Established in GPR software market since 2009

GEORADAR-EXPERT

SOFTWARE SYSTEM FOR AUTOMATED
GPR DATA PROCESSING

OVERVIEW

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Introduction

GEORADAR-EXPERT software is designed for automated processing of GPR profiling results. Automation in GEORADAR-EXPERT is used to perform time-consuming tasks that convert raw field measurements into an interpretable form with minimal operator involvement.

The software combines standard GPR data processing methods with specialized algorithms developed for GEORADAR-EXPERT to increase the informational value of a GPR survey.

A key element of the software is the automated analysis method for the BSEF (Back-Scattering Electromagnetic Field). It provides the transition from an amplitude-based data representation in the form of a radargram to a subsurface model in the form of an attribute section. Attributes are characteristics of the investigated medium and the wave field reflected from its heterogeneities, as well as values calculated from them.

BSEF analysis is implemented using neural network algorithms. These algorithms allow useful signals to be detected in cases where traditional processing methods are ineffective. Such cases include surveys in low-contrast or heavily noisy media, as well as media with a smooth change in electrophysical characteristics with depth. In such conditions, coherent reflection events do not form on the GPR profile. These events are interpreted as boundaries between layers.

A set of attribute sections obtained as a result of processing data from an area GPR survey can be converted into a three-dimensional array. This conversion provides additional capabilities for analyzing the spatial distribution of the characteristics of the investigated medium. It also supports determining the shape and volume of its structural elements.

A statistical analysis module is implemented to identify relationships between the physical-mechanical and electrophysical properties of the medium. These properties are expressed through the attributes of the sections and their statistical indicators. The identified patterns can be used to study similar objects.

To work with the amplitude representation of the survey result, the GPR profile, the software includes a required set of signal processing functions. These functions suppress noise and highlight useful reflections. The software also includes GEORADAR-EXPERT algorithms for software-based improvement of the resolution of GPR data.

The use of resolution enhancement algorithms makes it possible to reduce the inverse relationship between resolution and depth of the GPR survey. This relationship is determined by the frequency characteristics of the probing pulse. Low-frequency signals with high penetration capability are transformed into shorter-duration waveforms. As a result, reflections from closely spaced layer boundaries are localized more accurately.

The software supports GPR data file formats from most well-known geophysical equipment manufacturers. The processing results can be exported to graphic, text, and tabular files, as well as to gridded formats for further use in GIS or CAD systems.

GEORADAR-EXPERT contains all necessary processing options for solving GPR tasks, including cases with low informational value of field measurements. A more detailed overview of the key capabilities of the software is provided below.

Automated BSEF Analysis

Method Description

The automated analysis method for the BSEF back-scattering electromagnetic field is based on extracting and studying the diffracted component of the GPR profile in order to build a subsurface model.

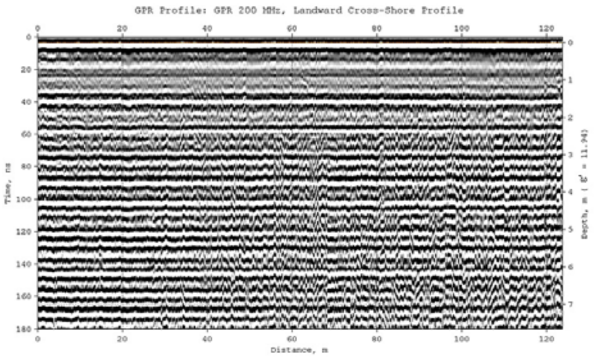
As a result of the analysis, a set of wave field analysis points is formed on the GPR profile. Each point is characterized by a set of attributes. This set includes both directly measured kinematic and dynamic parameters of reflected waves in the vicinity of the point, and values calculated from these parameters. Each attribute reflects a certain electrical or physical-mechanical property of the subsurface medium.

A neural network algorithm transforms the array of field analysis points into a subsurface model (neuromodel) presented as a set of clusters. Clusters are formed based on the spatial proximity of the analysis points and the similarity of their attribute sets. The properties of the medium within each cluster are characterized by statistical homogeneity.

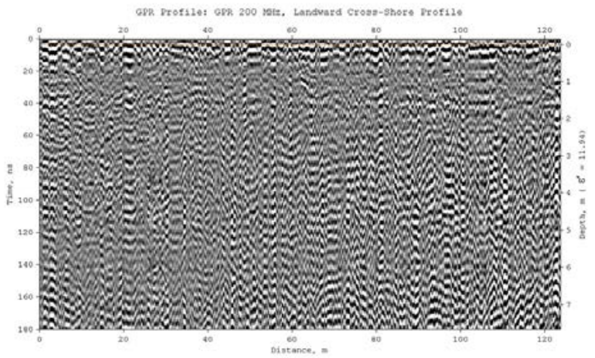
Based on the neuromodel, an attribute section is created. It shows the spatial distribution of its values along the GPR profile. The parameters for creating the section are adjusted by the user depending on the GPR survey task.

Application Example

The figure below shows an example of a GPR profile acquired with a GPR with a center frequency of 200 МГц on a sea beach. Profiling was performed in a direction perpendicular to the shoreline, at some distance from the waterline.

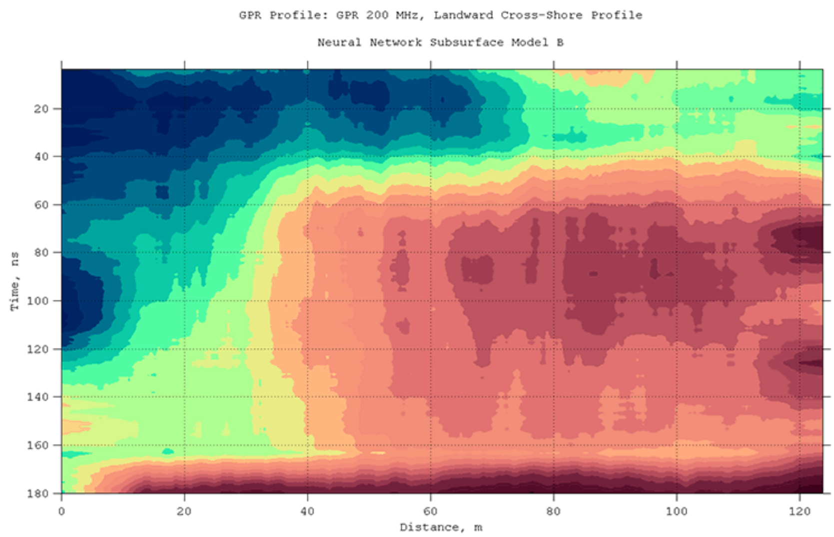


The investigated soil is characterized by high attenuation of EM waves caused by the salinity of coastal deposits. The profile shows intense horizontal noise that masks useful reflections. The next figure shows the result of applying the noise suppression algorithm.

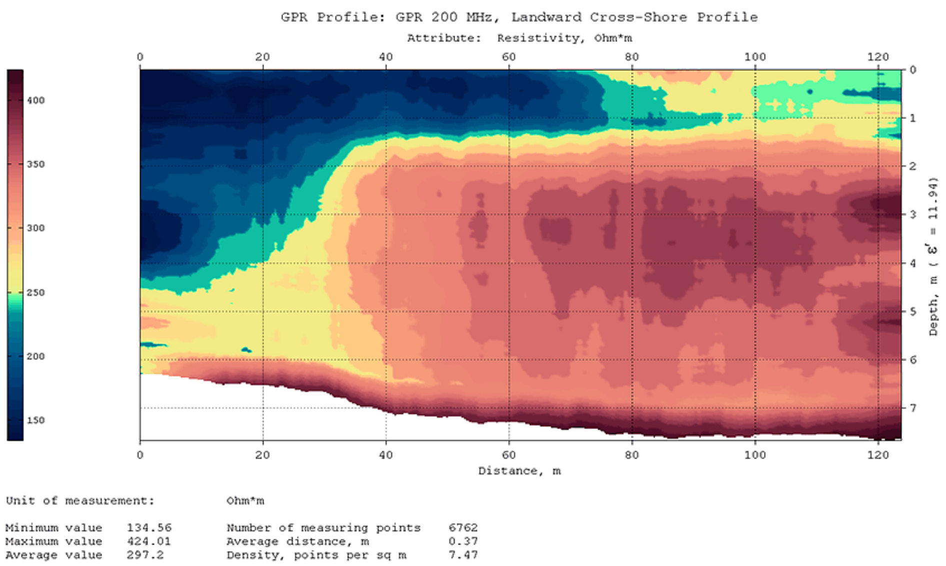


Visual analysis of the processed profile does not reveal coherent reflection events that could be interpreted as reflections from layer boundaries. This fact indicates a smooth change in the electrophysical characteristics of the soil with depth. This change does not create conditions for forming reflecting boundaries.

In such cases, it is only possible to obtain information about the subsurface structure by using the automated BSEF back-scattering electromagnetic field analysis method. The figure below shows a neuromodel of the medium as a system of clusters built from the results of BSEF analysis.



The neuromodel clusters are visualized with unique colors. The degree of similarity of the color shades of clusters corresponds to the degree of similarity of the medium properties within these clusters. The final processing step for the considered GPR profile is to create an attribute section Resistivity based on the neuromodel.



The attribute section provides a clear representation of the structure of the investigated soil. It shows the change in thickness of coastal deposits and the distribution of specific electrical resistivity in the direction from the shoreline. When the section is created, corrections based on the velocity model of the medium are automatically taken into account. This model is created during the section calculation process.

Method Advantages

Using the automated analysis method for the back-scattering electromagnetic field provides the following advantages compared to traditional GPR data processing methods:

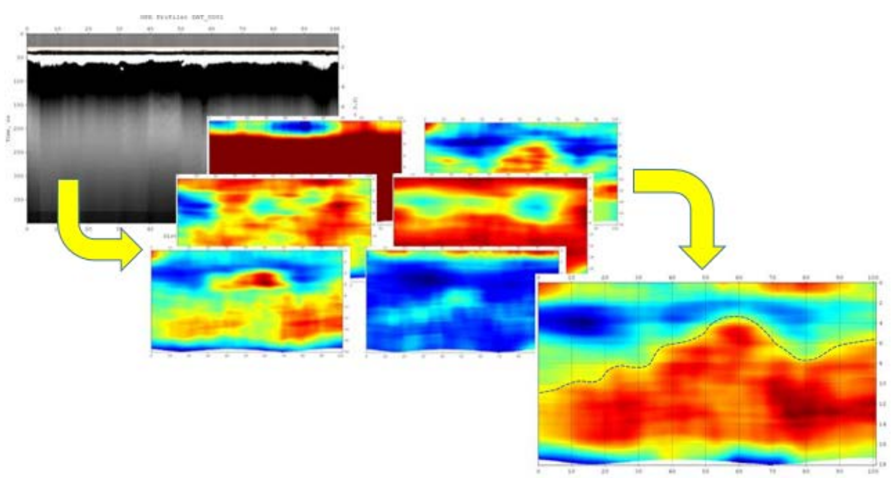
- Increasing the informational value of surveys, because the attribute section makes it possible to obtain data on the subsurface structure even with a smooth change in its electrophysical characteristics, when traditional radargram interpretation methods are not applicable;
- Providing integrated analysis of the medium due to the diversity of attributes, where each parameter quantitatively characterizes a certain electrophysical or physical-mechanical property of the subsurface thickness, which forms a more complete view of its structure and properties;
- Increasing the depth of the GPR survey due to high selectivity of the algorithm and effective detection of useful reflections under strong noise at large depths;
- Expanding capabilities for studying complex media that are not accessible when using other processing methods;
- Significant reduction of field data processing time, which is especially important for large volumes of work;
- No preliminary profile signal processing stage is required before performing BSEF analysis, which requires additional time and qualification;
- Expanding GPR application areas and the list of tasks to be solved;
- Minimizing the influence of the subjective human factor on data processing and interpretation processes.

