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### Signature Enhancement

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## EVALUATION OF COMBINED GROUND PENETRATING AND THROUGH-THE-WALL SURVEILLANCE UWB TECHNOLOGY

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**Abstract**  
 This work investigates the possible identification of underground targets using UWB pulsed GPR operating in the frequency range of about 300 MHz. For this test, the soil was chosen where buried pre-known objects were buried previously. Depth, location, shape, and material of testing targets were known before the experiment. In addition, the same device with different software for signal processing has been tested as a TWS for detecting human movement behind a thick wall [1].

**Principles and Performance Characteristics of the Device**

**Technical brief**

- Antenna frequency: 300 MHz
- Analogue-to-Digital Converter range: 16 bit
- Dynamic range: at least 135 dB
- Measuring rate: up to 20 frames per second
- Survey width: 66, 100, 133, 166 m
- Maximum number of targets per frame: 1000
- Track stacking number: up to 128
- Depth of measuring: up to 8 m (determined by soil properties)
- Central resolution: better than 0.3 m
- Operating modes: point collection, continuous, measurement of wall
- File size of a range profile: up to 2 GB
- Interface: USB2
- Dimensions (L x W x H): 410 x 312 x 170 mm
- Weight: 0.4 kg

**Some Features of this device are:**

- Modular design - all GPR modules are arranged all together into a single case, which is connected to computer via USB2 communication cable.
- Spectrum randomizing (fast-random sampling recovery) - interference immunity improvement especially to coherent influences
- Increased dynamic range owing to digitally stacking of received signals
- Real time signal pre-processing

**Description of the Proving Ground**

As an experimental test site to investigate the possibilities of modern GPR, the area reserved for the construction of private houses was chosen. There were various underground objects and communications at this site, such as a cellar, an underground concrete pit for waste water, sewage gas pipes, electric cables, and various objects.

**Results of GPR Function Implementation**

**Conclusions**

Modern methods of signal processing in conjunction with the development of UWB technology can detect the presence of underground objects and abnormalities, but there is ambiguity in their identification, which should be supported by detection methods and algorithms of object identification that is a very difficult task. Sometimes a two-dimensional view of data in the diagram is not enough for accurate viewing. One method of increasing the quality of image representation is transition from 2D to 3D view of information in the graphs on the screen in the paper.

Signal UWB technology can be applied for both TWS and GPR applications.

**References**

1. V. E. Ivashchuk, V. P. Frohoshko and F. J. Kowalsky, "Identification of Buried Targets Through the Wall Using UWB Technology," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 50, no. 12, pp. 7400-7408, Dec. 2012.
2. V. E. Ivashchuk, V. P. Frohoshko, A. A. Pilyarsky and F. J. Kowalsky, "Through-the-Wall Penetration Using UWB Technology," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 50, no. 12, pp. 7409-7417, Dec. 2012.