



RO-400 2D
Through Wall GPR-Detector
Technical Description
User Manual

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1. General safety rules and certification

To avoid injuries and damage to this product it is necessary to observe the following safety rules:

- Avoid strong shock impact and mechanical damage when using and transporting the device.
- Only users who have been trained or acquainted with the operation manual can operate the device.
- Only qualified personnel can perform servicing of the device.
- To avoid electric shock hazard do not disassemble device either partially or completely.
- Do not touch stripped parts of wiring. Do not touch non-insulated connections and live components.
- Do not repair this device yourself otherwise you can damage it.

Level of radiation power of the device is not hazardous for humans that is confirmed by Safety and Health Certificate

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2. Purpose

Through Wall GPR-Detector RO-400 2D is a portable and easy-to use the GPR security solution, designed for locating moving people behind reinforced-concrete walls and multi-layer building constructions in real time. RO-400 2D can be used for solving survey tasks to reveal hideouts, caches, saps, underground passes and utilities, criminal burials, hidden explosive devices and shells in engineering structures.

3. Principle of operation

The operation of GPR-Detector is based on the well-known principles of radiolocation. The property of radio waves to reflect from the media interface with different capacitive is the basis of the adopted method of detection.

Subsurface radiolocation employs short pulse signals. For these pulses to be formed, the use is made of broadband antenna excitation by voltage change with a leading edge of short duration. Direct processing of pulses of such short duration (hundreds of picoseconds) is quite difficult. Therefore the use is made of a method referred to in the literature as stroboscopic conversion.

The control unit generates commands, which are sent to receiving or transmitting units. The transmitting device generates signals, which are emitted by a transmitting antenna into medium being investigated. Echo signals are received by a receiving antenna, processed in receiving unit and forwarded to the processing and indication unit.

The processing and indication unit produces 2D image of received signals and displays them on a real time basis. If required, remote unit with LCD display can be connected by a cable of 50.0 m long to duplicate information from the monoblock screen.

To ensure connection with external PC, the device is furnished with a special connector to connect GPR detector and PC via Ethernet interface. WiFi connection also provided.

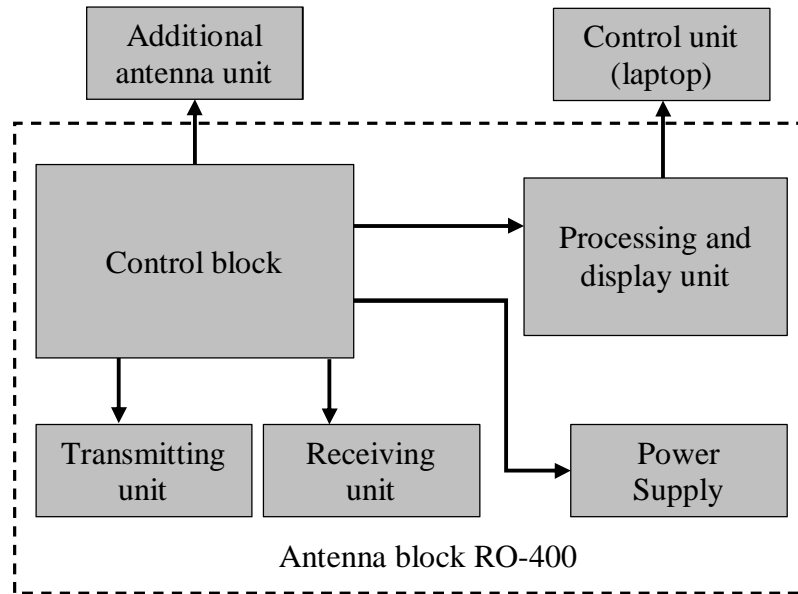


Fig. 3.1 GPR-Detector function block diagram

4. Components and technical specifications of GPR-Detector.

GPR-Detector consists of the following units*:

1. Monoblock with LCD display (Fig. 4.1).
2. Additional antenna
3. Power supply unit.
4. Tablet PC.
5. Odometer DP-32 D (or DP-32).
6. Ethernet cable, 10.0 m.
7. Tripod.
8. Charger.
9. Bedplate.
10. Handle rod
11. Radio Modem
12. Belt.
13. Documentation.
14. Transportation bag.

Software:

1. GeoScan32 software is installed on a PC to view and process the stored files after copying from the PO-400 2D antenna unit to the PC;
2. ðDetectorö software is installed on tablet PC to view the sounding results on the tablet PC transmitted from the PO-400 2D antenna to the tablet PC when connecting devices using one of two options:
 - Évia Wi-Fi channel, the module of which is integrated into the antenna;
 - Évia Wi-Fi channel with connecting the antenna to the external radio modem with a cable

4.1 R -400 2D GPR-Detector

Specifications:

- Center frequency ≈ 400 Hz
- Dimensions $\approx 396 \times 286 \times 155$ mm (without the additional antenna)
- Weight ≈ 4.3 kg
- Running time ≈ 4 hrs
- Standard - I 66
- Operating temperature range: from -20 to $+45^{\circ}$
- The life cycle is 7 years

Operating modes:

a) The moving object detection mode:

- detection of people by movement at a distance of minimum 7.0 m through a 0.6m width reinforced concrete wall or at a distance of minimum 12.0m through a 0.35m width brick wall;
- control of GPR-Detector using the software installed on the tablet PC via Wi Fi channel
- continuous self-contained monitoring and recording of sounding results;

b) The search GPR mode:

- surveying depth (for soil): min. 5.0 m;
- resolution: 0.15 m.



Fig. 4.1 R -400 GPR-Detector



Fig. 0.1 - R -400 GPR-Detector with the additional antenna

4.2 BP-3,8/12 Power Supply Unit

BP-3,8/12 power supply unit is designed for power supply of GPR-Detector. BP-3,8/12 power supply unit includes Ni-MH batteries.

Features:

- The batteries are designed for at least 500 cycles of discharging/charging;
- Due to low self-discharge rate the batteries storage period with working parameters not being deteriorated is up to one year.

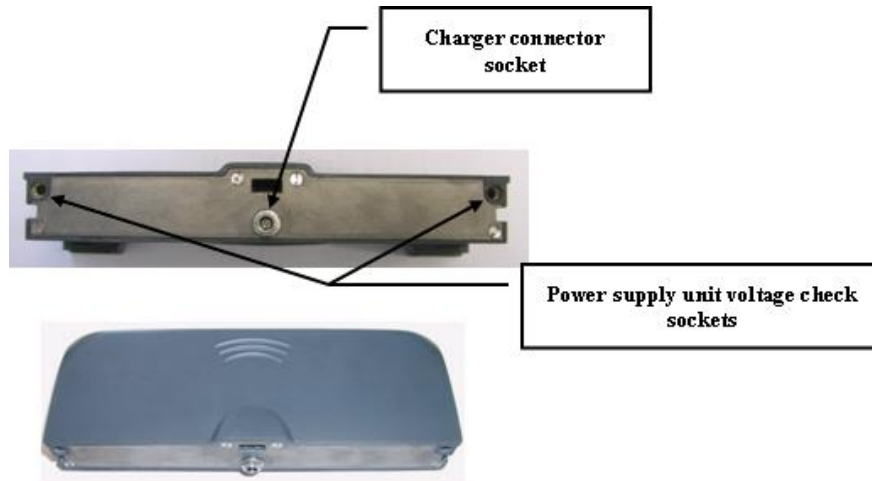


Fig. 4.3. BP-3,8/12 Power Supply Unit

During the operation of Ni-MH batteries, so called memory effect occurs which results in actual memory reduction. To reduce the possibility of such effect, it is necessary to carry out several cycles of complete discharge and charging of the battery every six months. To recover the batteries capacity, it may take up to 3-5 such discharging/charging cycles.

4.3 The additional antenna

The additional antenna (Fig. 4.4) is designed to search in motion detection mode by scanning through obstacles to display the detection results in real time in 2D format.



Fig. 0.2 6 Additional antenna

4.4 ZU-9/12 Charger

Microcontroller automatic charger (fig. 4.5) with discharge function is designed to charge BP-9/12 power supply unit.



Fig. 4.5 ZU-9 Charger

Description of LEDs indications:

- Yellow ó the power supply unit is not connected
- yellow ó battery analysis;
- orange ó fast charge
- green/yellow - trickle charge
- green ó battery is full. charge maintenance mode is on
- orange/green ó an error.

4.5. The battery pack

The battery pack (Fig. 4.6, Fig. 4.7) is designed to place 9 elements of type D size that can power the GPR-Detector for 30 minutes. This battery pack is used in emergency cases when both the power supply units are discharged.



Fig. 0.3 ó The battery pack



Fig. 0.4 -The battery pack

4.6 DP-32 (DP-32 D) Odometer

The DP-32 D Odometer (Fig. 4.8) is used during the movement of GPR-Detector in GPR mode over the surface and is designed for relation of the search results to the local area.



Fig. 4.8 DP-32 D Odometer

4.7 Bedplate

Bedplate (fig. 4.9) is designed to accommodate GPR-Detector when sounding in GPR mode.



Fig. 4.9 Bedplate

4.8 Handle rod

Handle rod (fig. 4.10) is designed to move GPR-Detector fixed on the bedplate when sounding in GPR mode.



Fig. 4.10 Handle rod

4.9 Tripod

Tripod (fig. 4.11) is designed to secure GPR-Detector monoblock when sounding in standalone mode or setting-up GPR-Detector next to the wall through which sounding is conducted.



Fig. 4.11 Tripod

4.10 Radio Modem

The radio modem (Fig. 4.12) is designed to transfer the detection results from the antenna connected to the radio modem to the control unit (the laptop or the tablet PC) via a Wi-Fi channel



Fig. 0.5 - Radiomodem

4.11 Tripod (radiomodem)

Tripod (radiomodem) (Fig. 0.6) is designed for fastening the radio modem



Fig. 0.6 ó Tripod (radio modem)

4.12 Tablet PC «Android»

The table PC is used to receive data from GPR-Detector via Wi-Fi.

It can work at temperatures from -20°C to $+70^{\circ}\text{C}$, and the buttons are placed so that the operator can work with the device in gloves.



Fig. 0.7 ó The tablet PC

Specifications for Hugerock T70 (T71):

- Operating system: Android 4.2.1
- Chipset: MTK 6589W Quad core
- Processor: 1.2Ghz 4 cores
- Graphic chipset: Power VR SGX544MP
- RAM: 1 GB
- Build-in memory: 8 GB
- Screen type: capacitive, multi-touch
- Screen: 7" IPSA, 1024x600
- Cameras: rear-facing camera - flash, autofocus 8 million pixels (flash, autofocus), Front camera 5 million pixels
- Sound: dynamics, headphone
- Support Bluetooth: Yes, V4
- Support Wi-Fi: Yes, 802.11 b/g/n
- G-sensor: Yes
- GPS module: Yes, A-GPS, EPO
- 3G module: Yes
- Mode cell phone: Yes
- USB port: Micro USB
- Memory card support: up to 64 GB MicroSD
- Connector: MiniUSB, 3.5 Jack, MicroSD, SIM
- Video format: ALL
- Audio format: ALL
- Battery power: 9650 mAh
- Weight: 660 gr

4.13 FULLY RUGGED CONVERTIBLE TOUGHBOOK Panasonic CF-19 (option)

Featuring a revolutionary LCD screen that transforms from a highperformance notebook to a fully portable tablet PC, the CF-19 incorporates transreflective display technology for perfect visibility even in direct sunlight. The LCD is protected by a durable, scratch-resistant magnesium alloy case, mounted to the base cabinet with a reinforced 180 degree rotatable hinge. A double waterproof structure ensures a tight, durable seal that exceeds IP65 water and dust-proofing standards and a special HDD-heater counters any adverse temperatures (-23°C í +60°C)



Fig. 0.8 – the toughbook CF-19

5. RO-400 2D GPR-Detector Operation.

5.1 GPR-Detector preparation for operation

Take the GRP-Detector and BP-3,8/12 power supply unit. Insert charged power supply unit into the GRP-Detector along the guides in the GRP-Detector body as shown in Fig. 5.1 until clamping lock operates (distinctive click). To remove the power supply unit, press the power supply unit clamping lock on the GPR detector body and pull the power supply unit out by moving along the guides.



Fig. 5.1. Installation of the power supply unit into the GPR-Detector

There are the sockets in the bottom part of GPR detector (fig. 5.2) to connect cables available in the GPR detector set as well as the bracket to secure GPR-Detector on the tripod.



Fig. 5.2. Arrangement of sockets to connect cables to the GPR detector

To carry out sounding by means of GRP-Detector in GPR mode, the following is required:

- fix the GRP-Detector monoblock onto the bedplate (fig. 5.3);
- attach handle rod to the bedplate bracket, for which purpose retract spring-loaded bracket retainer, insert the handle bar into the bracket slot and release the retainer so that it enters into the handle bar bottom part hole;
- attach DP-32 D odometer to the bedplate bracket found at the opposite side of the handle rod attachment bracket, for which purpose repeat the operations mentioned in the previous item. The handle rod attachment bedplate bracket and odometer attachment bracket are similar in design;
- connect electrical connectors on the odometer and the GPR-Detector by odometer cable.



Fig. 5.3. R -400 set to operate in the GPR mode

In the course of sounding in the movement detection mode with application of the tripod (fig. 5.4), it is necessary:

- draw off R -400 tripod attachment platform lever counterclockwise up to the stop (fig. 5.5) and retain it in this position;
- install GPR-Detector on the tripod platform so that the bracket configuration in GRP-Detector bottom part matches the tripod platform configuration;
- by retaining the monoblock body, turn GRP-Detector tripod attachment platform lever clockwise up to the stop.