Summation of Sections

GEORADAR-EXPERT software provides a wide set of attributes for solving various GPR tasks. In cases where an attribute section does not provide a sufficient representation of the investigated object, the summation of sections is used. This operation sums sections of different attributes created for the same GPR profile.

This procedure makes it possible to combine scattered data distributed across several attributes into a single summed section. An additional effect of summation is the removal of artifacts caused by the accumulation of errors during the stages of acquisition and processing of GPR information.

The figure below shows the results of a buried valley survey using a 100 MHz GPR. On the left, the original GPR profile is shown. In the center, a set of attribute sections prepared for summation based on Automated BSEF Analysis is shown. On the right, the result of the summation operation is shown.



Visual analysis of the GPR profile indicates low informational value of the wave pattern at depths greater than 2 meters. According to a priori data, the valley bottom lies below this level. The attribute sections show individual elements of the buried relief. However, none of the sections alone characterizes the structure of the investigated subsurface thickness sufficiently.

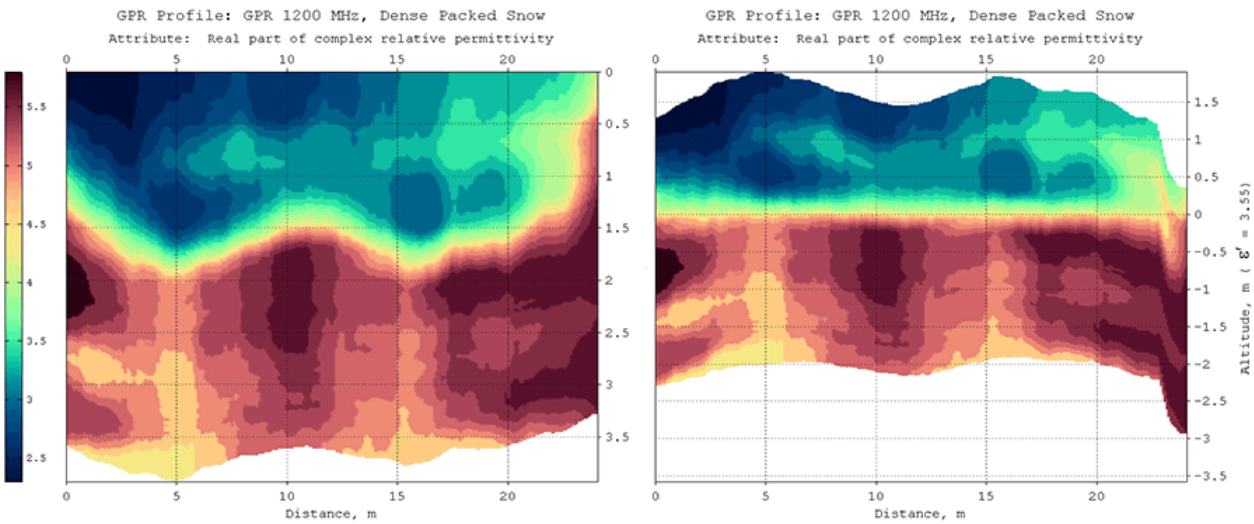
The summation operation integrated the scattered data into a coherent model. On the resulting section, the relief of the buried valley bottom is clearly traced along the entire length of the profile. It is marked with a dashed line. This example demonstrates the effectiveness of the summation module for overcoming the limited informational value of the GPR profile and individual attribute sections.

Terrain Correction

When an attribute section is created in GEORADAR-EXPERT software, it is possible to account for topographic features of the terrain. Terrain correction is applied when elevation data are available along the profiling line. The input data can be provided as manually prepared tables, or as files from GPS and GLONASS global positioning systems.

Accounting for terrain eliminates distortions caused by the curvature of the sounding surface. It also makes it possible to correctly determine the depth and spatial position of subsurface objects. The correction is especially important when working in complex terrain, such as slopes, embankments, and artificial fills.

In the figure below, on the left, a relative permittivity section along a snow berm in the longitudinal direction without terrain correction is shown, and on the right, a section with applied corrections is shown.



3D Assembly of Sections

To study the structure of the subsurface medium in detail and detect objects within it, an area GPR survey method is used. Within this method, the investigated object is covered by a grid of GPR profiles with accurate coordinate referencing. The profiles can have arbitrary length, orientation, and a curvilinear shape.

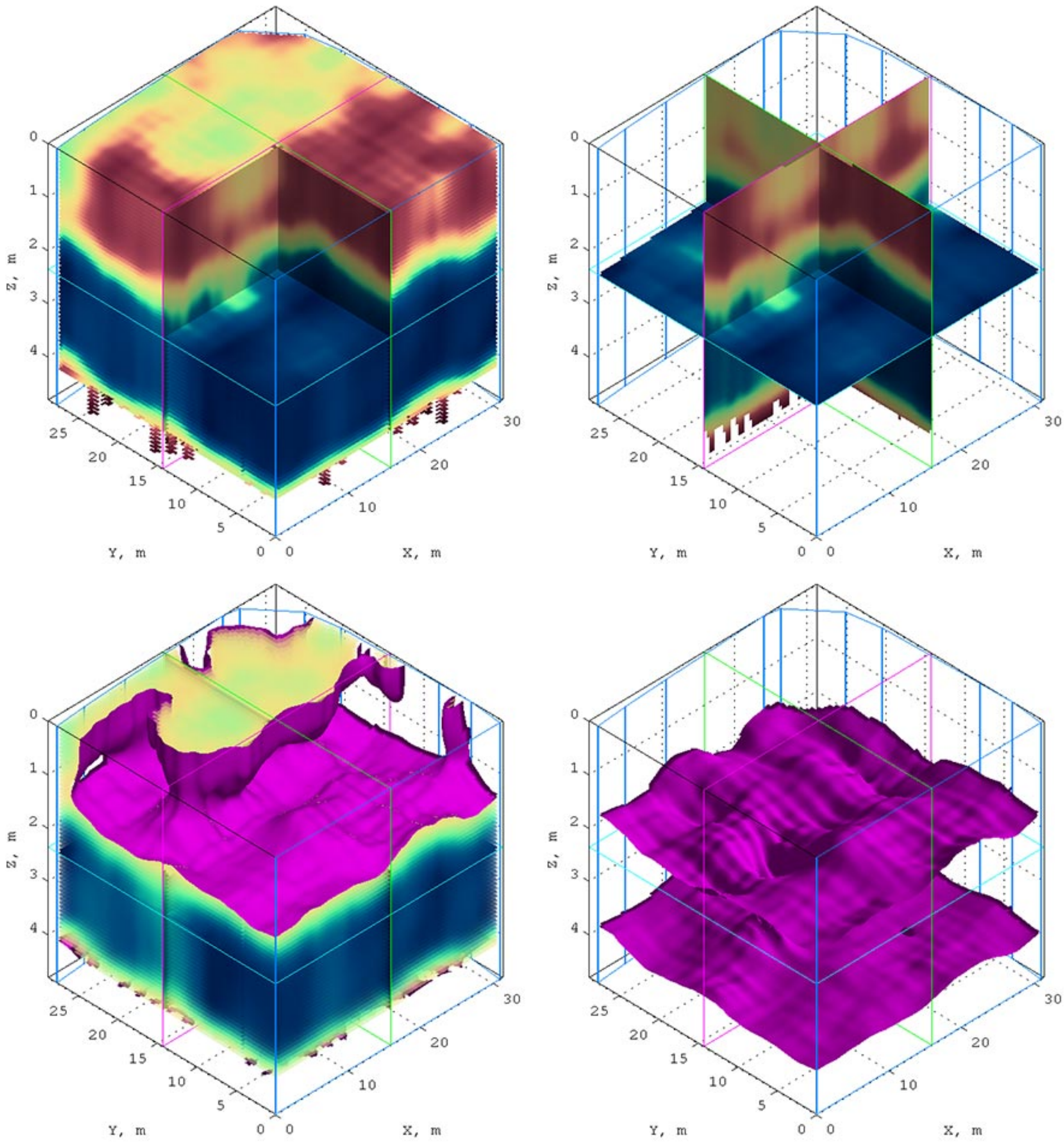
Based on Automated BSEF Analysis, an attribute section is created for each profile of the area survey. The obtained sections are combined into a three-dimensional data array. The attribute values between the sections are determined by interpolation.

The spatial position of the sections during assembly formation is set using coordinates from files of GPS or GLONASS global positioning systems. Manual coordinate tables can also be used.

The software provides a wide set of tools for working with the 3D assembly. Volume visualization of the assembly and its individual slices is implemented. Both orthogonal slices and slices of arbitrary configuration are supported. Isosurfaces passing through specified attribute values and dividing the volume into regions can be created, followed by calculation of their volumes.

It is possible to remove fragments of the volume, control the transparency of assembly elements, and set transparency by the range of attribute values. For slices of the 3D assembly, manual operations for picking layer boundaries, statistical analysis, and exporting data to various formats are provided.

The figure below shows some visualization options for the volume of the 3D assembly of sections. In the top row, on the left, an array with the upper quarter of the volume cut out is shown. On the right, orthogonal slices are shown. On the bottom left, an array with a cut-out volume of a specified attribute range is shown. On the bottom right, isosurfaces as layer boundaries are shown.



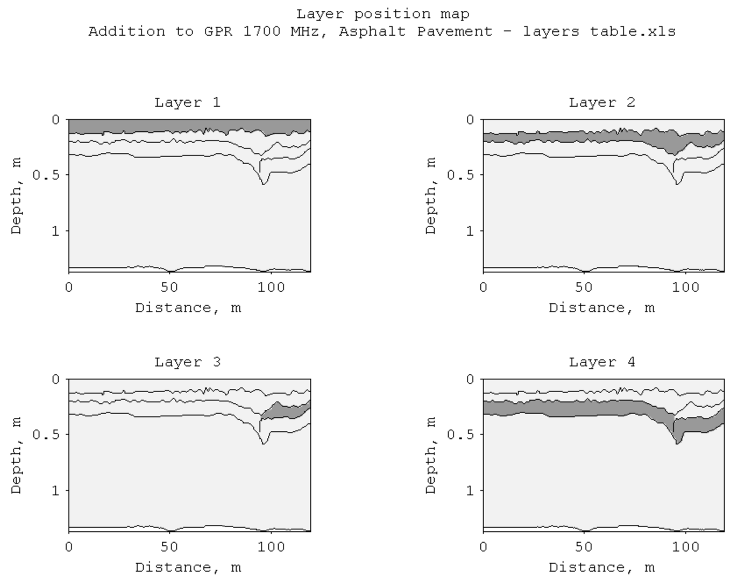
Boundary Picking

Boundary picking is an alternative method for clustering the subsurface model. It complements the automatic clustering performed by the neural network algorithm. The picking process supports fully manual and semi-automatic modes. In semi-automatic mode, the user sets the upper and lower boundaries of an area. Within this area, a boundary is automatically created based on signal extrema.

When boundaries are created on the GPR profile, the layers formed by these boundaries can be taken into account when a section is created. If boundaries are defined on an attribute section, individual visualization settings become available within each layer. During statistical analysis, the presence of boundaries is also taken into account. Statistical indicators are calculated for each layer defined by boundaries, and also along the boundaries themselves.

Boundaries can be edited. They can be split into parts, merged, and renamed. Boundary data are saved to a file and can be loaded for later use. Based on the created boundaries, a layer table is generated with a specified step. This table contains the top position, bottom position, thickness values, statistical characteristics, and the area of each layer. In addition, a summary table is created with the characteristics of all layers and a diagram of their layout.

On the left, an example of a layer layout diagram is shown. For each layer, a section thumbnail is created, and the target layer is highlighted with a dark fill. On the right, the upper and lower fragments of the data table for the Layer 1 layer are shown. They are exported with a step of 1 meter. Below, an example of a summary table of characteristics of all layers is shown.



