data the Tama Group provides an application that enables a fast and efficient information extraction for the user. The images are analyzed according to certain user-driven criteria and with the objective to extract distinct objects. These objects can be distinguished into objects lateral or parallel to the road itself, both being horizontal pipes. Roundish objects are most likely vertical pipes.

During the first step, the imagery is acquired by a radar system mounted onto a vehicle (cf. (Fig. 1, Step 1;Fig.**2**: schematic view of GPR data acquisition. The radar system is mounted onto a vehicle and the radar beams vertically into the underground. The acquisition generates progressive stripes of depth-layers [Tama Group].). Subsequently, the second and the third step represent a two-stage analysis. Each layer of depth is analyzed separately above-mentioned criteria (Fig. 1, Step 2). Then, a multi-layer analysis is performed in order to detect objects that are found on several spatially adjacent layers (Fig. 1, Step 3). The result is a classification of each layer of depth.

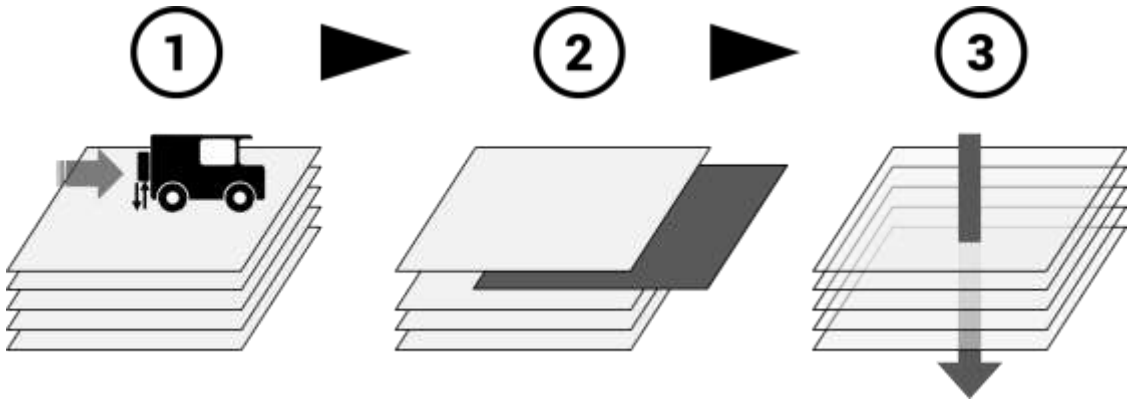

Fig. 1: Workflow of the automated analysis. After the acquisition (Step1), each layer of depths is analyzed separately (Step2). Subsequently, the layers of depths investigated for similar objects that appear on spatially adjacent layers (Step3).

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APPLICATION GROUNDPENETRATING RADAR

INFORMATION EXTRACTION FROM GPR-SYSTEMS

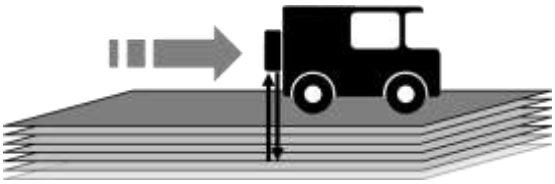

Fig.2: schematic view of GPR data acquisition. The radar system is mounted onto a vehicle and the radar beams vertically into the underground. The acquisition generates progressive stripes of depth-layers [Tama Group].

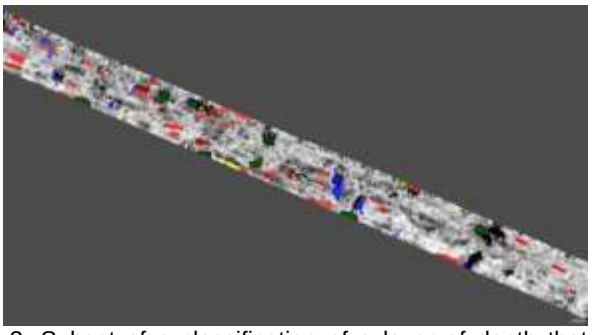

Fig.3: Subset of a classification of a layer of depth that has gone through the automated analysis. There are objects parallel to the road (red), lateral to the road (blue) and roundish objects (green). Yellow objects were detected on spatially adjacent layers of depth [Geoprospectors AT, Tama Group Ruleware].