Fig. 0.1 ó the GPR Detector on the tripod



Fig. 5.5. Tripod's platform to install the GPR-Detector

5.2 Charging of BP-3,8/12 Power Supply Unit

BP-3,8/12 power supply unit charging is performed in the following sequence:

- connect the charger and BP-3,8/12 power supply unit as shown in fig. 5.6;
- connect ZU-9 charger to electric main of 220V, 50 Hz;



Fig. 5.6. ZU-9 charger assembly for BP-3,8/12 charger

Once the charger is connected to the power supply unit, the charging process starts automatically. The storage battery testing phase goes in the first place and last for around 10 sec; at that, the red LED blinks on the charger body.

Upon completing the testing phase, BP-3,8/12 charging process begins, which is indicated by the permanently lit red LED. Charging of fully discharged power supply unit takes not more than 5 hours.

Once the charging process is over, the green LED lights up, while the red LED is not lit and the charger goes into trickle charge mode. The storage battery is now charged but may remain indefinitely connected to the charger.

5.3. Main Principles of operation

The GPR-Detector is most sensitive to any movement (including breathing). To receive the correct result, you must follow the following rules.

- Put the GPR-Detector to the wall (if possible);
- Fix the device on a tripod (if possible);.

- When working with the device, the operator must stand motionless
- If possible, work with the device when there are no people around. If it is not possible, people standing nearby should stand still.

When the device detects non-moving living objects, consider the following factors:

- Detection of non-moving living objects is more difficult than moving objects
- non-moving moving objects can make some movements (breathing, heartbeat, body movements from time to time), which allows the user to detect the target
- During detection, it is important what position the target is in: a person in a standing position is the easiest form to detect; a seated person makes fewer movements, and the most difficult type is a person in a prone position
- be patient, wait for 364 triggers of the "breath detection" mode;
- set the highest level of sensitivity that does not cause false alarms.
- Use a tripod to fasten the device
- If you are not sure whether the object or you yourself are on the screen, try to move from time to time and look at the results on the screen.
- If an object is in a "dead zone", the device will not be able to detect it, try moving the device to another point of the wall (both left-right and up-down) and repeat the detection process.
- False reflections from the operator, generally, appear in the first 1-2 meters of the detection range
- When working on hollow walls (drywall, etc), the device is more sensitive to operator movement and breathing.

5.4 Sounding techniques by the GPR-Detector

Employment of the GPR-Detector for detection of moving objects depending on the surveying conditions and requirements (operational monitoring or long-term monitoring, the operator is located in the immediate vicinity or at some distance from the wall of the building being surveyed, etc.) is provided in the following modes

1. Operator surveying. Operator is holding the monoblock by the handles and presses it against the wall through which the limited access room is being surveyed. The operator see the results on the monoblock display.
2. Tripod-mounted monoblock surveying. The monoblock is mounted on the tripod and positioned at a distance not exceeding 0.5 m from the wall through which surveying is performed or is pressed against the wall by adjusting the monoblock position on the tripod and by means of three adjustable legs of the tripod. The operator is viewing the results staying close to the monoblock or at some distance from it.
3. Scanning using the tablet PC with the data transmission via Wi-Fi. The operator selects the Wi-Fi option in the main menu and run the program on the tablet PC. The program connects to the GPR-Detector automatically via the Wi-Fi. To increase the distance when transmitting data via a Wi-Fi channel, it is possible to use the radio modem, which is connected to the antenna unit by cable. The device is fixed on tripod (at distance no more than 0.5 m from wall) or mounted close to the wall by adjusting the position of the antenna on the tripod and three adjustable legs of the tripod. If necessary, the antenna is connected to the radio modem by cable (length up to 20.0 m). The sounding results are transmitted to the tablet PC via Wi-Fi channel and observed on the screen of the tablet PC when the operator is at a distance from the wall.

When carrying out survey operations by GPR-Detector in GPR mode, the sounding results may be observed on the monoblock's screen or on the Tablet PC's screen connected to the monoblock via a Wi-Fi channel.

5.5 Selection of the GPR-Detector sounding modes and parameters

Switch on GPR-Detector power supply by pressing the red button. Within 365 sec automatic the GPR-Detector software testing goes on following which the moving objects detection mode will automatically set off.

Pressing the red button at the started mode of detection of moving objects causes main the menu (the Fig. 5.7). Pressing of the yellow button gets out the necessary option, the chosen option becomes more active pressing of the red button.

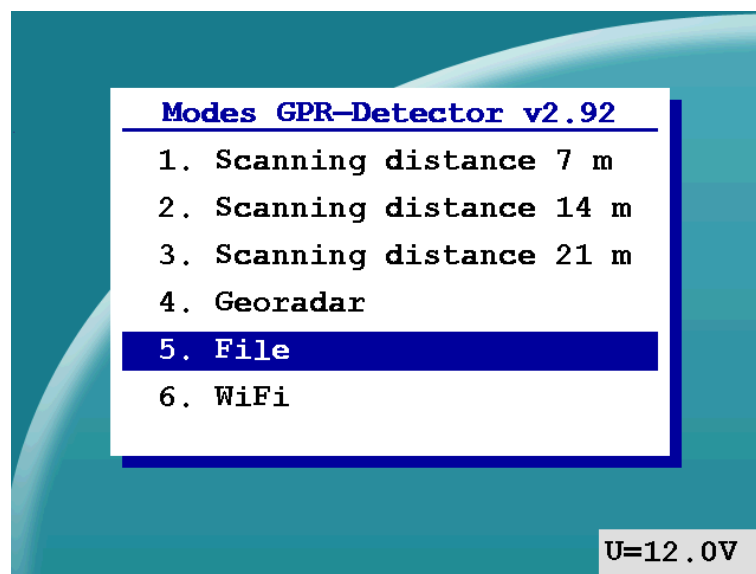


Fig. 5.7 The main menu of the GPR-detector

Points of the main menu of the GPR-Detector designate following options:

1. «Detection to 6,0 » - the maximum distance of detection of moving object behind a barrier is equal to 6,0 meters;
2. «Detection to 12,0 » - the maximum distance of detection of moving object behind a barrier is equal to 12,0 meters;
3. «Detection to 22,0 » - the maximum distance of detection of moving object behind a barrier is equal to 22,0 meter;
4. "Georadar" - GPR-Detector switching in a GPR mode;
5. "File" - the menu "File" (a Fig. 5.8) with which help it is possible: to open for viewing the kept file (button click to "Open" the list of the kept files opens, the chosen file opens for viewing). To remove not the necessary saved file (button click to "Remove" the list of the saved files opens, the chosen file will be removed). The option to "Format" is applied in case of failure in the GPR-Detector program when it is not possible to open saved files, after formatting there is a removal of all files.
6. «Wi ó Fi» - switching on the mode of transfer of search results from the antenna block to the control unit (the tablet PC , the notebook) via Wi-Fi

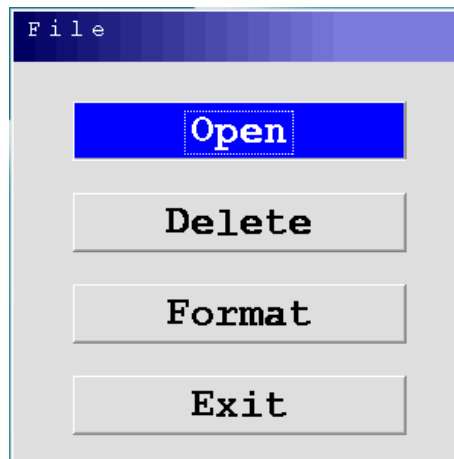


Fig. 5.8 The menu «File»

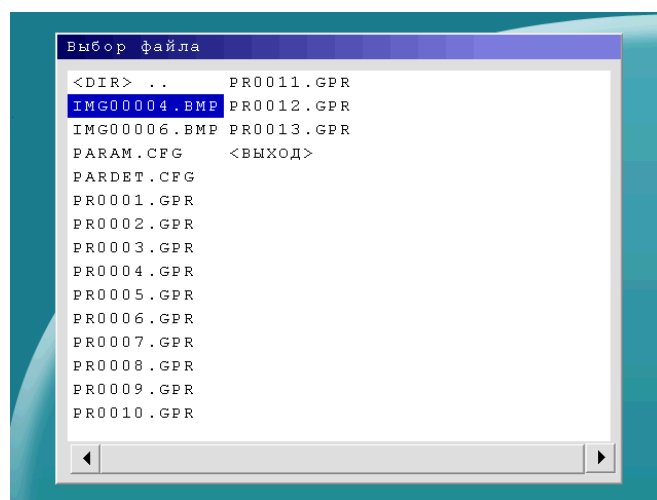


Fig. 5.9 The selection of the file for opening/removing

The GPR-Detector software controls the operation modes, enables to visualize and store sounding results both in the movement detection mode and GPR mode. Fig. 5.10 shows the program menu structure of the GPR-Detector, which allows the operator to make settings and modes switchover.

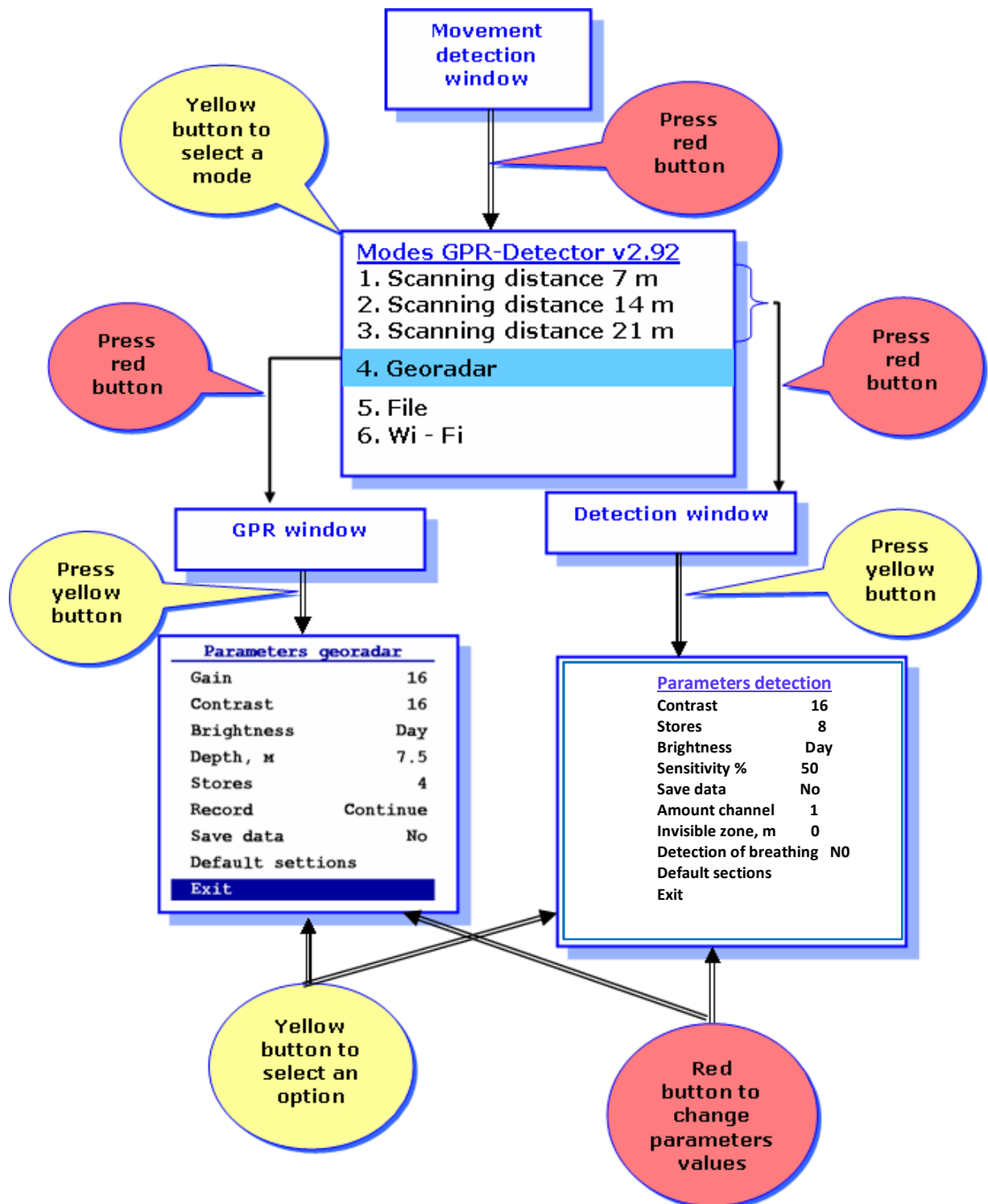


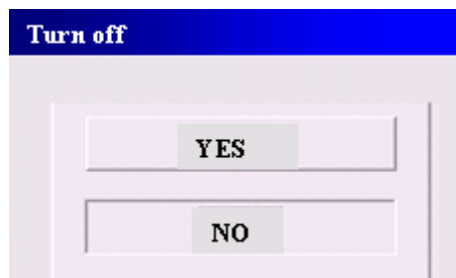
Fig. 5.10 The GPR-Detector menu

Table 5.1. Functions of GPR-Detector parameters in the movement detection mode

Sl. No.	Option	Function	Factory settings value
1	Contrast	Modifies visualization contrast of signals reflected.	16
2	Brightness	Adjust the screen backlight level depending on the ambient lighting	day
3	Sensitivity %	Modifies sensitivity of moving objects detection algorithm throughout the range.	50
4	Save data	Moving objects detection with results storing in GPR-Detector's memory.	NO
5	The number of channel	1 - 1,5D mode; 2 - 2D mode	2
6	View mode	1 - radarogram (only for one channel); 2 - Pseudo 3D 3 - Pseudo 3D with the breathing line	2
7	Invisible zone, m	The area, where moving objects cannot be found	0,00 m
8	Factory Settings	Setting of the factory settings.	
9	Language	Russia, English, Chinese	Russian
10	Exit	Exit into the moving objects detection mode.	