GPR profile name: GPR 1700 MHz, Asphalt Pavement Layer name: Layer 1			
Distance, m	Top, m	Bottom, m	Thickness, m
0	0	0.127	0.127
1	0	0.127	0.127
2	0	0.127	0.127
3	0	0.132	0.132
4	0	0.121	0.121
5	0	0.127	0.127
115	0	0.132	0.132
116	0	0.127	0.127
117	0	0.111	0.111
118	0	0.106	0.106

Min	0	0.084	0.084
Max	0	0.153	0.153
Mean	0	0.119	0.119
Std	0	0.014	0.014
Sectional area of layer: 14.24 sq. m.			

Automated processing of GPR data
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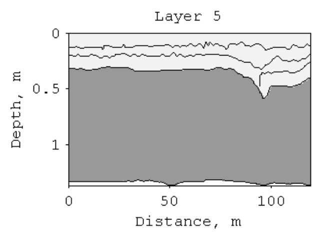

Summary Layers Table GPR profile name: GPR 1700 MHz, Asphalt Pavement							
				Average values			
Layer Name	Start, m	End, m	Length , m	Top, m	Bottom, m	Thickness, m	Area, sq.m
Layer 1	0	119	119	0	0.119	0.119	14.24
Layer 2	0	119	119	0.119	0.218	0.099	11.87
Layer 3	94	119	25	0.247	0.343	0.096	2.45
Layer 4	0	119	119	0.238	0.366	0.127	15.28
Layer 5	0	119	119	0.366	1.332	0.966	115.89

GPR profile start position: 0 m
GPR profile end position: 119 m
GPR profile length: 119 m

Automated processing of GPR data
GEORADAR-EXPERT 2.2

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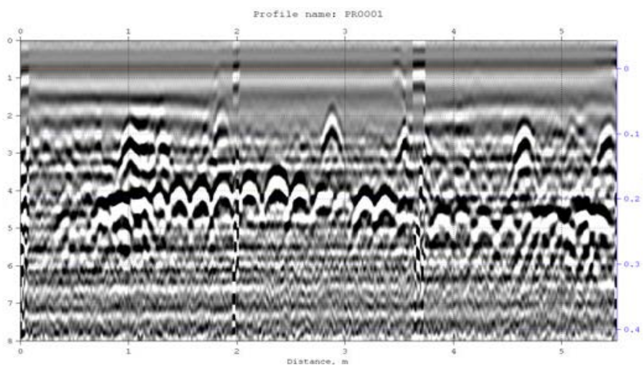
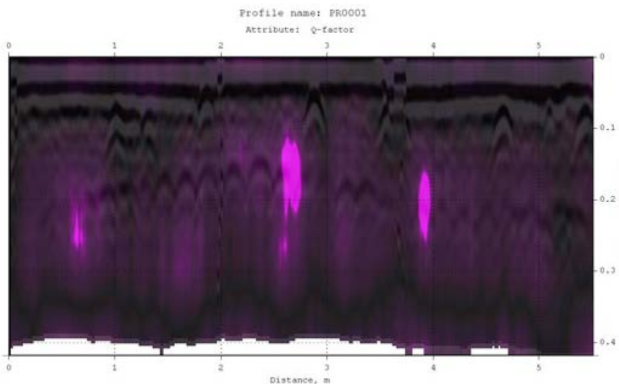
Flaw Detection of Civil Structures

Flaw detection is based on identification of areas of the section with Q-factor attribute values exceeding a specified threshold value. Objects of flaw detection include concrete structures, pavement layers, and soil strata.

An example of GPR profiling of a reinforced concrete floor beam is shown below. On the left, the radargram obtained during the survey is shown. On the right, the processing result in the flaw detection module is shown. Zones of weakened concrete are visualized as clearly expressed anomalous areas.





For a set of sections, a defect report in MS Excel format is generated automatically. For each profile, the report presents flaw detection results with indication of the proportion of defective areas as a percentage of the section area and other required information. For visual representation of the structure condition, color indication is used in the table. Red corresponds to an unsatisfactory condition. Yellow indicates a satisfactory condition. Green indicates a good condition of the investigated object.

	A	B	C	D
1	Flaw detection			
2	Profile	Length,m	Percentage of defect	Average value of Q-factor
3	PR0001	5.504	3.4 (bad condition)	4.010154563
4	PR0005	5.712	5.1 (bad condition)	4.116571617
5	PR0006	5.52	3.5 (bad condition)	3.96010161
6	PR0013	4.768	0 (good condition)	3.882983155
7	PR0014	4.984	0.2 (good condition)	3.988803473
8	PR0015	5.064	0 (good condition)	3.421331768
9	PR0017	2.848	0.1 (good condition)	3.967186861
10	PR0018	2.912	1.6 (satisfactory condition)	3.973430245
11	PR0019	2.928	0.8 (good condition)	3.796458625
12	PR0020	5.304	4.5 (bad condition)	4.082640406
13	PR0021	5.752	0.3 (good condition)	3.574097381
14	PR0023	4.512	1.6 (satisfactory condition)	3.85229483
15	PR0024	4.704	2.4 (satisfactory condition)	3.919674657
16	PR0025	4.888	1.5 (satisfactory condition)	3.907902669
17	PR0026	4.8	3.1 (bad condition)	4.092442579
18	PR0027	1.312	2.1 (satisfactory condition)	3.997140071
19	PR0028	1.304	0 (good condition)	3.820281343
20	PR0029	1.16	1 (good condition)	3.855245325
21	PR0030	1.136	0.2 (good condition)	3.64604494
22	PR0031	1.104	0 (good condition)	3.68049131
23	PR0032	1.568	1.4 (good condition)	3.874556741
24	PR0033	1.552	0 (good condition)	3.858071825
25	PR0034	1.4	0 (good condition)	3.683725269
26	PR0035	5.224	0.5 (good condition)	3.807352914
27	PR0036	5.608	1 (good condition)	3.738205661
28	PR0037	5.384	3.1 (bad condition)	3.790646495
29	Total length:	96.952		
30	Number of profiles	26		
31	Of them in bad condition:	6 (23.1%)		
32	Of them in satisfactory condition:	5 (19.2%)		
33	Of them in good condition:	15 (57.7%)		
34	Global average value of Q-factor:	3.85760909		
35	Color cells where values > global average value:			
36	Color cells where values < global average value:			

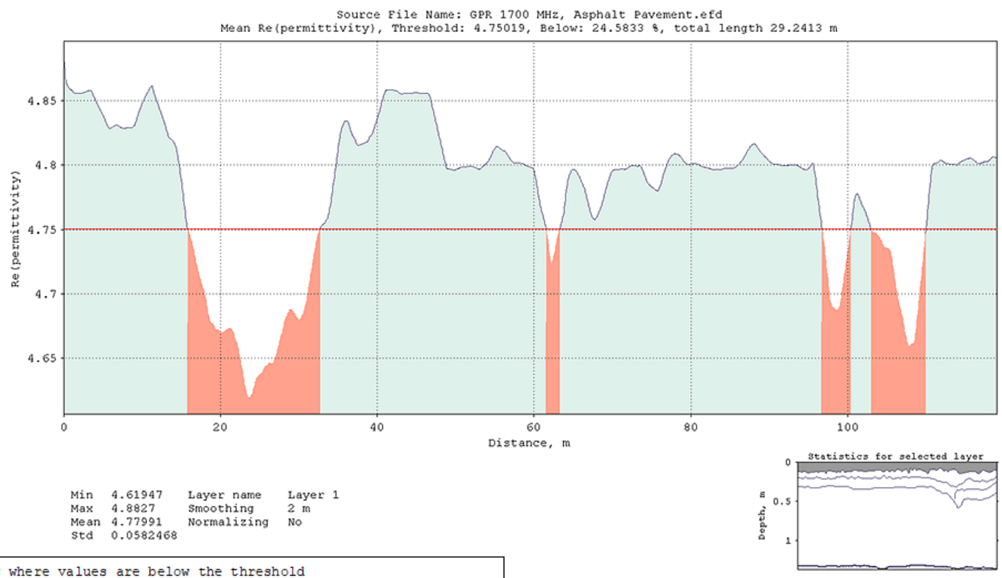
Statistical Analysis

Statistical analysis of GPR profiling results provides information about attribute variability for the investigated section as a whole and for its individual structural elements. The analysis results can be used to identify relationships between the physical-mechanical and electrophysical properties of the medium, which are expressed through statistical indicators of attributes.

The analysis is performed using 12 statistical indicators for the GPR profile, the attribute section, and the 3D assembly slice. The results are presented in tabular and graphical form. Threshold processing of data is implemented. In this mode, the areas of the graph that exceed or do not reach the specified level are highlighted visually, and their characteristics are summarized in a table. This approach is effectively used for detecting and documenting anomalies, for example, in diagnostics of pavement defects.

An example of a graph of changes in the mean values of relative permittivity in the upper layer of the pavement is shown below. At the time of the survey, it was in a dry condition. On the right, below the graph, a section thumbnail with layer boundaries is shown. The layer whose data are displayed on the graph is highlighted with a fill.

A threshold level is set on the graph. Values below this level are interpreted as indicators of pavement defects. The corresponding graph areas are highlighted in red. Below the graph, a table of the identified defect areas is shown. It contains the characteristics of each area. The table is saved automatically when the image of the statistical graph is exported.



Areas where values are below the threshold						
Source file name: GPR 1700 MHz, Asphalt Pavement.efd						
Statistics file name: GPR 1700 MHz, Asphalt Pavement Re(permittivity), layers.gestat						
Layer name: Layer 1						
Attribute: Re(permittivity)						
Threshold value: 4.7502						
Layer length: 119 m						
Data step horizontally: 0.2 m						
Total length of below the threshold: 29.2413 m						
Percentage of areas below the threshold from layer length: 24.5833 %						
Number	Start, m	End, m	Length, m	Extreme position, m	Extreme value	Below threshold, %
1	15.875	32.68	16.805	23.626	4.619472548	2.75
2	61.577	63.252	1.675	62.197	4.722949728	0.57
3	96.738	100.397	3.659	98.598	4.687221476	1.33
4	103.063	109.946	6.883	107.9	4.659319151	1.91
Normalizing: No						
Data smoothing: 2 m						

GPR Profile Signal Processing

GEORADAR-EXPERT software includes a standard set of editing and processing methods for GPR data used in professional software.

Along with standard methods, the software implements specialized algorithms developed for GEORADAR-EXPERT. These algorithms provide resolution enhancement of GPR profile signals and effective suppression of complex types of noise.

