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Procedure for detecting underground utilities with specific shape

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Nowadays GPR technology is acknowledged as a reliable, fast, non-destructive remote sensing technology whose area of applications is wider every day. One of its most common applications is underground utility detection. Not only it is possible to detect the utility in the field, but using certain algorithms utilities which haven't been detected in the field can be detected in radargrams. There is a number of procedures for automated detection of utility in the radargrams. Further, there are procedures that can estimate certain parameters such as propagation velocity, diameter or even characteristics of the material.

However, the majority of these procedures is designed to detect cylindrical shape utilities, which, in a radargram, are represented with hyperbolic reflection. According to geometry of hyperbola, utility parameters can be estimated.

In this paper we present a procedure that is designed to estimate characteristics of non-cylindrical utilities. It is worth mentioning that these utilities are not so rare. Some underground tanks and sewage collectors are among them.

Heat line is consisted of two insulated pipes of the same diameter, often placed in a concrete channel and covered with plates made from reinforced concrete. Therefore, it can be considered as non-cylindrical utility and such structure has characteristic signature in a radargram. The main idea of the proposed procedure is to detect this signature, and then, based on standardized parameters for the heat lines, to estimate the diameter of the pipes.

The proposed procedure is based on artificial neural network. As a training set we made a number of radargrams collected on different locations which contain heat lines of various dimensions. Pipe diameters were in a range from 65 to 250 mm. 400MHz antenna was used since the depth hasn't exceeded 2m. After the network is trained it is validated using radargrams that haven't been used in the training set. Further tests were done with radargrams that contained none, one or several heat lines.

Experiments showed that it is possible to automatically detect heating lines in a radargram and later, based on detection results, to estimate the diameter of the pipes using standard heat line dimensions.

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