Seen below is the sequence of the device powering up, its modes and parameters selection by the buttons located on the GPR-Detector handles:

1. brief pressing of the red button - the device powers up and movement detection mode sets off;
2. short pressing of the red button in movement detection mode - menu call-up to select either the movement detection distance or GPR mode by pressing the yellow button;
3. brief pressing of the red button after the detection distance selection - entry into detection mode with selected detection distance;
4. yellow button hold down during 5 sec with initiated detection mode or GPR mode - call up of "Detection parameters" or "GPR parameters" menu according to the running mode of the GPR-Detector;
5. yellow button pressing selects the parameter in "Detection parameters" or "GPR parameters" menu (according to the running mode), pressing of the red button modifies the selected parameter value;
6. to power off the device, the red button should be pressed and held down for 5 sec. In any running mode, the power off window calls up (fig. 5.11), pressing of the yellow button selects "YES" item and brief pressing of the red button powers off the GPR-Detector.

**Fig. 5.11. The GPR-Detector power off window**

For the operator's convenience, there is a label under the monitor screen on the front panel of the GPR detector (Fig. 5.12), which indicates the procedure to select modes and parameters similarly to the one described in Items 1 ó 6 above.

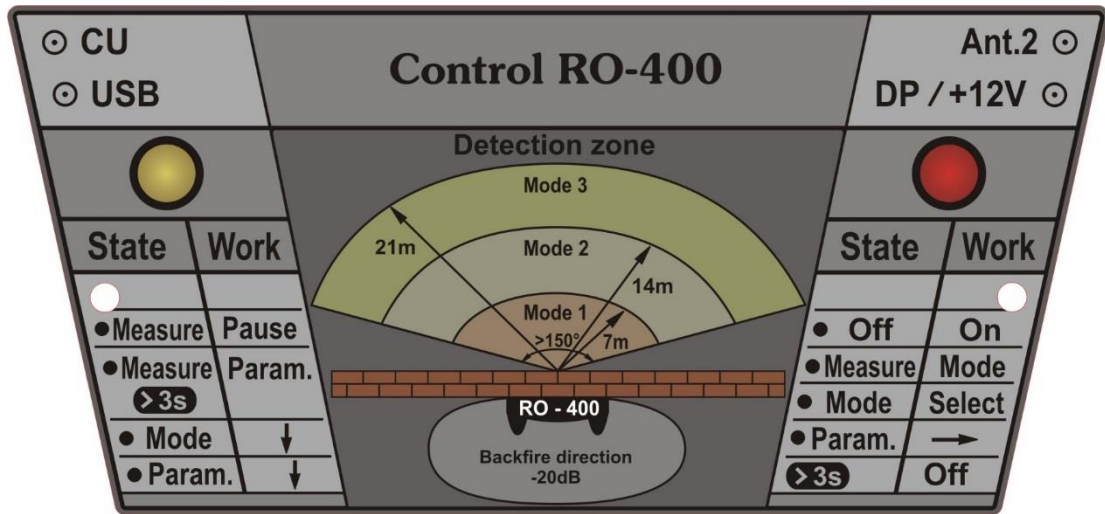


Fig. 5.12 scheme of the GPR-Detector modes control

Table 5.2. Designations and functions of GPR detector parameters in GPR mode

Sl. No.	Option	Function	Factory settings value
1	Contrast	Modifies visualization contrast of signals reflected.	16
2	Brightness	Adjust the Gadget backlight level depending on the ambient lighting	Day
3	Depth	the maximum depth of sounding in the GPR mode for search	6 m
4	Recording	The mode during which survey operations are carried out w/o the use of the odometer, and the travel distance is not recorded. This mode is used when sounding out in the terrain where the use of the odometer is impracticable. Record by the wheel. The mode is used for sounding on relatively even surfaces. At that, by means of the DP-32 odometer connected to the DP socket of the GPR-Detector the sounding results are correlated with the distance covered by the operator.	Continuously
5	Save data	Sounding and storing of its results in the GPR-Detector memory.	Without storage
6	Factory settings	Setting of the factory settings.	
7	Exit	Exit into the GPR mode with reset sounding parameters.	

5.6 GPR-Detector preparation for sounding

First you need to take the device and the additional antenna from the transport case. An additional antenna is designed to detect objects through obstacles to detect moving objects and display the detection results in 2D format. 1.5D surveying is performed without the additional antenna.



Fig. 0.13 ó GPR-Detector RO-400 2D with the additional antenna



Fig. 0.2 - Location of an additional antenna mount (pos.1) and electrical connector for connecting an additional antenna (pos.2)

To operate with an additional antenna, it is necessary to fasten the additional antenna in the bracket (Fig. 5.14, pos.1) and connect the electrical cable of the additional antenna to the connector, as shown in Fig. 5.14, pos.2

- The GPR-Detector with an additional antenna unit operates in the following sequence
1. fasten the additional antenna on the enclosure of the GPR-Detector
 2. connect the electrical cable of the additional antenna to the connector (Fig. 5.14, pos.2) on the GPD-Detector
 3. install a charged power supply unit into the GPD-Detector, as described above
 4. turn on the GPR-Detector by pressing the red button

- When you first turn on devices with an additional antenna, the mode of detection of moving objects in 2D format is displayed on the GPR-Detector's screen. The screen of RO-400 2D will display information as shown in Fig. 5.15. The results are displayed in the pseudo-3D format in the left half of the screen, and 1.5D in the right half (radarogram)

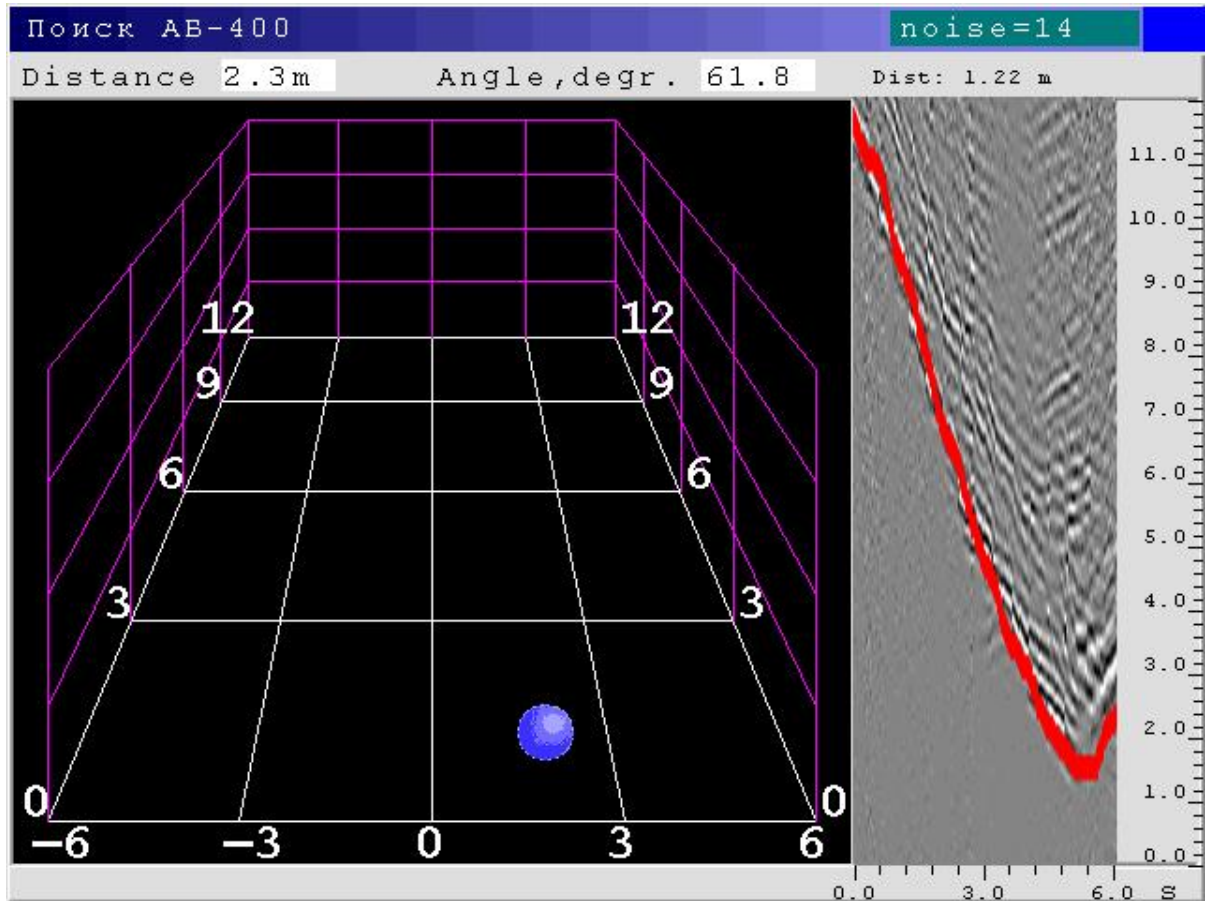


Fig. 0.3 6 GPR-Detector in 2D format

- In order to see the results in the 1.5D format, it is necessary (when the movement detection mode is running) open the settings menu and set the number 010 in the 'Number of channels' parameter (single-channel mode) and turn on the movement detection mode again, the picture (as shown in Fig. 5.16) will appear on the screen.

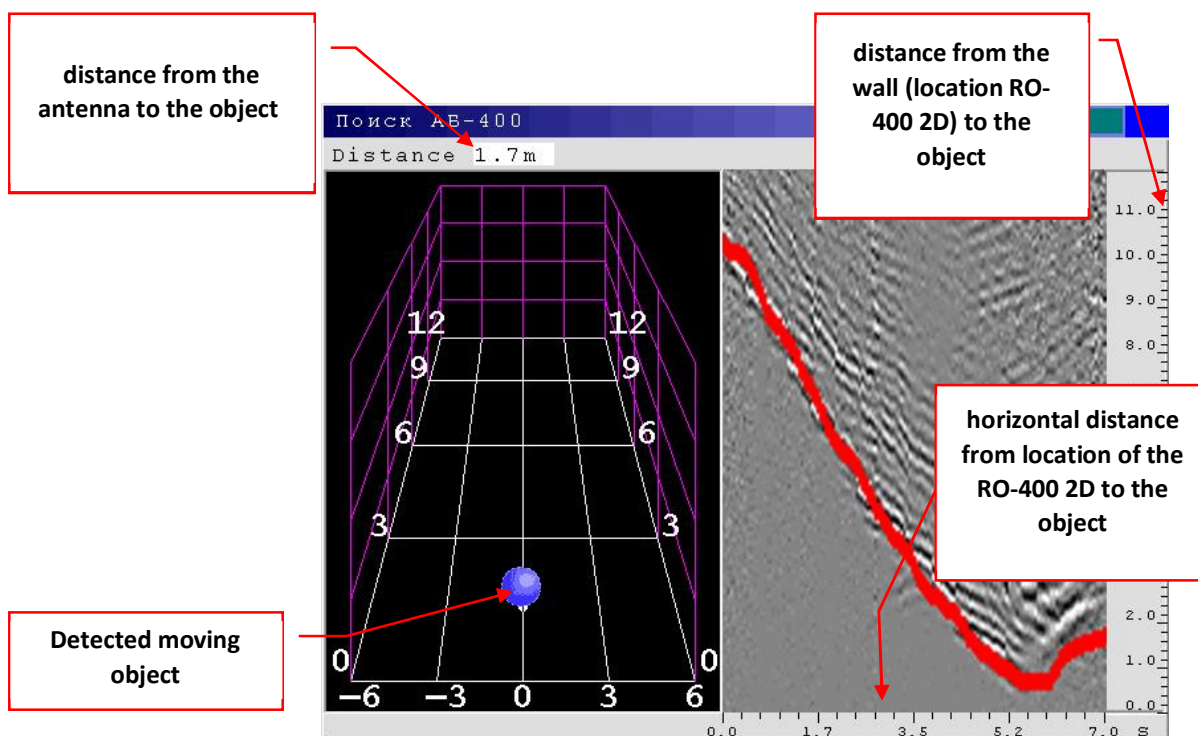


Fig. 0.4 - GPR-Detector in 1.5D format

To change the detection distance, you must exit the motion detection mode to the main menu and select the required distance, then turn on the detection mode again.

To operate the device in GPR mode, it is necessary to select the *Georadarö* option in the Main menu, but before that you need to prepare GPR-Detector for search operations as shown in Fig. 5.7.

Interpretation of the sounding results in motion detection mode and GPR mode is presented in Chapter 6 of this User Manual.

5.7 Sounding results recording on the tablet PC

The GPR-Detector provides the ability to record the sounding results, both in the detection mode and in the GPR mode, on a tablet PC that connects to the GPR-Detector via a Wi-Fi channel (Fig.5.17). Also it is possible to record the results in the mode of motion detection over the channel Wi-Fi when a GPR-Detector is connected to the radio modem with a cable (Fig.5.18).