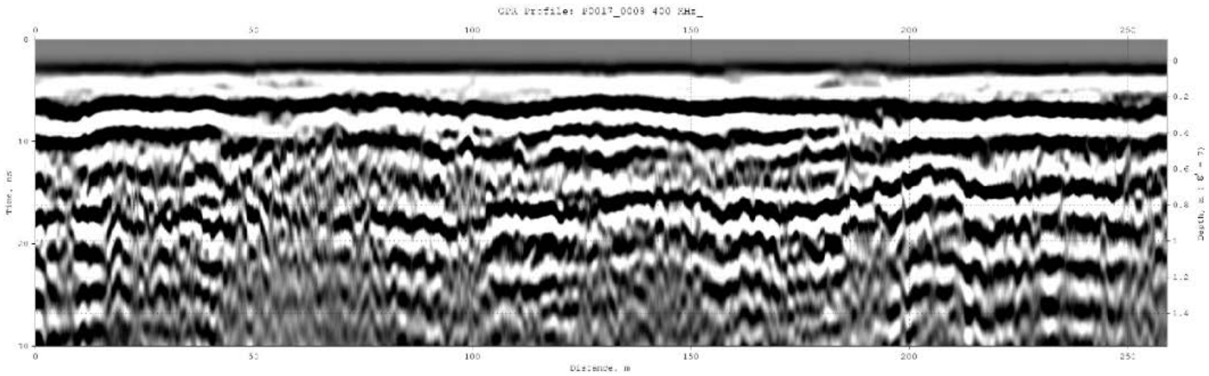
Signal Resolution Enhancement Using Wavelet Transform

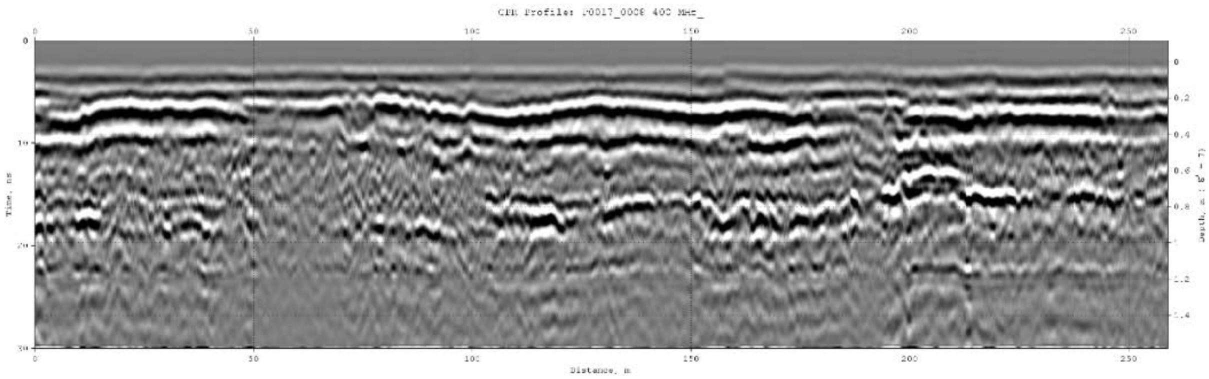
The resolution of a GPR trace is determined by the frequency characteristics of the antenna and the transmit-receive chain of the GPR. These elements form the effective bandwidth and, accordingly, the effective duration of the probing pulse. The wavelet transform makes it possible to increase signal resolution during office processing by adaptively extracting and amplifying high-frequency components.

In the wavelet transform, a GPR trace is represented as a set of wave components, wavelets, localized in time and frequency and similar in shape to the probing pulse. Each component characterizes the contribution of a certain frequency range over the corresponding interval of the time axis. As a result, a 2D representation “time–decomposition level” is formed. The decomposition levels correspond to different frequency ranges.

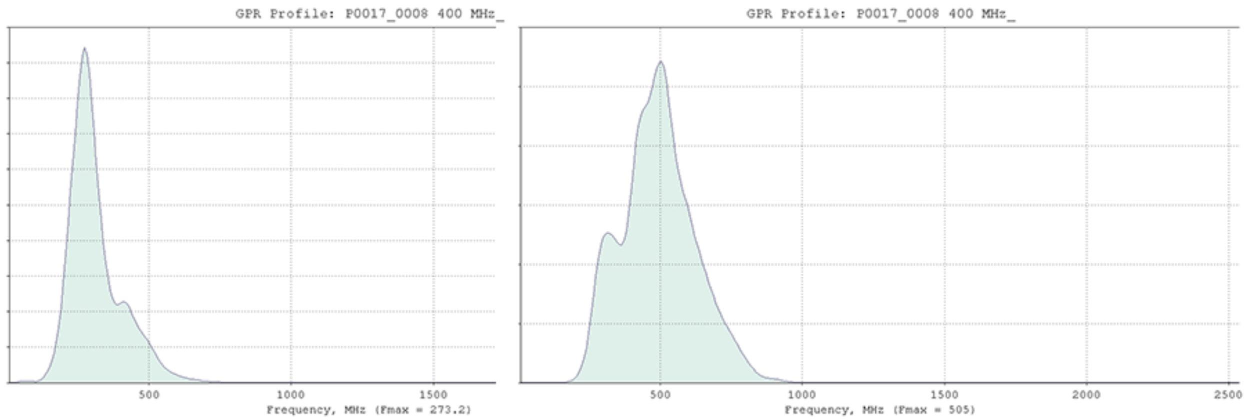
Excluding low-frequency decomposition levels followed by signal reconstruction leads to a decrease in reflection duration and an increase in the clarity of medium boundaries on the GPR profile. Side oscillations are usually weaker, because the transform and filtering are performed locally in time. This differs from classical frequency filtering based on the Fourier transform.

The figure below shows a GPR profile acquired with a frequency of 400 MHz during a longitudinal survey of a road, and the result of the wavelet transform of this profile.





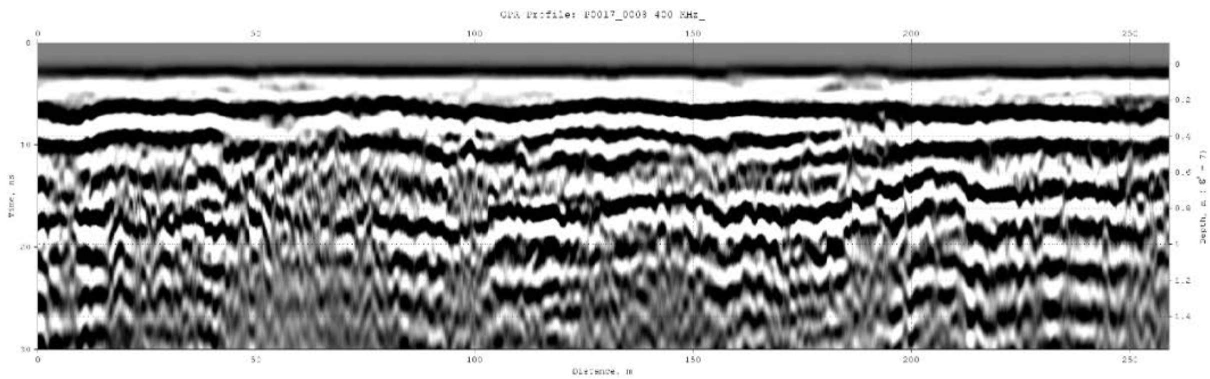
The wavelet transform result shows improved time localization of reflections from layers of the road structure compared to the original data. On the left, the frequency spectrum of the original profile signals is shown. On the right, the spectrum after processing is shown. After the transform, the signal spectrum is characterized by an increased bandwidth and a center frequency shift. Its value increased by 1.8 times, from 273 MHz to 505 MHz.

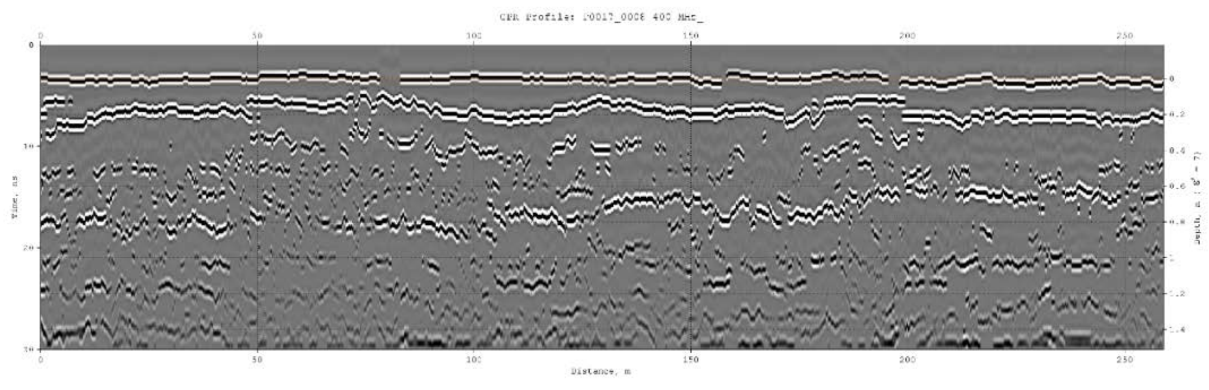


Signal Resolution Enhancement Using B-Detector Method

The B-Detector method (Boundaries Detector) was developed for GEORADAR-EXPERT software to suppress noise and enhance the resolution of GPR profile signals during office processing. The method is based on convolving a GPR trace with a short high-frequency pulse. The frequency range of the pulse is selected above the main band of the original signals.

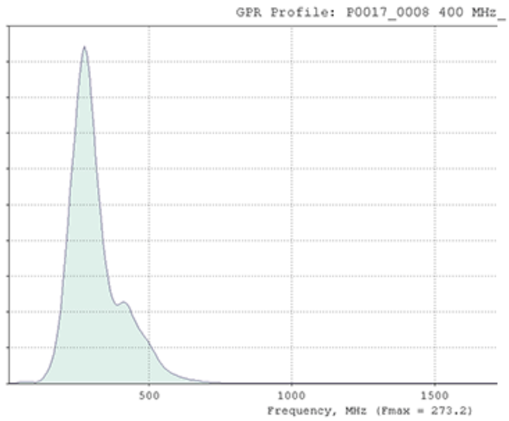
A GPR profile discussed in the previous section is shown in the figure. The profile was recorded with an antenna center frequency of 400 MHz during a longitudinal road survey. The result of processing this profile using the B-Detector method is shown below.

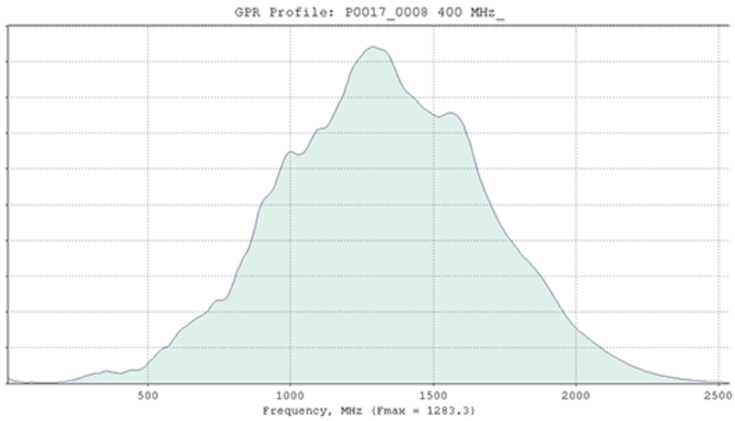




The results demonstrate improved time localization of reflections from the road structure layers compared to both the original data and the results obtained using the wavelet transform. The lower boundary of the asphalt concrete pavement is confidently traced along the entire profile. In the final part of the profile, its position is 0.2 m.

On the left, the frequency spectrum of the original profile signals is shown. On the right, the spectrum after processing is shown. As a result of using the B-Detector method, a significant increase in the signal spectrum width and the center frequency is observed. Its value increased by 4.7 times, from 273 MHz to 1283 MHz.





An additional advantage of the method is phase alignment of the signals. This simplifies their tracing and the automated boundary picking of medium boundaries, which is implemented in GEORADAR-EXPERT.

Software-based resolution enhancement makes it possible to overcome the trade-off between resolution and investigation depth of a GPR survey. The use of the wavelet transform and the B-Detector method for processing data acquired with low-frequency antennas increases radargram detail to a level comparable to that of high-frequency antennas. This expands the range of tasks solved using low-frequency antennas. It includes tasks that previously required higher-frequency GPR.