Within the second part of the analysis, the user is asked to use an interactive interface with only few tools to validate the detected objects (Fig.4). This validation ensures that the result contains only those objects that most likely represent the target object.

The validated classification can be exported to an image-format or a vector-format with exact 3D-coordinates, as needed.

With the result at hand, the excavation is insured to only take place where necessary.

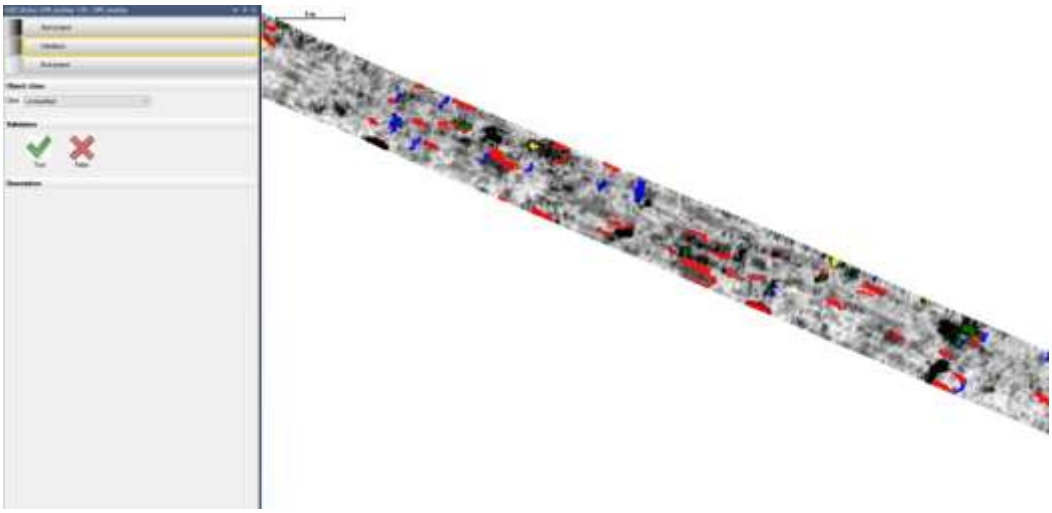

Fig.4: Interactive user interface in the software eCognition Architect. Only few tools enable the user to perform a fast and efficient validation of the automatically detected objects [Tama Group].

Based on the GPR application provided by the Tama Group and an experienced user, there is a considerable amount of time saving taking place in the workflow of preprocessing, analysis, validation and highly dedicated excavation.

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Workflow overview for GPR-data

Original data	Layered images from the radar system mounted onto a vehicle
Preprocessing	Georeferencing / calibration (if necessary)
Software	eCognition Developer eCognition Architect eCognition Server (for large datasets)
Ruleware	3-staged approach: • Analysis of each single layer of depth (autom.) • Analysis through the “image cube” (autom.) • Validation of objects by user (interactive)
Result	Formats: • Images (JPEG/TIF/PNG) • Coordinates (XY-position and exact depth) • Tabular information

We look forward to present our application for information extraction from GPR imagery to you as well as to apply it with you in order to maximize your efficiency in data evaluation.

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Tama Group specializes in automated information extraction, especially in object-based image analysis with eCognition.

We analyze images from various sensors and continue to refine our methods of automating information extraction. In doing so we combine machine learning, deep learning and expert knowledge.

With our **forest portal**, we are able to offer an image-based digital twin of his forest to practically every forestry company. This allows us to provide important information about the managed forest area in a clear manner.

Our **information factories** offer solutions for specific questions in various industrial areas such as agriculture, construction, energy, transport, environmental protection and materials science.

Distribution of Trimble eCognition: We offer an extensive sales, support and training portfolio, including our 4D maintenance package.

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