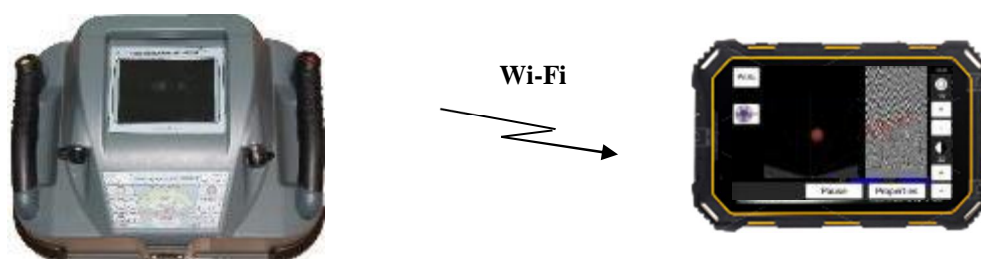


Fig. 0.5 - Connecting the GPR-Detector to the tablet PC via Wi-Fi

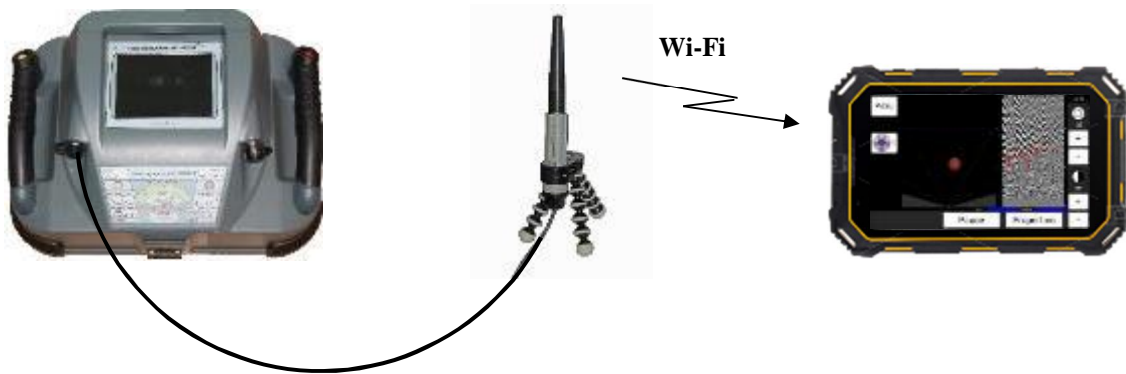


Fig. 0.6 - Connecting the GPR-Detector to the tablet PC via Wi-Fi using the radio modem

The "network" mode is also provided (Fig. 5.19). This mode is that the tablet PC (base) connects to the GPR-Detector via a Wi-Fi channel built into the GPR-Detector, and already other Tablet PCs (client's Tablet PC) can connect to this tablet PC (base) via this Wi-Fi channel. It is possible to view the results and control the settings from the client's tablet PC clients. However, one should always remember, that when a tablet PC (base) and GPR-Detector are disconnected, the client's Tablet will lose connection with the device. For simultaneous connection, achieve a stable connection with one of the devices (PC or tablet PC) to the GPR-Detector. After one device is connected to the GPR-Detector, you can run the program on other devices.

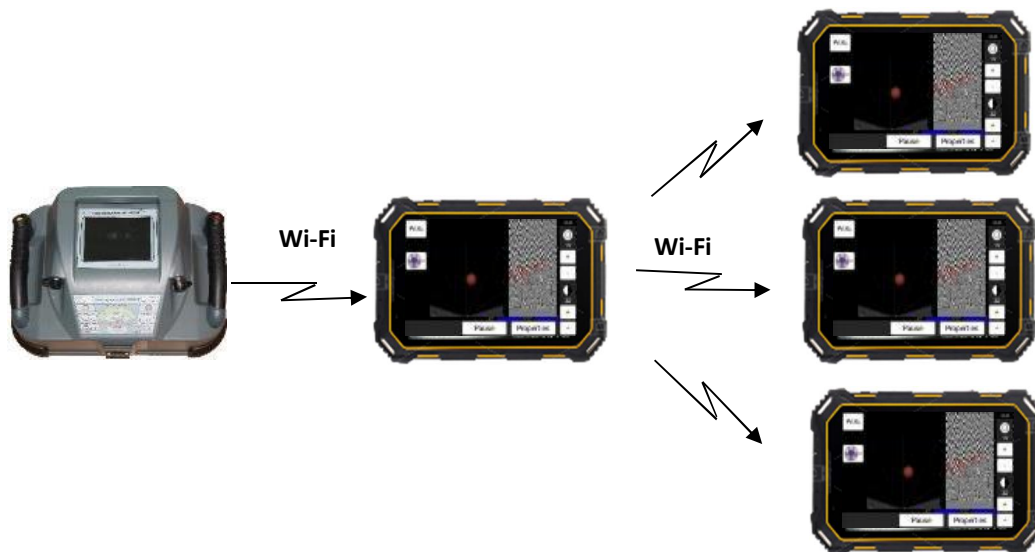


Fig. 0.7 - Connecting the GPR Detector to the tablet PCs via Wi-Fi in the "network" mode


In the client mode, it is possible:

- ÉChange the type of horn in 1.5D mode;
- ÉChange the number of detection channels in 2D mode;
- ÉRecord the radarogram to a disk;

When changing modes or parameters on the main tablet PC, these changes will automatically occur on client's tablet PCs.

To record the sounding to the tablet PC via Wi-Fi using the built-in Wi-Fi module of the GPR Detector, it is necessary:

- Éswitch on the GPR-Detector and the tablet PC;
- Éselect the option "Wi-Fi" in the Main menu of the GPR-Detector;


Édouble click  tag (õDetector.exeö) on a tablet PC desktop, run a program that allows you to monitor the sounding results on the tablet PC screen both in motion detection mode and in GPR mode;

Éafter starting the program, the tablet PC connects to the GPR-Detector via a Wi-Fi channel automatically.

To record the sounding results to the tablet PC via Wi-Fi using the radio modem, it is necessary:

Éswitch on the GPR Detector and the tablet PC;

Éconnect the radio modem to the GPR-Detector directly to the connector of the Ethernet cable or through an extension pole;

Édouble click  tag (õDetector.exeö) on the tablet PC desktop, run a program that allows you to monitor the sounding results on the tablet PC;

Éafter starting the program, the tablet PC connects to the GPR-Detector via a Wi-Fi channel automatically.

The õDetector 2Dö program can work with the GPR-Detector both in the õGPRö mode (Fig. 5.20) and in the õDetectorö mode (Fig. 5.22).



Fig. 0.8 - The program õ Detector» (2D motion detection mode)

Control buttons of the main window:

1. Mode switching (GPR/Detector)
2. The choice of distance (depth)
3. Markers on radarogram
4. Screenshot
5. Menu «Parameters»
6. «Pause»
7. Record radarograms to the file
8. Viewer_GPR_File
9. Brightness
10. Contrast

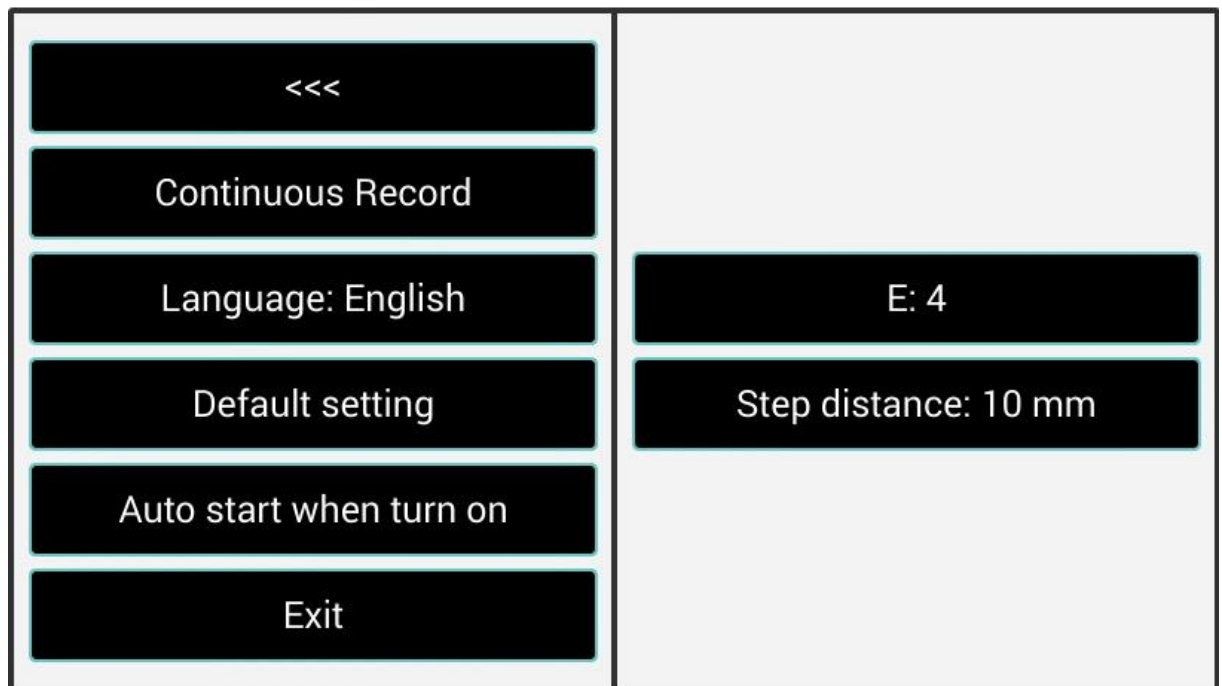


Fig. 0.9 - Menu «GPR parameters»

Table 5.3

/	Option	Function	Factory settings
1	Continuous recording	For operations without the odometer, the "Continuous" mode is selected. The distance is not recorded. This mode is used where it is impossible to apply the odometer. For survey with relation of results to the length of the surveyed area, the "By wheel" mode is selected. The odometer is connected to the "DP" connector of the GRP-Detector. The "step by step" mode is used if there is no possibility to carry out continuous scanning.	Continuously
2	Language	Russian English Chinese Vietnamese	Russian
3		epsilon (dielectric constant of environment)	4
4	The step	Sets the move step when recording in steps	10 mm
5	Factory settings	Setting of the factory settings.	

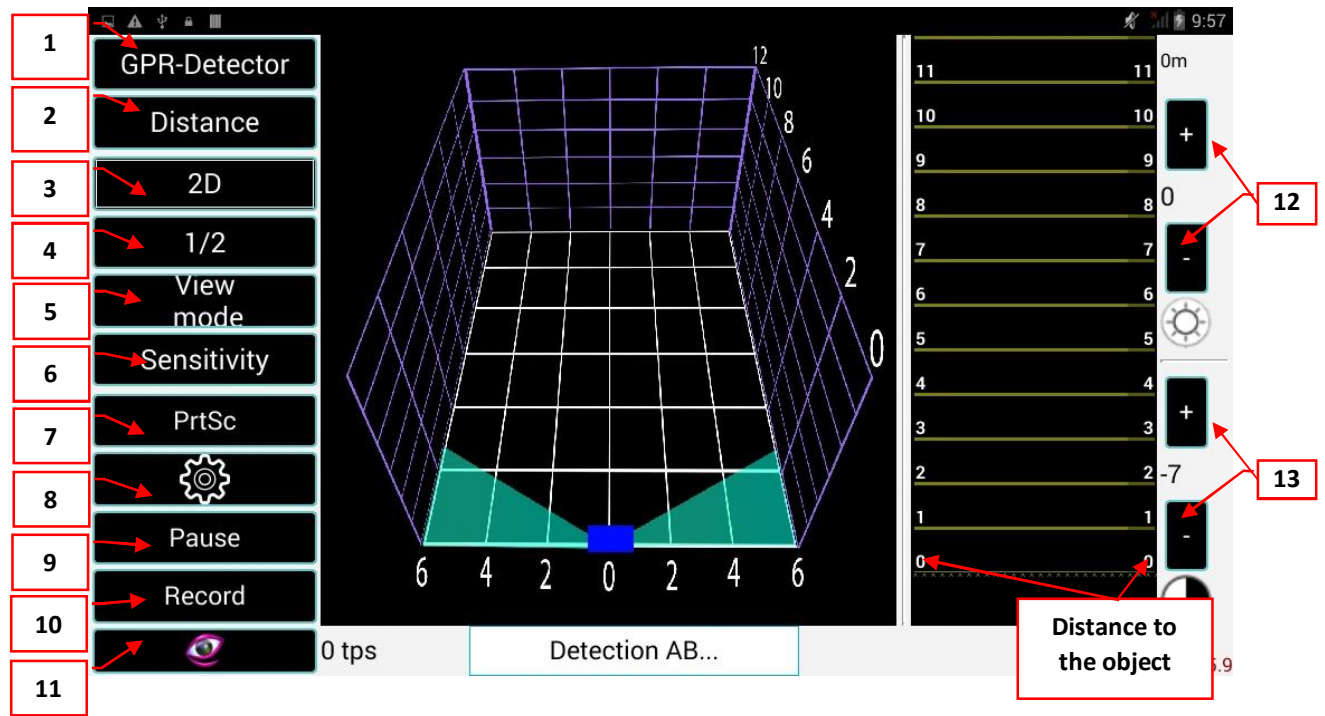


Fig. 0.10 6 The mode 6Detector6 (there are no moving objects)

Control buttons of the main window:

1. Mode switching (GPR/Detector)
2. The choice of distance
3. Switching detection mode (2D/1.5D)
4. Display of 1 or 2 channels
5. Switching display modes (2D/pseudo 3D)
6. Sensitivity
7. Screenshot
8. Parametres»
9. «pause»
10. Record radarograms to the file
11. Viewer GPR File
12. Brightness
13. Contrast