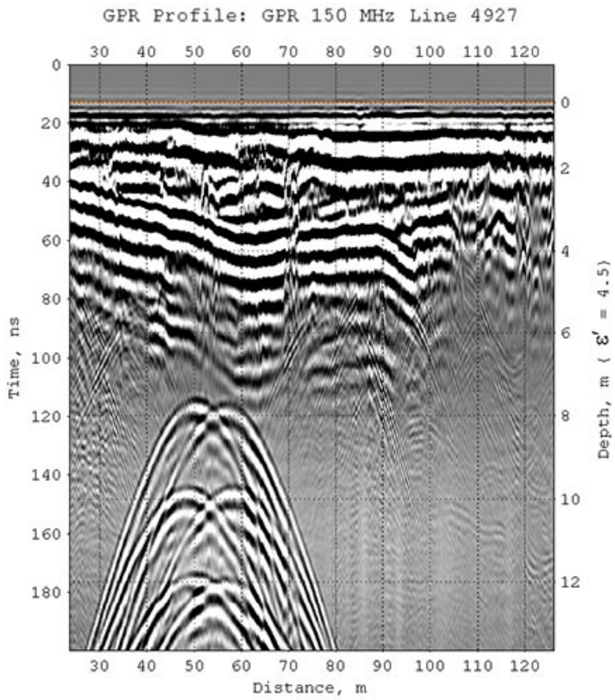
Noise Suppression Using Wave Field Decomposition Method

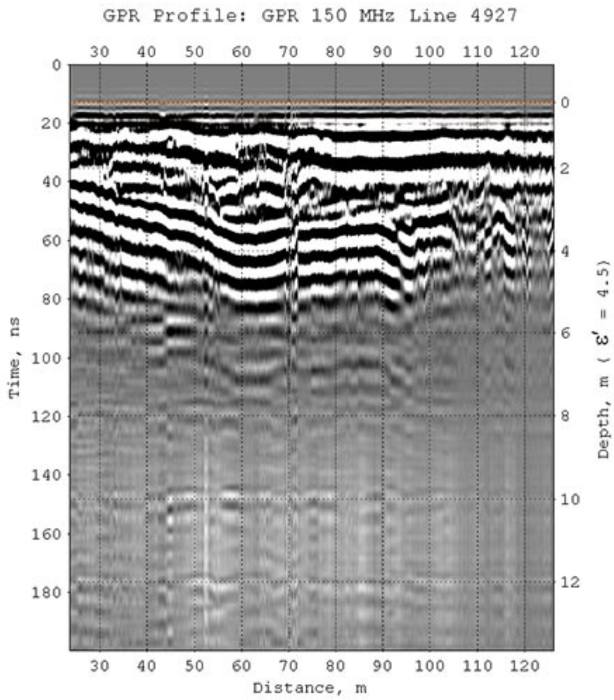
One of the key tasks of office processing of GPR data using traditional methods, without using BSEF analysis, is suppressing reflections from objects located on the ground surface. Such air reflections have a high amplitude level. This leads to masking of useful signals from subsurface structures.

Antenna shielding of the GPR does not provide complete removal of air reflections. These types of noise are most pronounced on radargrams acquired using dipole low-frequency antennas whose design does not include shielding. Additional noise sources that interfere with extracting useful deep reflections are diffracted reflections from high-contrast local objects in the near-surface layer.

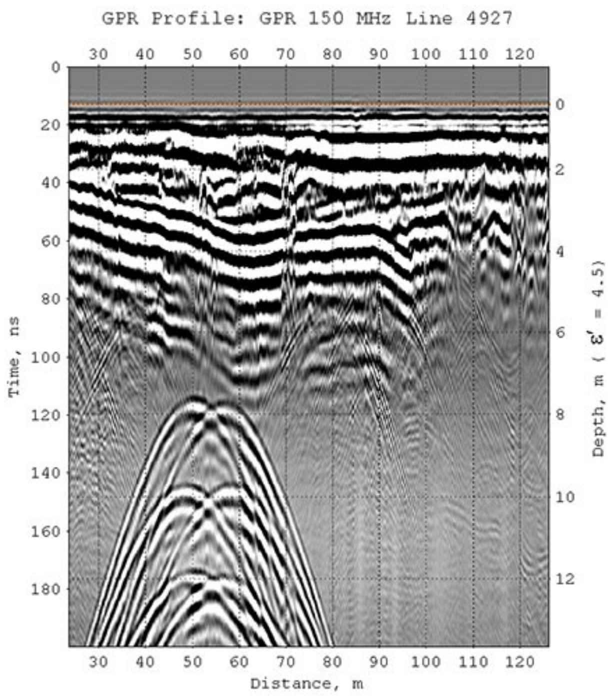
To remove noise, including air reflections, the wave field decomposition method is implemented in the software. The idea of the method is to decompose the GPR profile into independent components corresponding to different types of wave objects. After excluding components that contain noise, the profile is reconstructed from the remaining components. As a result, the excluded noise waves are absent on the reconstructed profile.

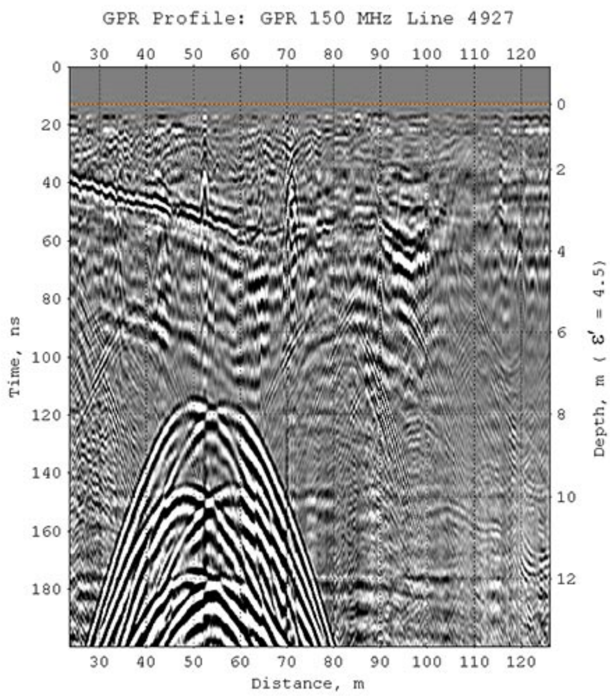
An example of removing wave components formed by air reflections is shown below. On the left, the original profile recorded with a center frequency of 150 MHz is shown. On the right, the result of applying the decomposition method is shown.





To study local heterogeneities, components with diffracted waves are preserved. Components of reflections from predominantly horizontal medium boundaries are suppressed. Below, on the left, the original data are shown. On the right, the result of extracting diffracted waves is shown.



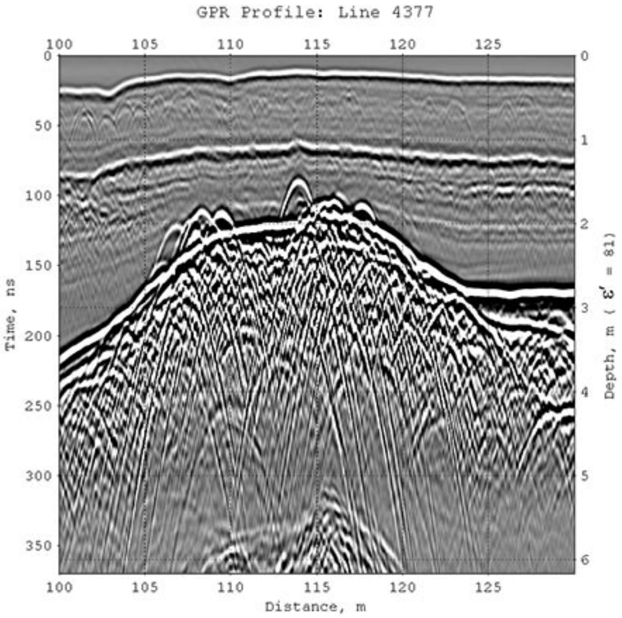


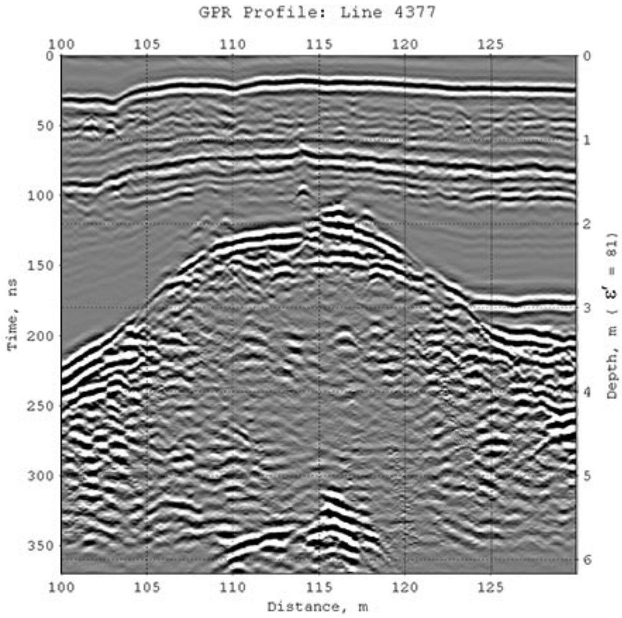
Noise Suppression Using Spatial Filtering

Along with the wave field decomposition method, GEORADAR-EXPERT implements noise removal using spatial filtering. Filtering is performed by analyzing the spatial-temporal parameters of diffracted reflections and extracting waves with a certain apparent velocity and propagation direction. The signals of the extracted waves are then subtracted from the signals of the GPR profile.

Spatial filtering effectively removes noise in the form of air waves and intense diffracted reflections from local objects. At the same time, reflections from medium boundaries are preserved. The algorithm allows flexible adjustment of filtering parameters according to the features of the wave pattern of each specific profile.

An example of using spatial filtering to remove numerous reflections from submerged logs and boulders located on the riverbed surface and in silt deposits is shown below. On the left, the original profile is shown. On the right, the result of spatial filtering is shown.





Processing Automation

GEORADAR-EXPERT software supports saving GPR profile signal processing parameters to a separate file and then applying the saved data to process a group of profiles in an automated mode.

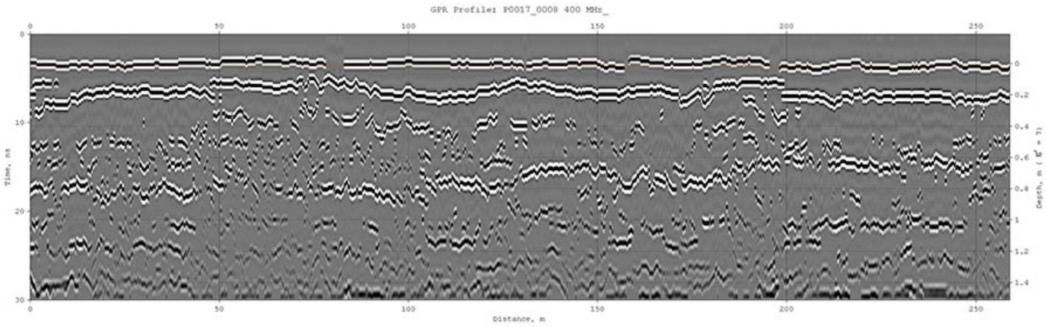
Automation of processing for similar data eliminates the need for constant interaction with the software interface. In batch processing mode, the selected profile files are loaded automatically, the processing procedures specified in the data file are started, and the results are saved without additional operator involvement. This approach is especially effective when working with large sets of GPR data.

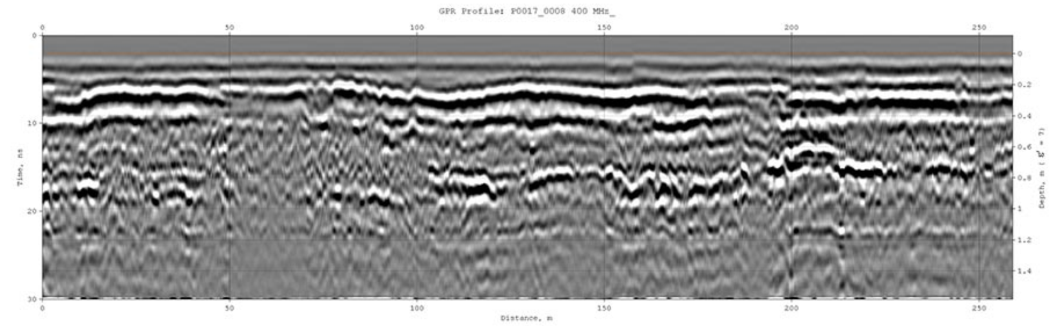
Multi-Channel GPR Data Merging

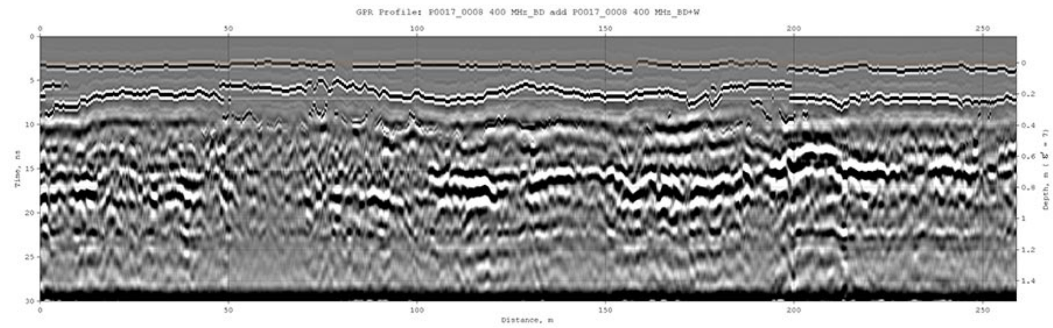
GEORADAR-EXPERT software supports merging GPR profiles that have the same number of traces into a single GPR profile. This function is used for processing and interpreting data from a multi-channel GPR. In this case, several profiles are recorded by different antennas in a single pass.

As a result of merging individual radargrams of a multi-channel system, a single time and spatial referencing of reflections is formed. This reduces scatter in positioning of subsurface objects. It is also possible to merge processing results for a single GPR profile obtained with different parameters. This increases the informational value of the final profile.

The same profile acquired during a road structure survey with a 400 MHz GPR is shown below. At the top, the profile after resolution enhancement using the B-Detector method is shown. In the middle, the profile after applying the wavelet transform is shown. At the bottom, the result of merging these two profiles is shown.







In road surveys, pavement thickness measurement requires increased accuracy. The result obtained using the B-Detector method localizes the lower boundary of the asphalt pavement well. It is confidently traced along the entire length of the GPR profile. At the same time, deeper boundaries are characterized by some fragmentation.

On the profile processed using the wavelet transform, the asphalt boundary is less localized. However, the underlying boundaries look more continuous. On the resulting profile formed by merging the results of these processing methods, optimal representation of the boundaries of road structure layers is achieved. First, the asphalt pavement layer is shown, followed by the crushed stone and sand layers.

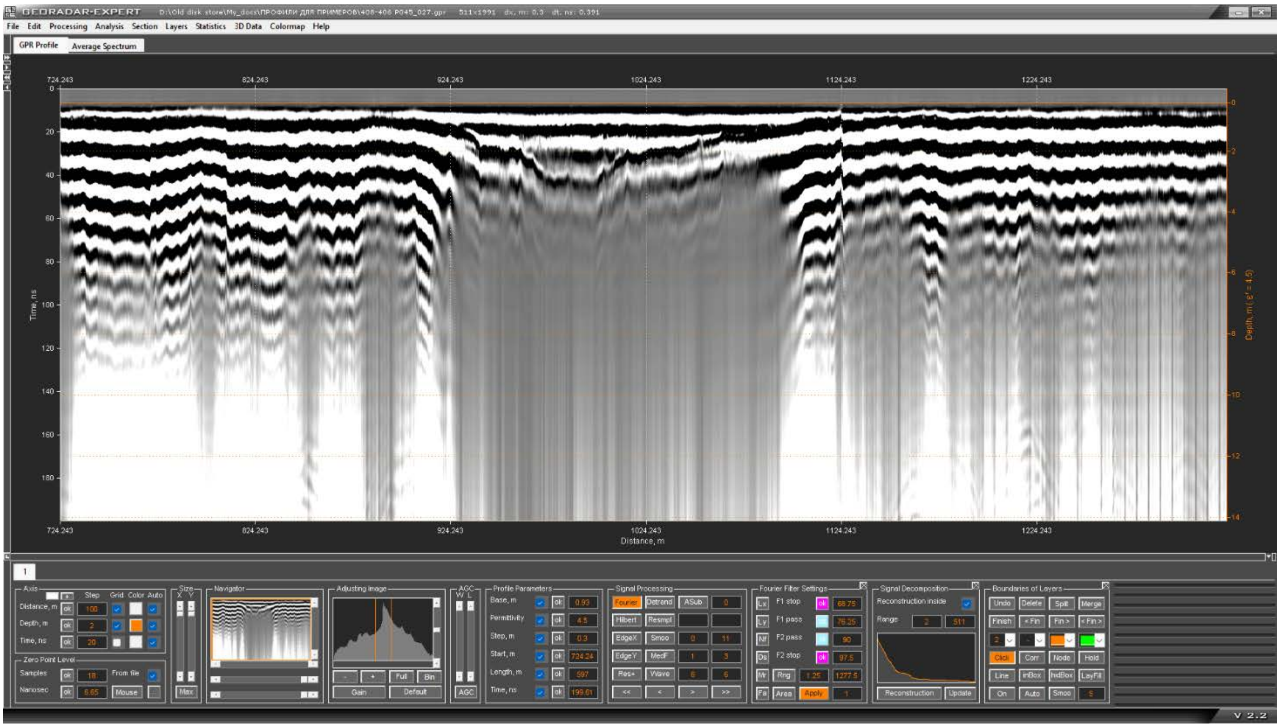
Graphical User Interface

GEORADAR-EXPERT supports work with two-dimensional and three-dimensional representation of GPR profiling data and their processing results. When a file is opened, a workspace adapted to the specifics of the loaded data type is generated automatically.

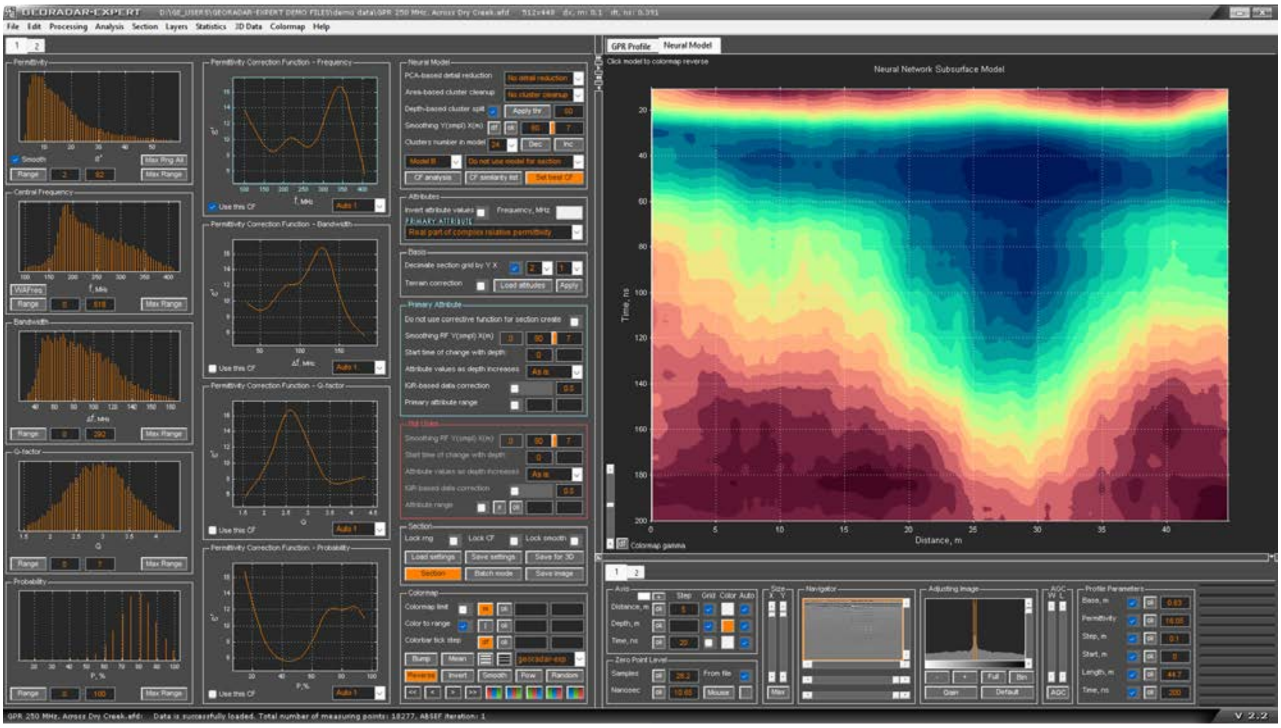
The workspace of the software suite is organized as tab groups. Each group combines control panels by functional purpose. Fast switching between tabs allows the user to focus on the current task by displaying only the relevant controls for data processing and visualization.

Examples of the main window of the software suite in different workspace configurations are shown below.

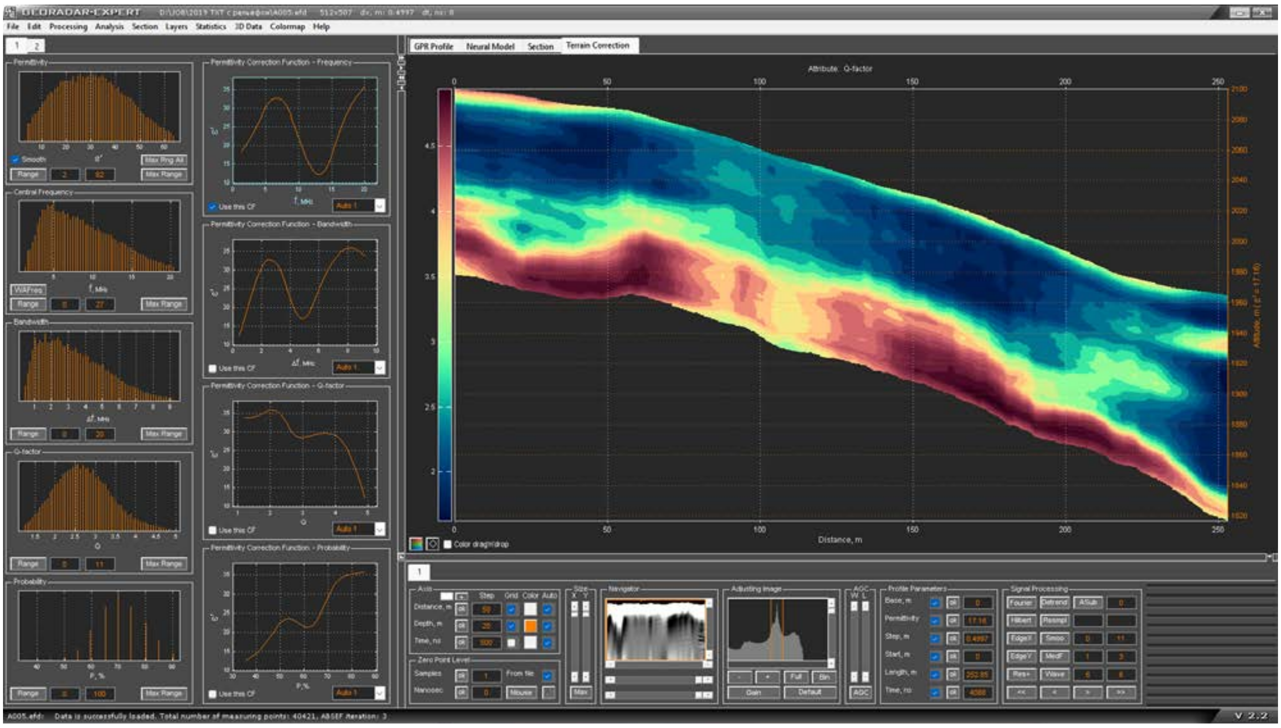
GPR profile visualization tab. Panels for controlling profile visualization, its parameters, and processing are located in the bottom tab group.