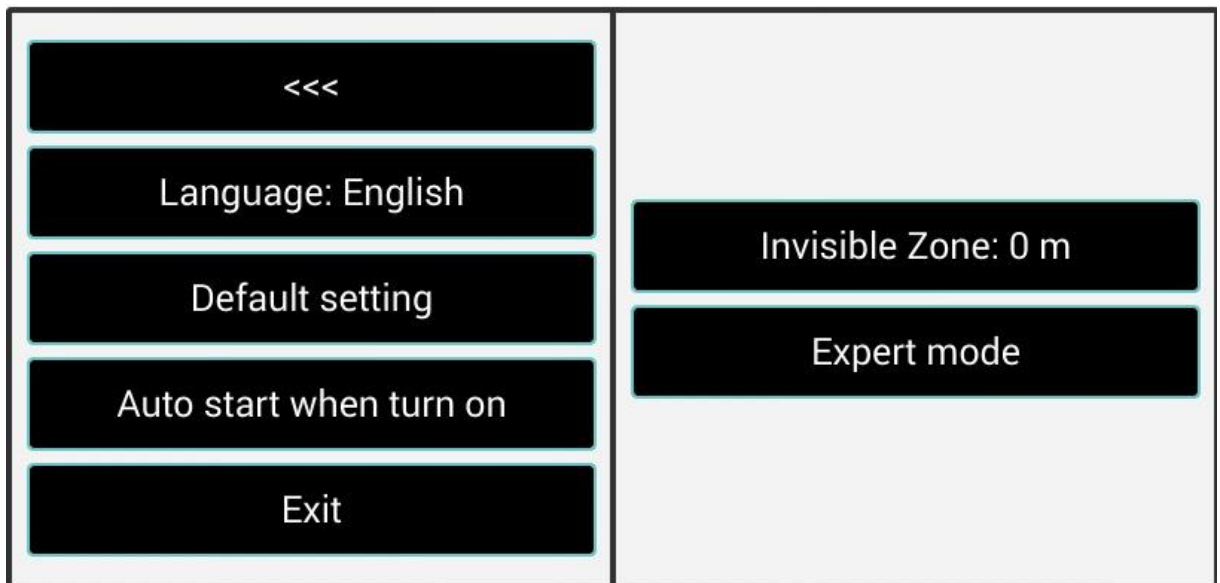


Fig. 0.11 - Menu «Parametres»

Table 5.4 - Functions Adjustable by the Parameter Operator in Detector Mode

/	Option	Function	Factory setting
1	Detector	Mode switching (GPR or Detector)	GPR
2	Language	The choice of language	Russian
3	Factory settings	Factory setting	
4	Invisible zone, m	The area, where moving objects cannot be found	0
5	Display	Display the number of channels in 2D mode: 2D: Channel 1 - the right field - the detection of radarogram of the main antenna: 2 channels - the right field - two radargrams of the main antenna and an additional antenna	1

The view of the program window when displaying the sounding results by movement in the 1.5D format is presented in Fig. 5.24. When a moving object is detected, the man moves relative to the central axis by a distance where the detected moving object is located relative to the location of the GPR-Detector

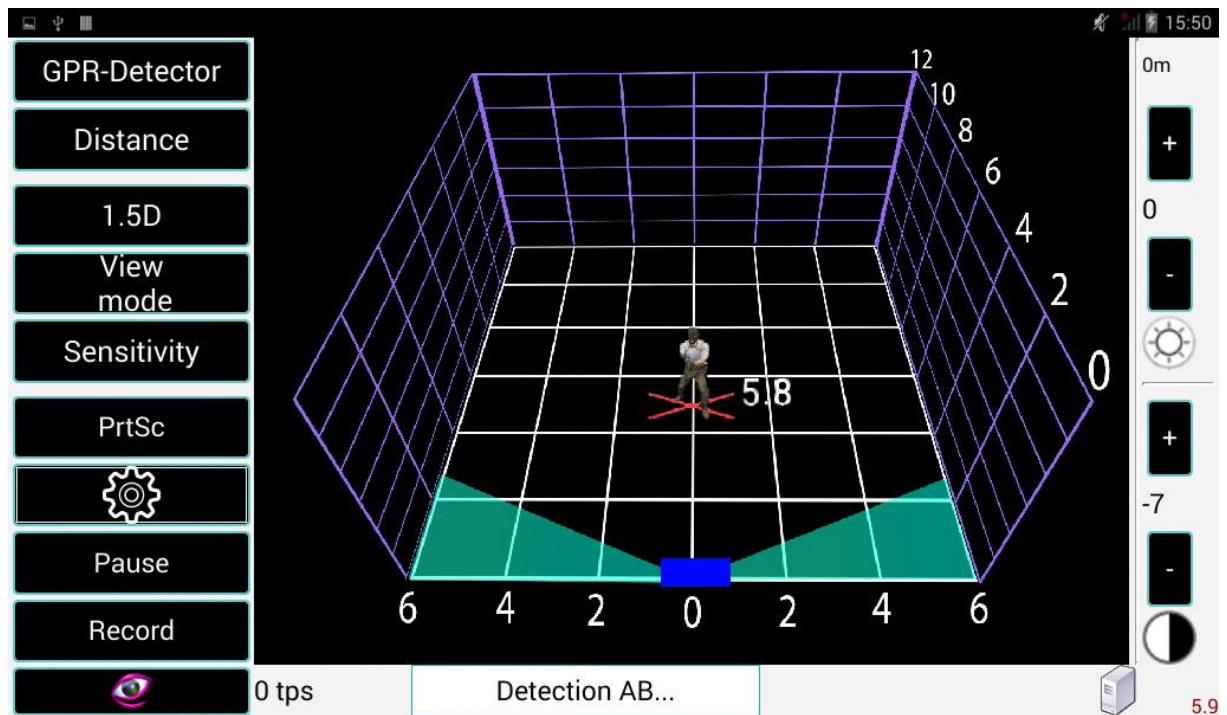


Fig. 0.12 ó The program ò Detector» (1.5D motion detection mode)

The GPR-Detector detects living objects not only by movement, but also non-moving living objects by breathing. Breath detection mode works in both 1.5D format and 2D format. If the device detects non-moving living objects, a blue line appears on the screen at the distance from the GPR-Detector to the detected object. In the 1.5D mode, the device can detect the living objects both in breathing and in movement at the same time, BUT The moving object must be farther from the GPR-Detector than the breathing one (Fig. 5.25, Fig. 5.26). In Fig. Figure 5.27 shows the program window in 2D detection mode.

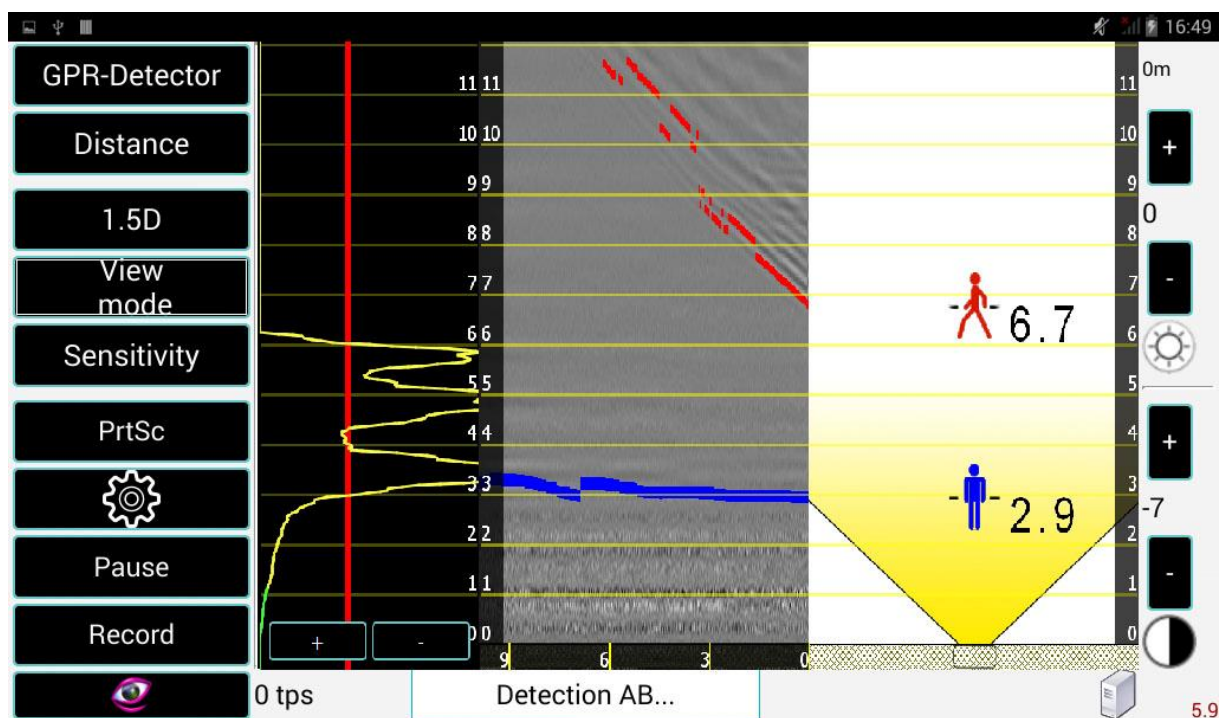


Fig. 0.13 - Simultaneous detection of objects by breathing (2.9 m) and by movement (6.7 m) in 1.5D format (view 1)

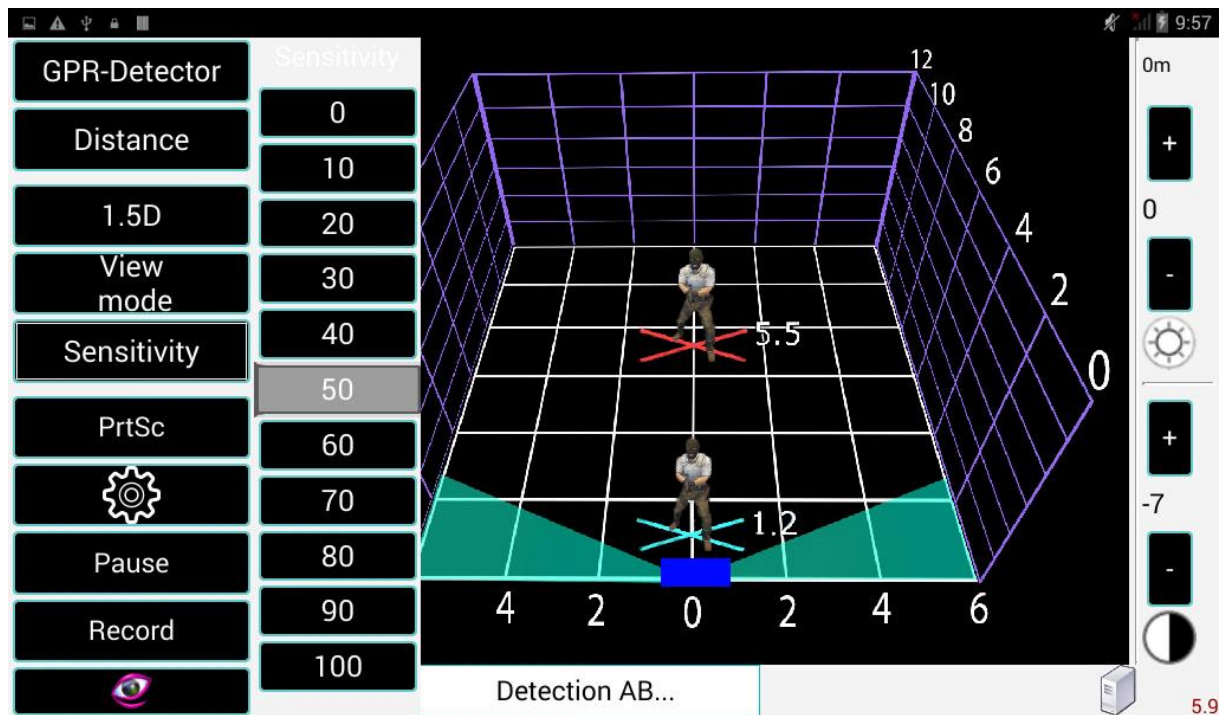


Fig.5.26 simultaneous detection of objects by breathing (1.2m) and by movement (5.5m) in 1.5D format (view 1)

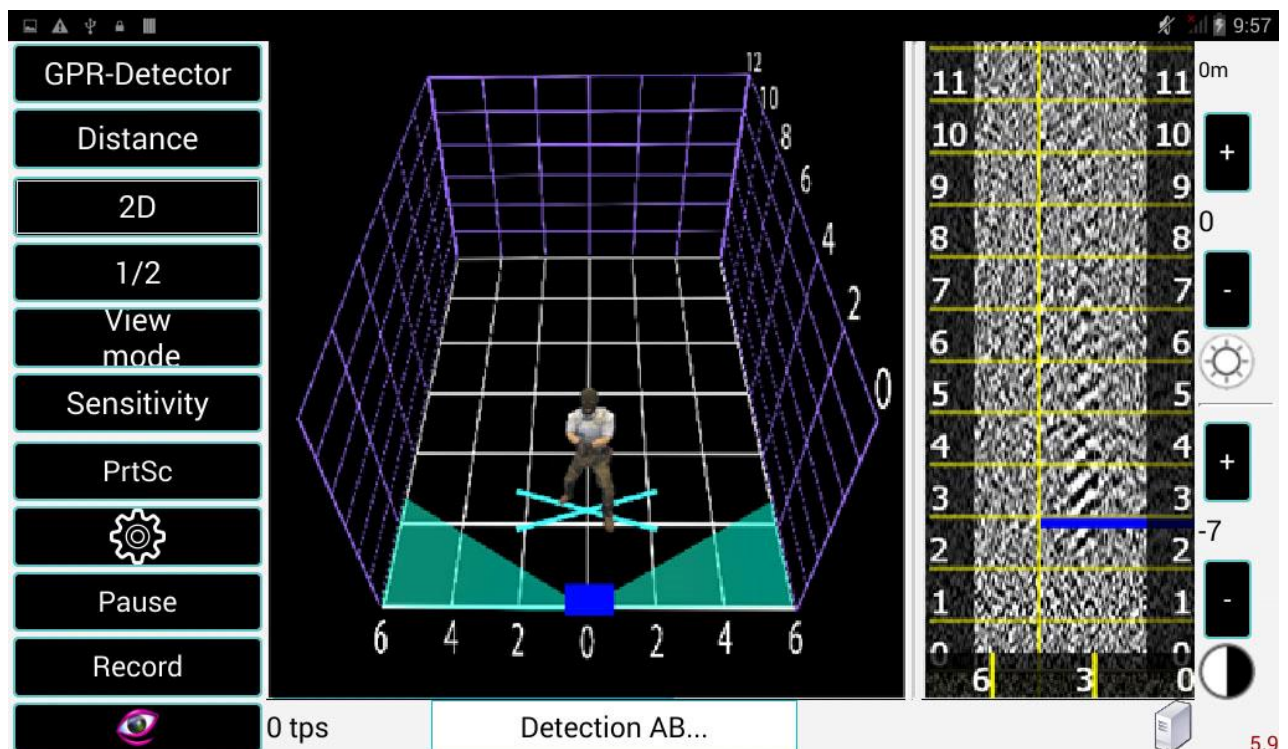


Fig.5.27 - Program ȃDetectorȃ in motion detection mode (by breathing) in 2D

5.8 Sounding results copying to a PC (laptop)

There is a provision to save the sounding results both in moving objects detection mode and GPR mode.

When you click on the "record" button, two files will be recorded in the following formats:

ÉGPR2 - for further processing and viewing in the GeoScan32 program;

ÉGPRX2 - for viewing in the òDetectorö program.

Saved files can be copied to a laptop as well, the files with *.gpr2 and *.gprx2 available in the laptop memory can be copied to the GPR-Detector memory. To copy the saved files from the GPR-Detector to a laptop, do the following:

- switch on the laptop;
- switch on the GPR-Detector
- connect the laptop to the GPR-Detector by USB cable (see Fig. 5.28);

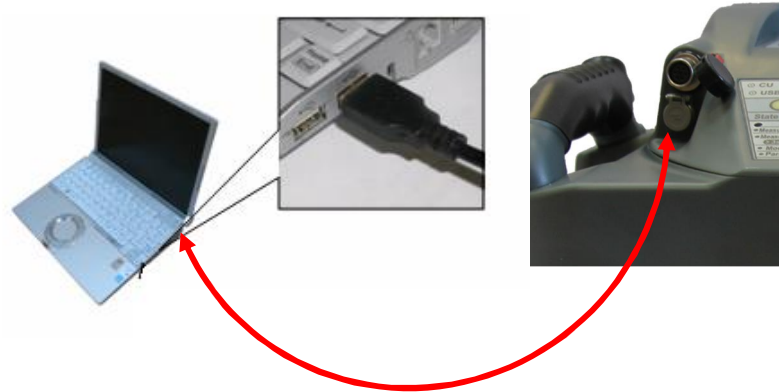



Fig. 5.28 GPR Detector and laptop connection to copy the saved files

- open òMy computerö folder (the GPR detector is found as a removable disk). Then the files copy process is similar to that for any USB storage device. Copied files are viewed and processed using the GeoScan32 program.

You can also view the results (detection mode) not only through the GeoScan32 program on the PC, but also through the viewer program on the tablet PC.

To open the viewer program, click the button on the tablet screen . The program is similar to most video players (Fig. 5.29, Fig. 5.30).

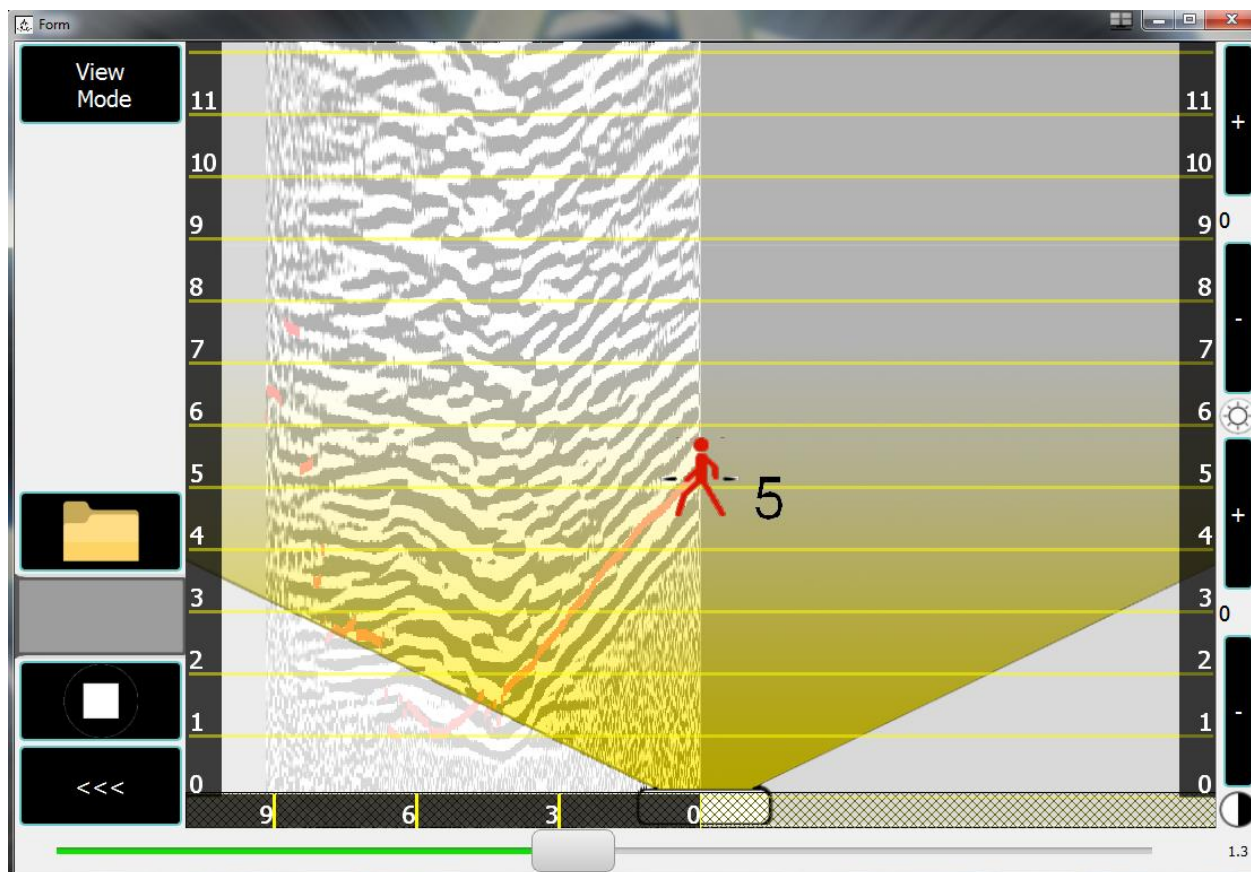


Fig. 0.14 ó File viewer *.gprx2 (view 1)

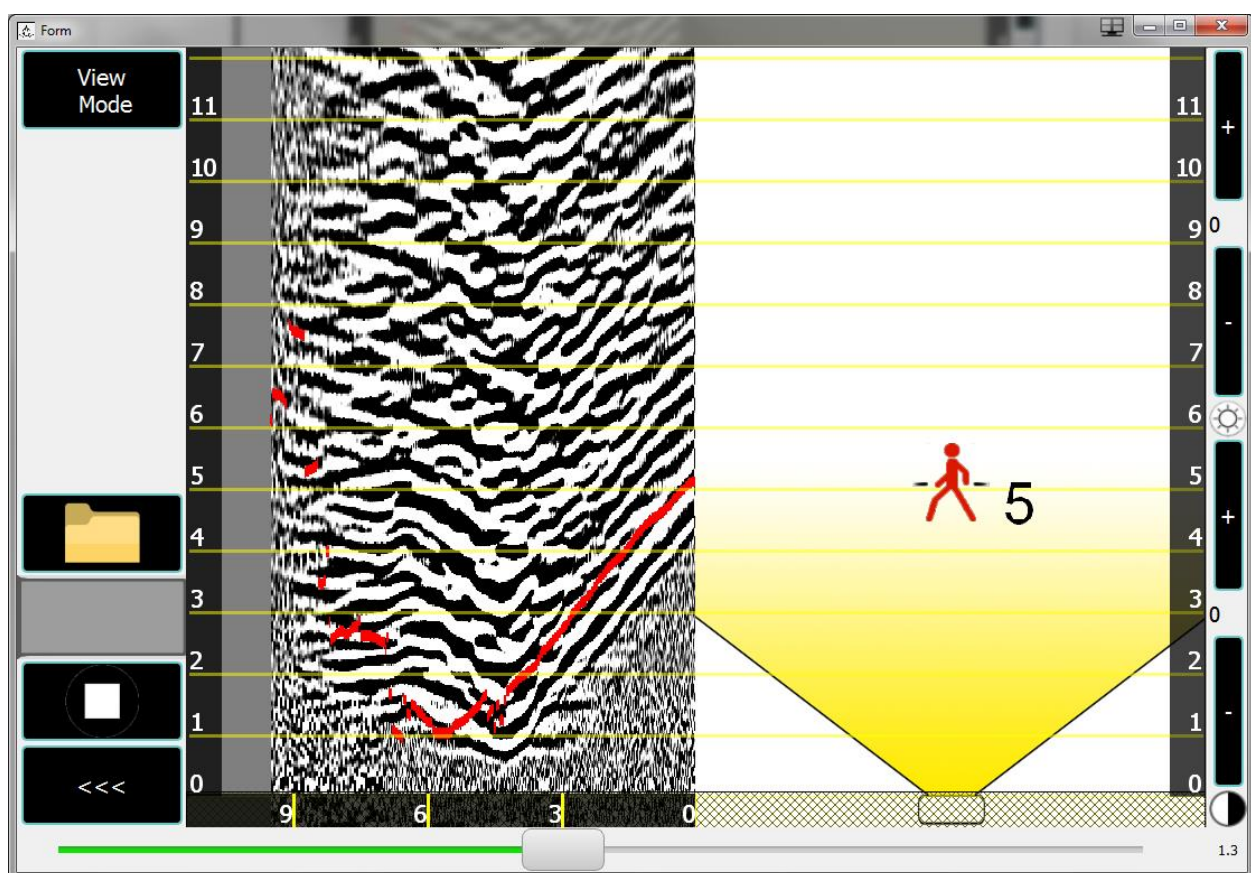







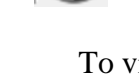


Fig. 0.15 ó File viewer *.gprx2 (view 2)

Control buttons in the GPRX2_viewer (detection mode)

-  - File selection and opening (*.gprx2). Playback will start automatically immediately after opening the file.
-  - Start playback
-  - Pause playback
-  - Stop playback
-  - Fast forward / rewind playback file
-  - Switching the playback file
-  - Brightness change («+» and «-»).
-  - contrast change («+» and «-»).

To view the *.gpr2 files (GPR mode) open a viewer program by pressing a button (Fig. 5.31).