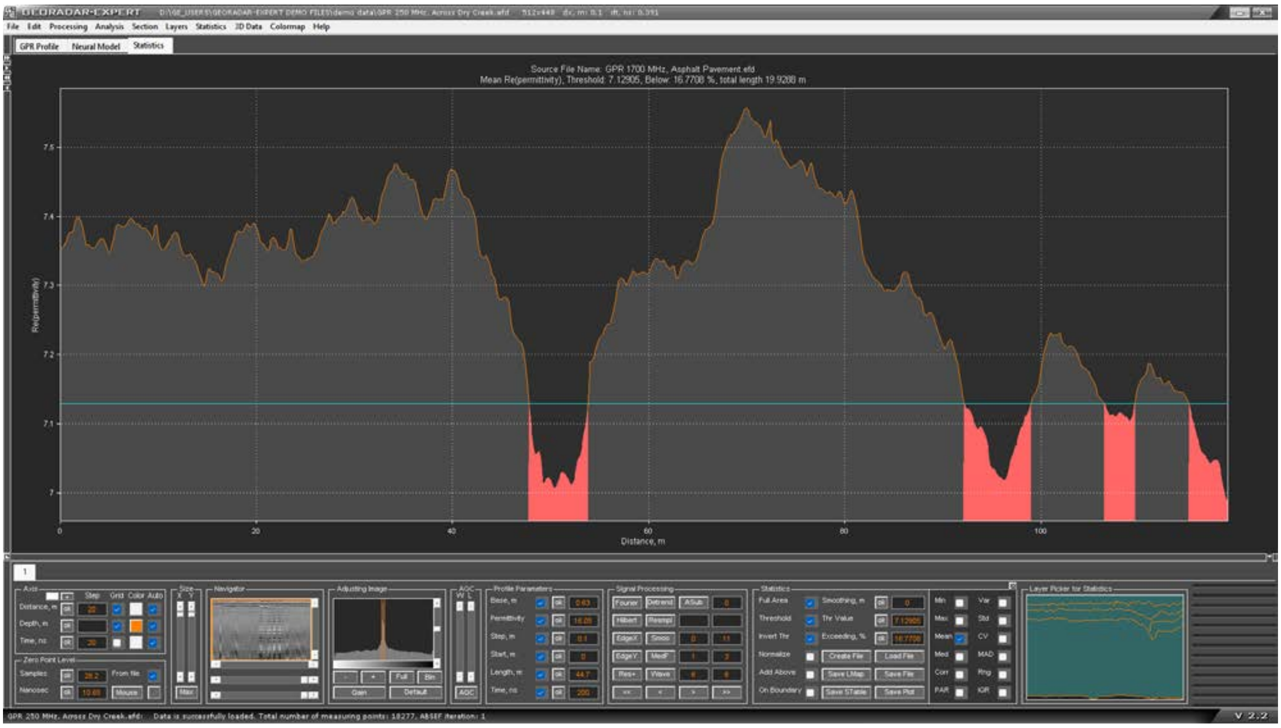
Attribute section creation setup tab and subsurface environment neuromodel visualization tab. Histograms for visualization of the automated BSEF analysis result are located on the left side of the workspace.



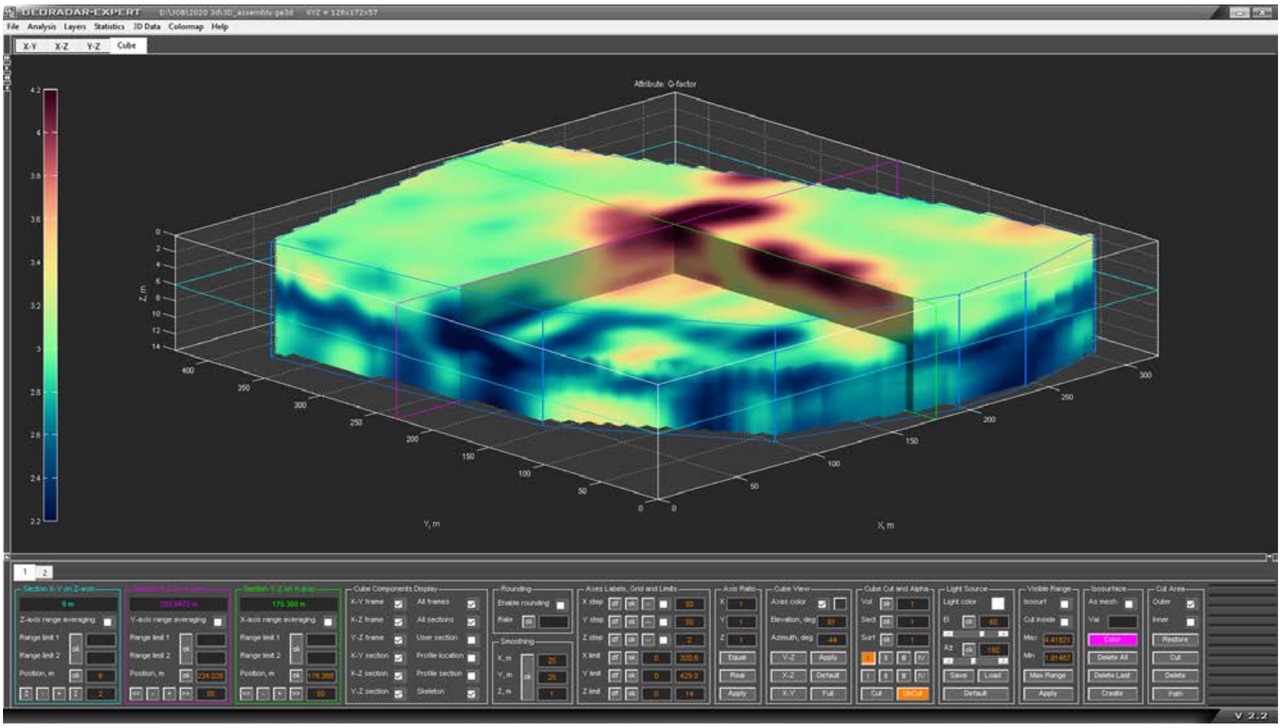
Attribute section tab with terrain correction.



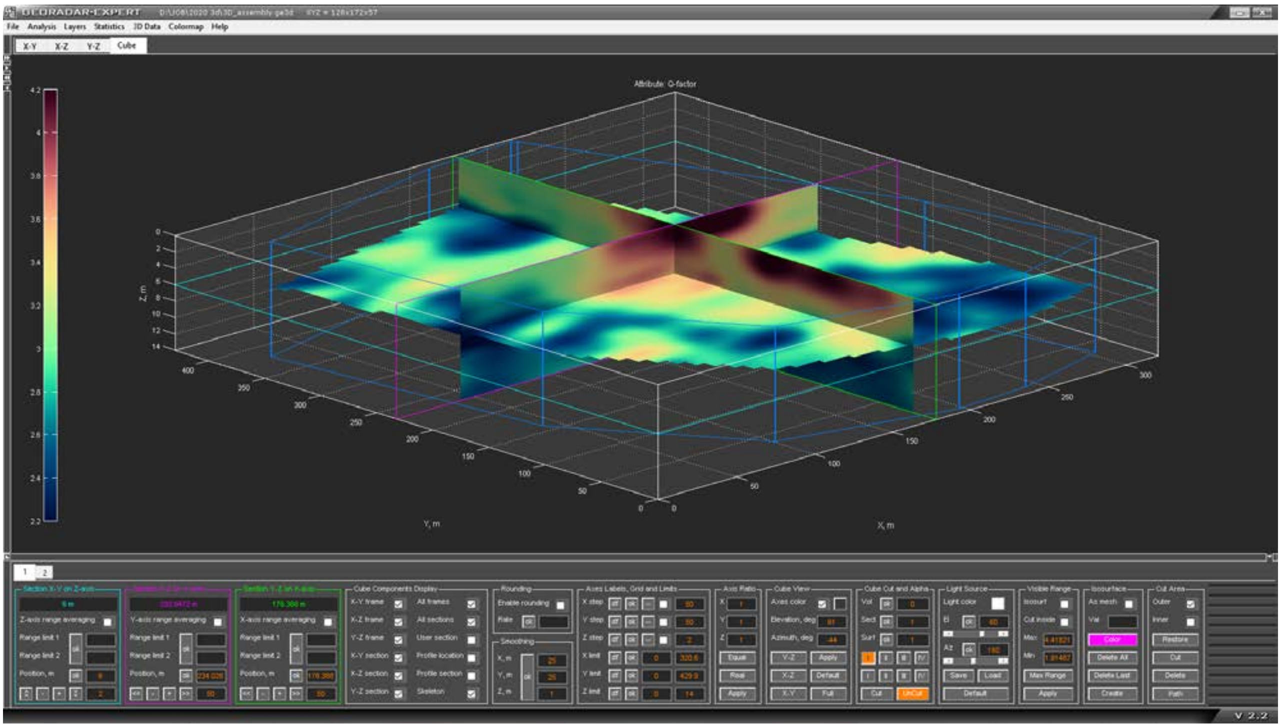
Tab for visualization of the statistical analysis result of GPR data. The interactive plot provides a threshold for detecting violations according to the specified rule. Threshold violation areas are shown in red. Positions of violation areas and their characteristics are exported to an MS EXCEL spreadsheet.



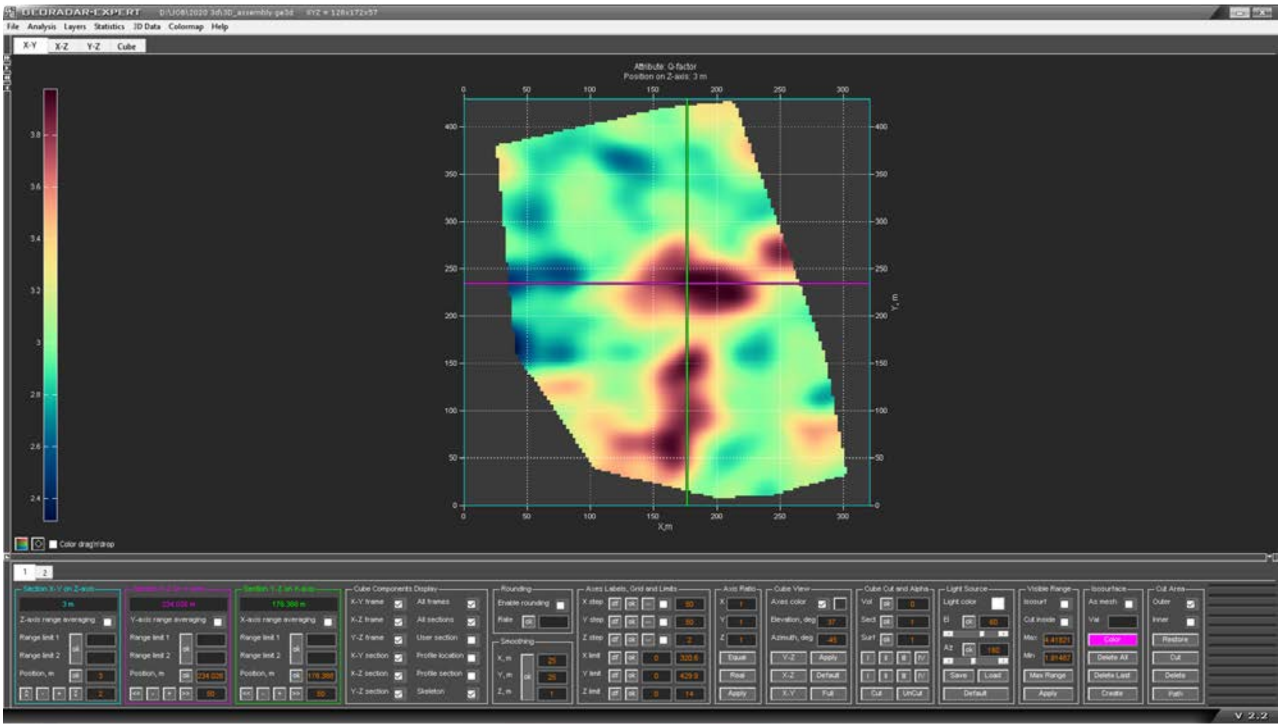
Tab for visualization of a 3D assembly of sections with the upper quarter of the volume cut out. Visualization axes are rotated using the mouse. Viewing angles of the 3D assembly and the light source position can be specified numerically using the corresponding parameters.



Tab for visualization of the volume of a 3D assembly of sections with orthogonal slices. The position of each slice can be adjusted interactively using the mouse or by precise numeric specification of coordinates. Creation of a curvilinear vertical slice by the user is also provided.

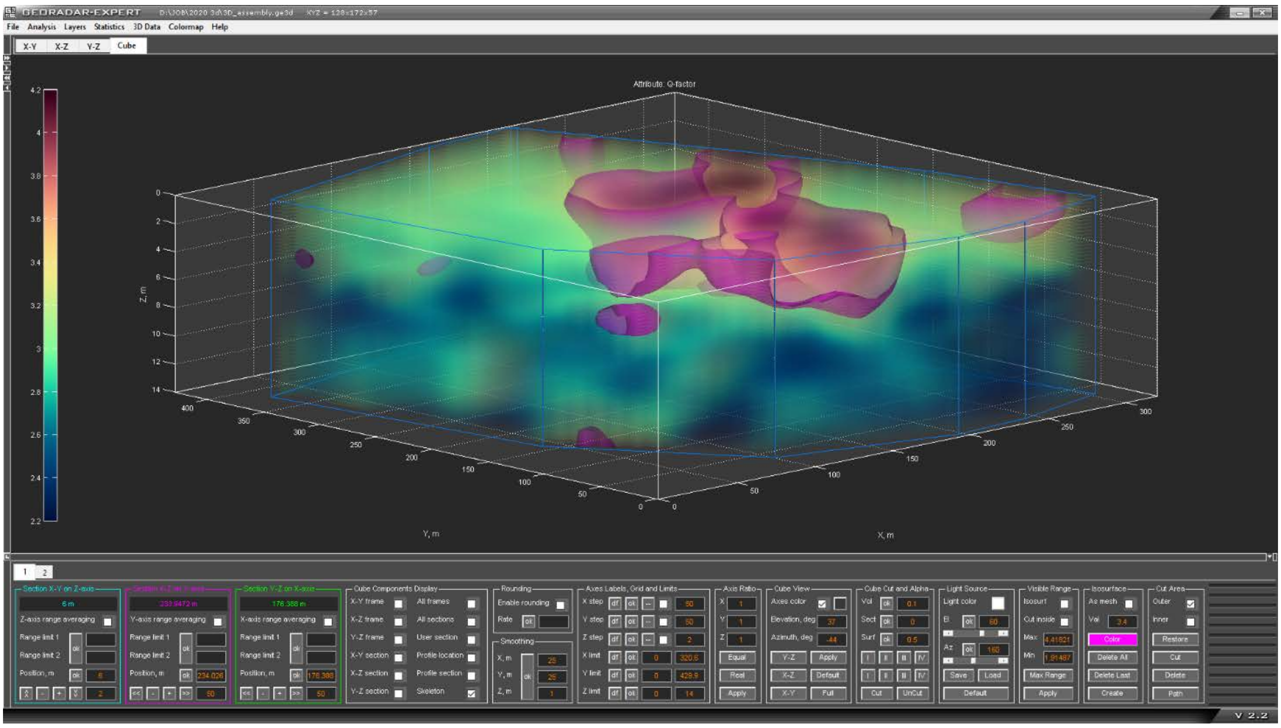


Tab of a horizontal slice of the volume of a 3D assembly of sections. Similar separate tabs are provided for vertical slices.

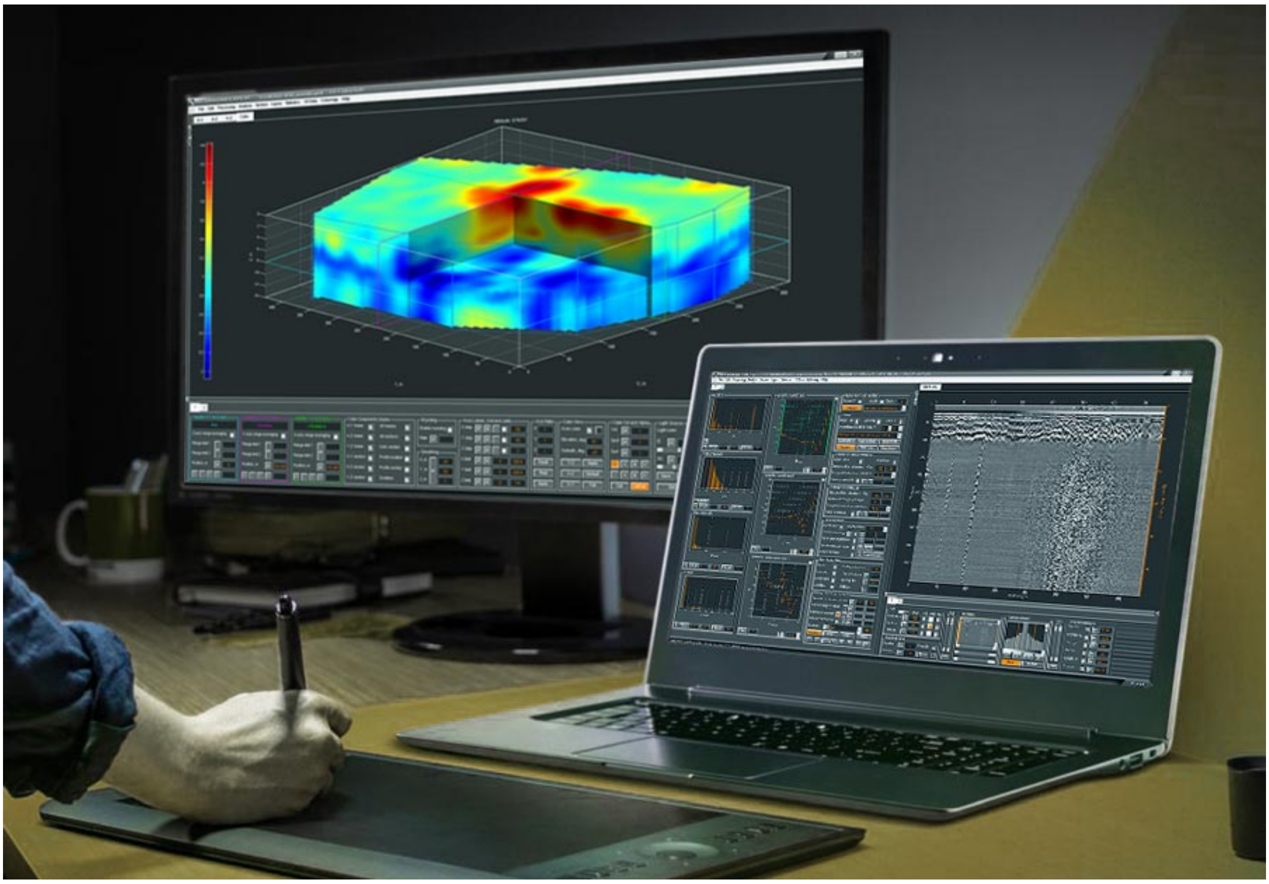


The volume of a 3D assembly of sections can be divided for visualization using isosurfaces created by specified attribute values. This makes it possible to highlight layer boundaries or contours of anomalous zones. After isosurfaces are created, export of a table with calculated volumes of the selected areas in MS EXCEL format becomes available.

The tab below shows a visualization where isosurfaces are shown in purple and the volume of the 3D assembly is made semi-transparent for clarity.



Advantages of GEORADAR-EXPERT



GEORADAR-EXPERT software was developed based on many years of experience in processing GPR data. It is designed to solve a wide range of GPR tasks, including complex cases in which software solutions from other vendors are insufficient.

Increased informational value and improved quality of office processing performed using the software contribute to improving the competitiveness of the organization that uses GEORADAR-EXPERT in the geophysical services market. The common and distinguishing features of the software compared to other GPR data processing solutions are provided below.

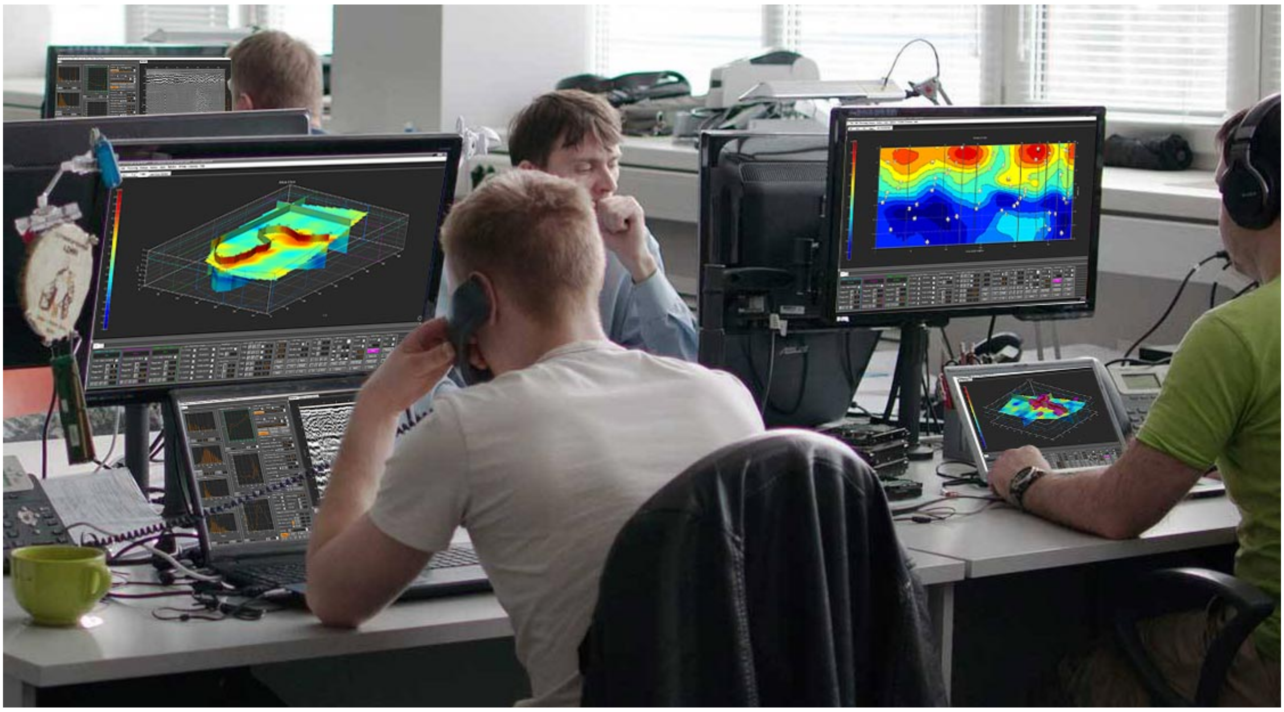
Similarities

The software includes a set of data editing and processing functions typical of professional office processing systems for GPR data. The implemented functions provide solutions for typical GPR survey tasks.

Differences

The main difference of GEORADAR-EXPERT software is the implementation of specialized algorithms designed to solve complex tasks of office processing and interpretation of GPR data. The implemented methods increase the informational value of the results and expand interpretation capabilities. This also applies to processing field measurement data acquired under conditions of strong signal attenuation and a complex noise environment.

License Purchase



Delivery of GEORADAR-EXPERT software is performed under a license contract (license agreement) concluded between the right holder and the purchaser of the right to use GEORADAR-EXPERT. Purchasers under the agreement can be legal entities and individuals.

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A request for a commercial offer and the information required to prepare the license agreement should be sent to the right holder’s email address: info@gpr-soft.com.

Useful Links

GEORADAR-EXPERT web site:
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GEORADAR-EXPERT software overview:
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