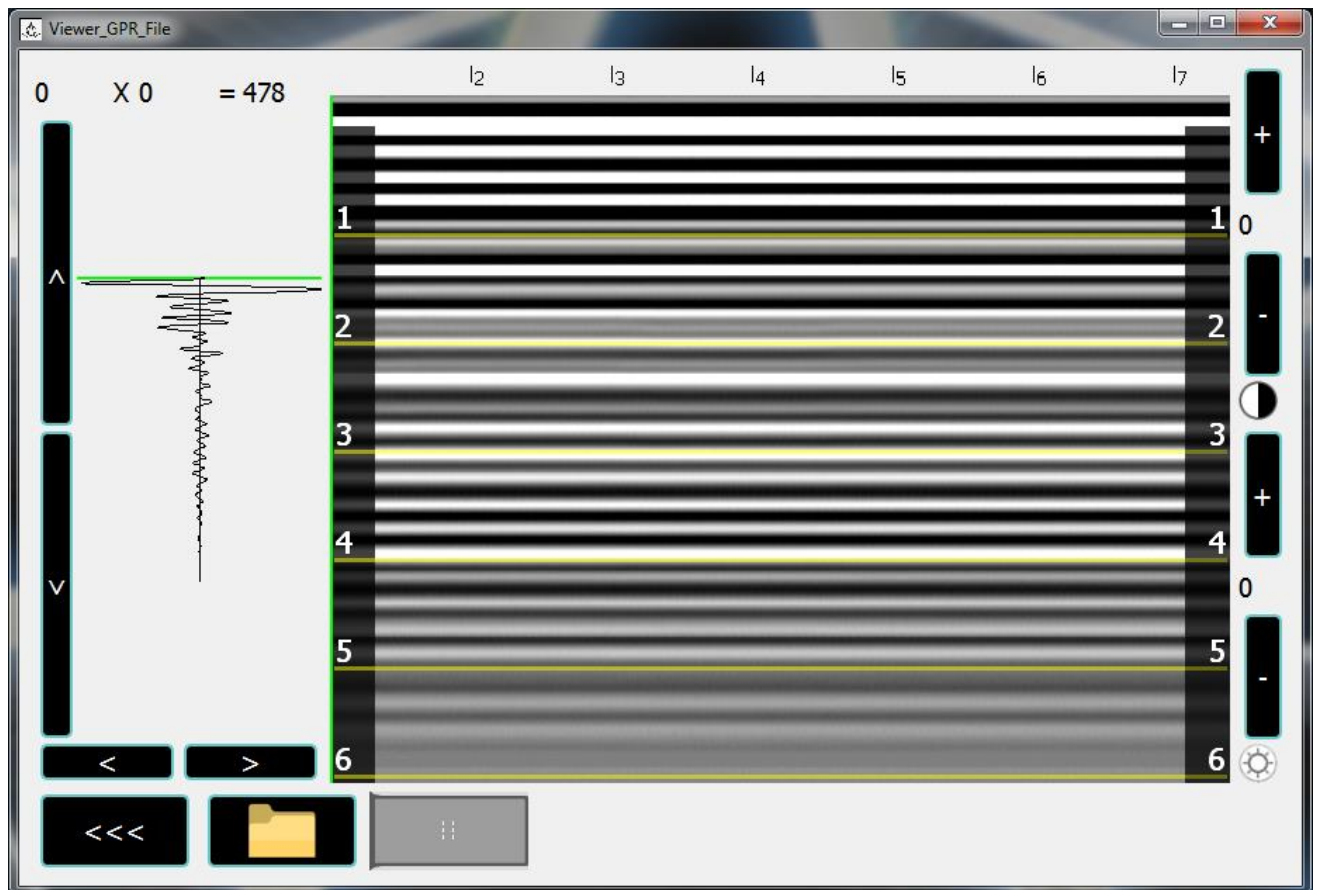





Fig. 0.16 - File viewer *.gpr2

-  - File selection and opening (*.gprx2). Playback will start automatically immediately after opening the file.
-  - Show / do not show markers
-  - Moving around the tracks



- Moving around the track points
- Brightness change («+» and «-»)..
- contrast change («+» and «-»).

6. Interpretation of the GPR-Detector sounding results.

6.1 Interpretation of the sounding results in the GPR mode

Local object on the radargrams obtained during the sounding in the GPR mode can be detected based on their echo signals both on a real time basis and in the postprocessing of the saved files. Signals reflected from the detected objects are imaged in the radargrams depending on how the antenna unit travels against the object axis during the sounding. When the antenna unit travels either normal to the object axis or at an acute angle, the object is imaged as an isolated hyperbola (fig. 6.1). When the antenna unit travels along the object axis, the image of echo signals on the processing and indicating unit screen will be as shown in fig. 6.2. If the antenna moves along the axis of extended object (pipe, cable), there is a good likelihood that that the operator can skip or overlook the object.

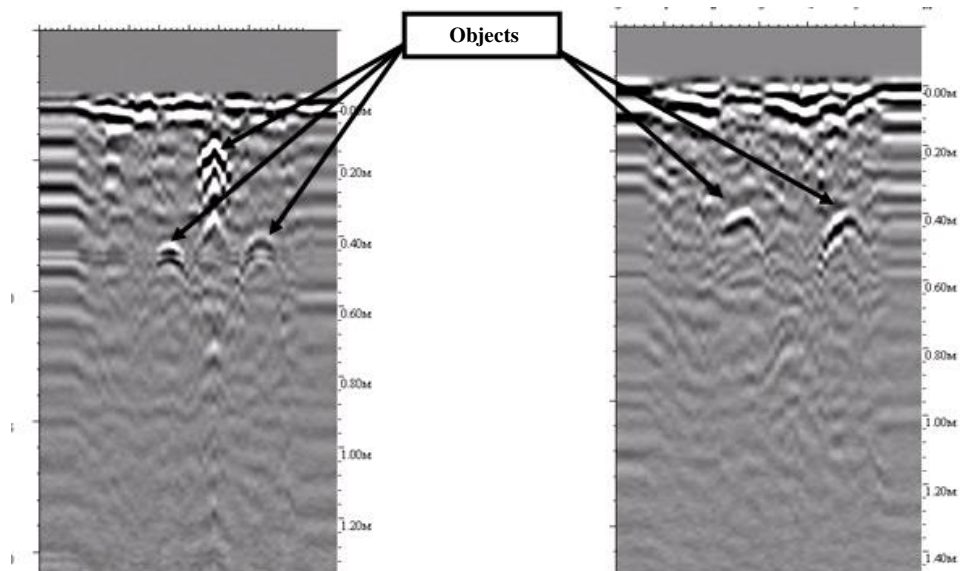


Fig.6.1 Radargrams of the objects detection in the GPR mode when moving the monoblock square with the object axes

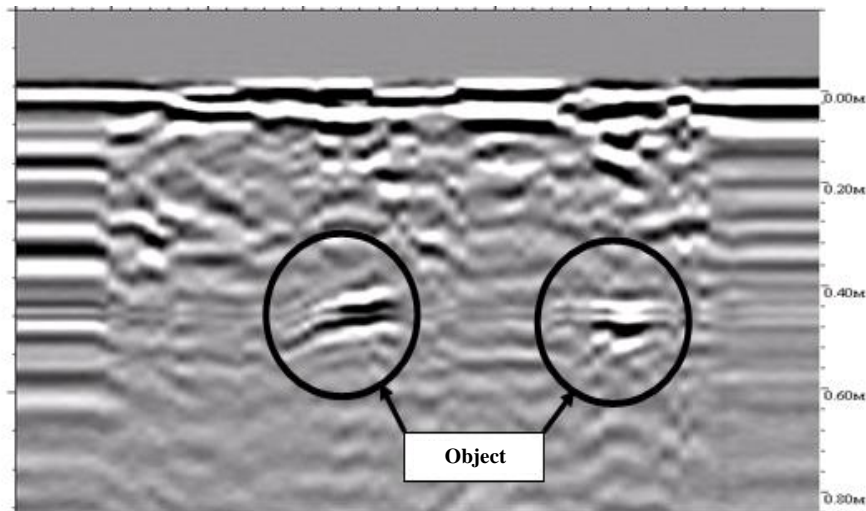


Fig.6.2 Radargrams of the objects detection when the monoblock passing along the object axis

The GPR detector in the GPR mode allows detecting not only the objects but also voids and hideouts. Fig. 6.3 shows radargrams of voids (hideouts) detection:

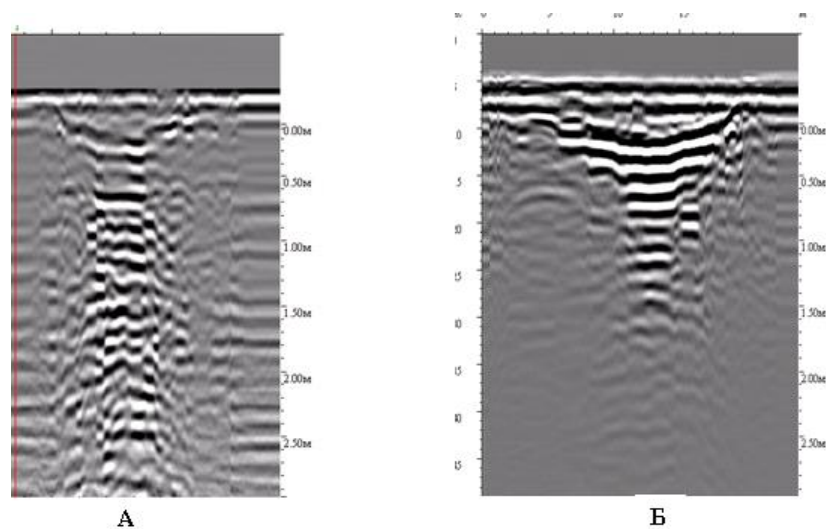


Fig.6.3 Detection of the concrete tunnel (A) and ground hideout (B)

6.2. Interpretation of sounding results in detection mode of the moving and non-moving objects

The sounding results are displayed on the monitor of monoblock or the tablet PC in real time. Imaging of the sounding results on the monitor screens is right to left.

The sounding are filled with red markers. The distance from the device to moving object behind the wall can be determined against the distances scale. The operator can see the object movement direction (whether the object is moving away or approaching the device) and determine the number of moving objects.

The GPR-Detector program allows you to detect living objects not only by movement, but also by breathing. If the "Detection by breathing" option is activated in the "Detector parameters", then in case of detection of a stationary object a blue line is displayed on the device's screen. Blue line is displayed at a distance from the detected object to the GPR-Detector.

Detection by breathing is possible in 1.5D and 2D mode. In 2D mode, if an object is detected, a breathing is drawn (blue line) in the area of channel 1, which displays the results of detection in the 1.5D mode window.

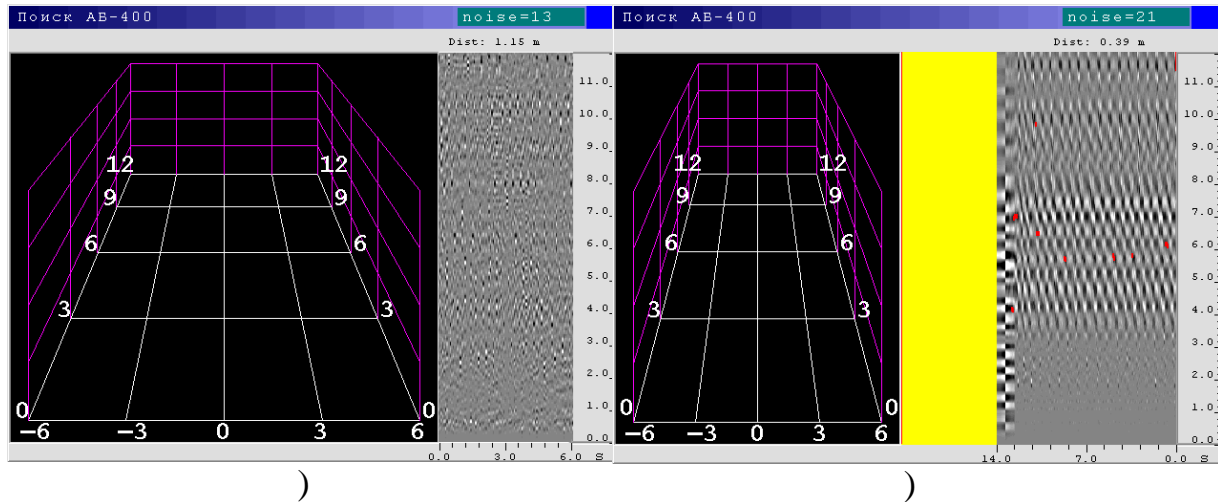


Fig. 0.1 ó There are no objects (ó two channel mode; ó Two channel mode with the breathing graphs

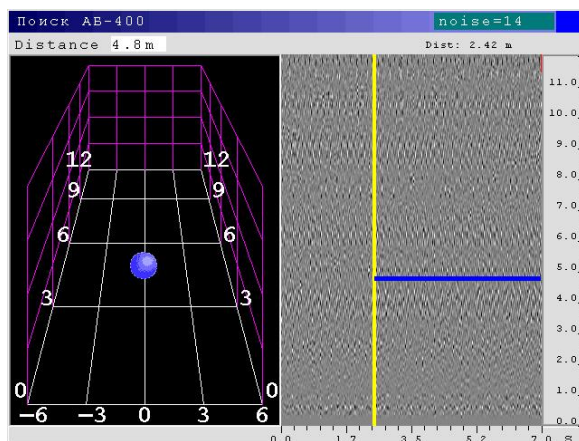


Fig. 0.2 ó detection by breathing" (single channel mode)

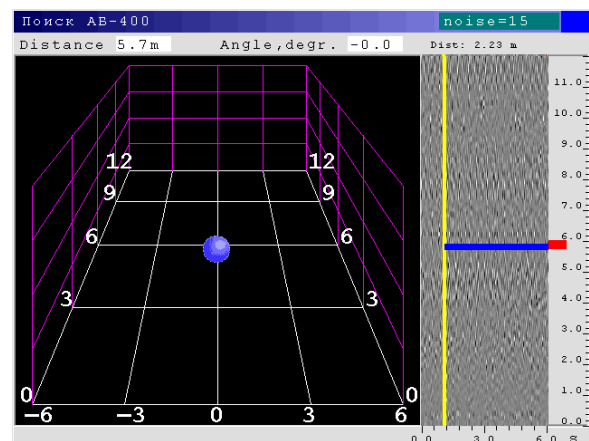


Fig. 0.3 - detection by breathing " (two channel mode)

Fig. 6.7 shows the sounding results with the detection of an object by breathing when displaying a breathing graph. The breath graph shows the level of the breath signal at each point in the distance. But please notice

- after switching on the device, before the first breath detection cycle, the yellow field of the graph remains empty (Fig. 6.4, b)
- breath graph begins to appear in the yellow field after the first breath detection cycle
- if after detection by breathing the object begins to move, the graph will remain unchanged, and will be updated only with a new detection by breathing

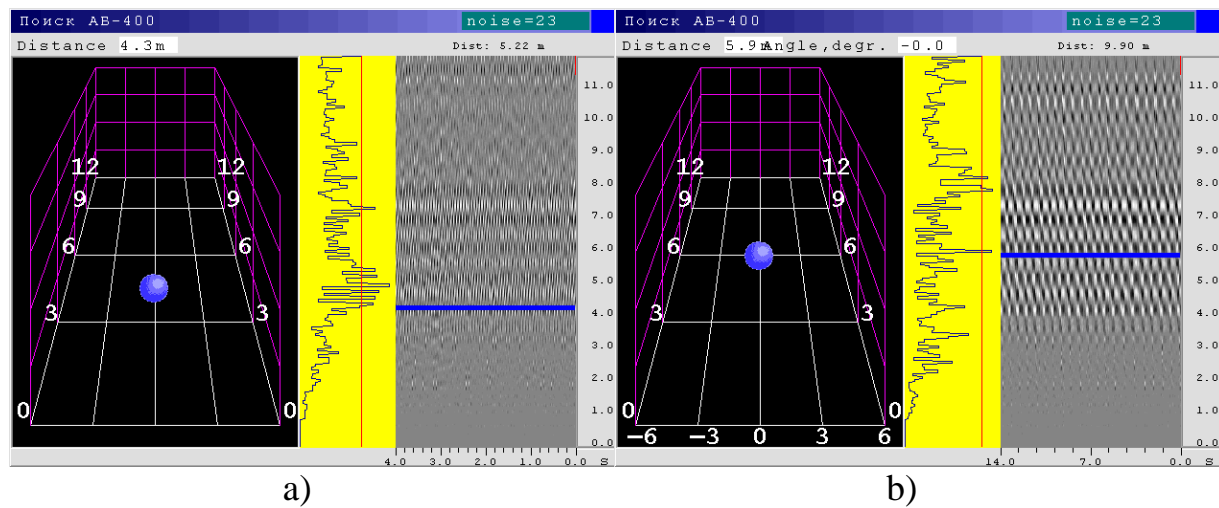


Fig. 0.4 ó Detection by breathing (a ó single channel mode; b ó two channel mode)

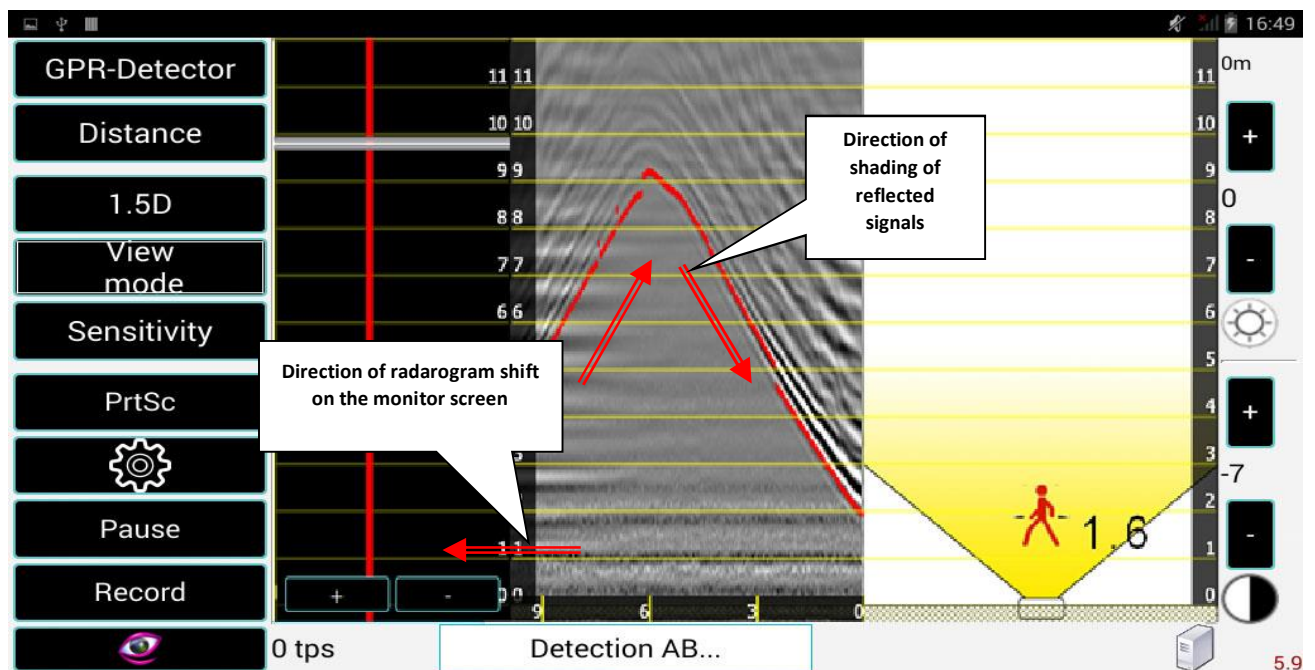


Fig. 0.5 - First, the object moved away from the GPR-Detector, and then went up to 1.6 m to the radar (1.5D mode)

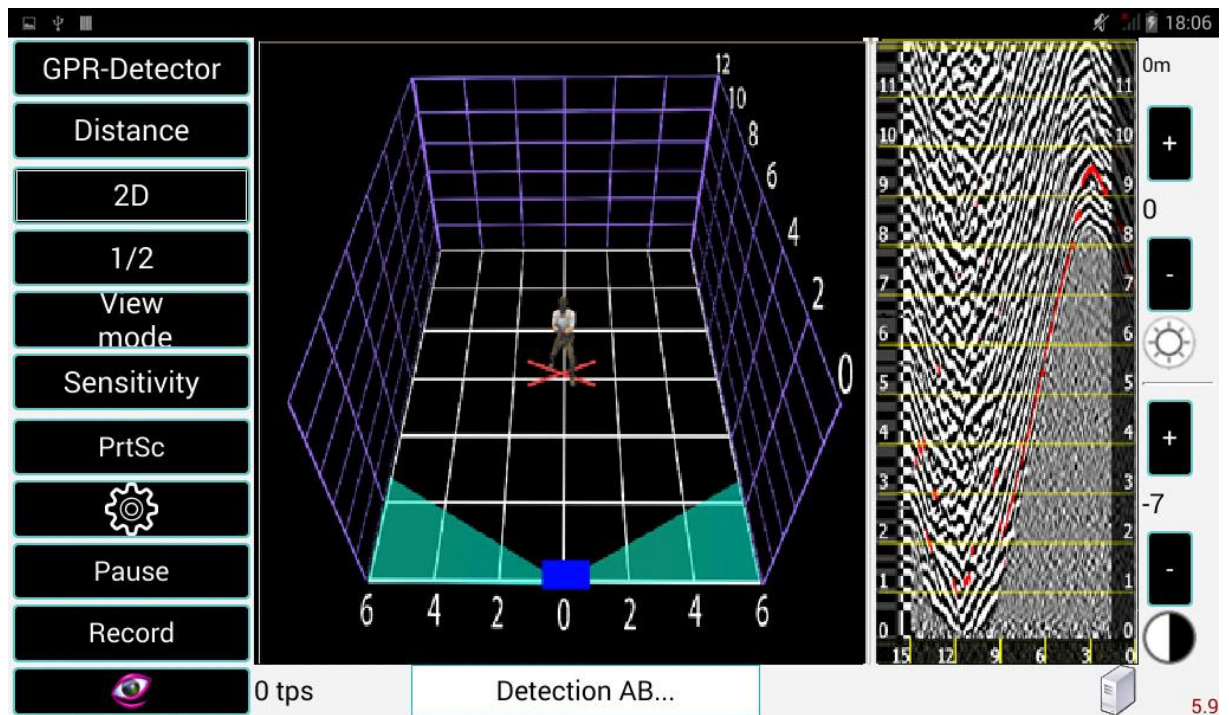


Fig. 0.6 - The object approached the GPR-Detector and then moved away from it (2D mode)

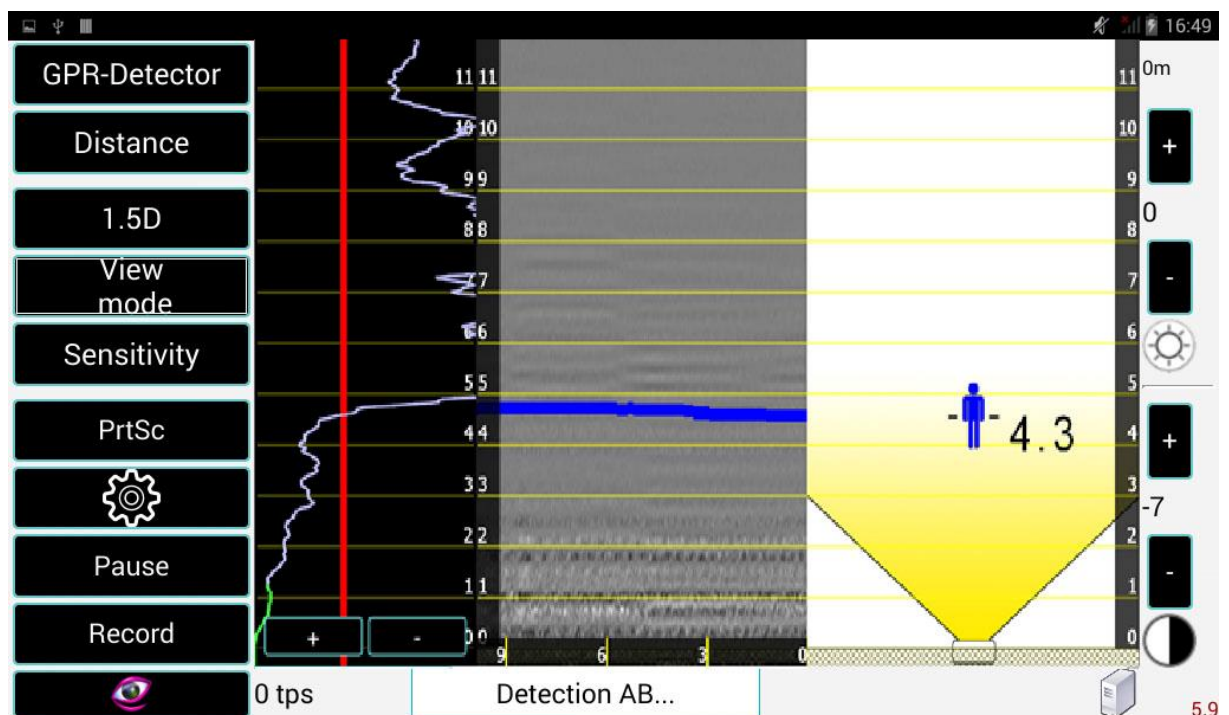


Fig. 0.7 - Detection of the object by breathing at a distance of 4.3m (1.5D mode)

7. General guidelines

The technical maintenance of the device includes preventive operations with the aim to keep it in working order and provide normal operation within its service life (7 years).

Recommended periodicity and types of preventive operations (scheduled maintenance):

External examination of prior to every operation of there should not be any damages beyond repair on device body and connection cables, i.e. insulation faults, cracks etc;

External cleaning of quarterly of removal of soil from the device surface and detachable connections;

Charging of BP- 3,8/12 storage batteries from accessories set of at least quarterly, inclusive of the power supply from SPTA-0 set which is put to operation when the need arises.

8. Requirements on safe operation and electromagnetic compatibility

It is prohibited to immerse antenna units into water or any other liquids.

During the device operation and transportation, strong impacts and mechanical damages should be avoided.

This device creates no electromagnetic interference above the allowed level.

9. Technical maintenance

During the device external condition examination, there should be a check of paint coating condition, absence of chipping and cracks on fiberglass and plastic items and painted parts.

Charging of BP- 3,8/12 storage batteries should be carried out in case of voltage reduction to 10½ V at least quarterly.

Safety directions:

- Use the charger for BP- 3,8/12 power supply units storage batteries charging only.
- Use the device indoors only.
- Do not plug in if the device body or plug is damaged.
- Disconnect the device when not in use.
- After charging the power supply sources, do not leave the charger plugged in as this may result in its failure.

To avoid failure of the power supply sources and to increase their service life, strictly observe their connecting order when charging.

10. Repairs

The running repairs are done by the manufacturer. To carry out running repair, the faulty device unit should be sent to the manufacturer with detailed description of revealed faults. If the faulty unit cannot be isolated, the whole device should be sent to repair.

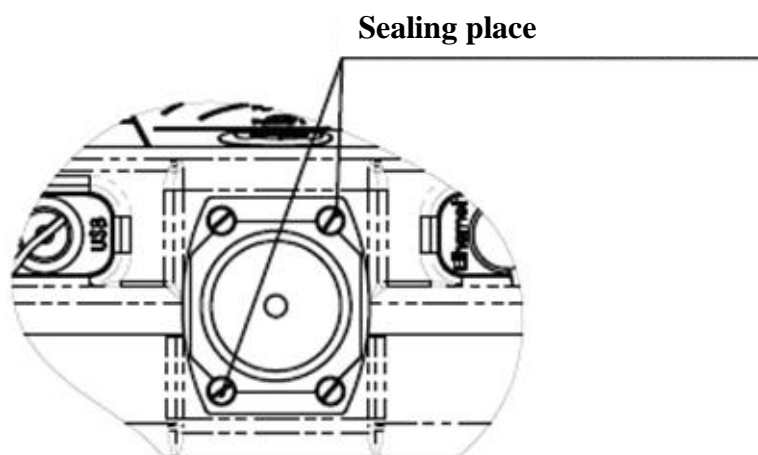
11. Transportation

The device transportation is performed by any transport means at any distance in the original manufacturer's packaging and subject to observance the following rules:

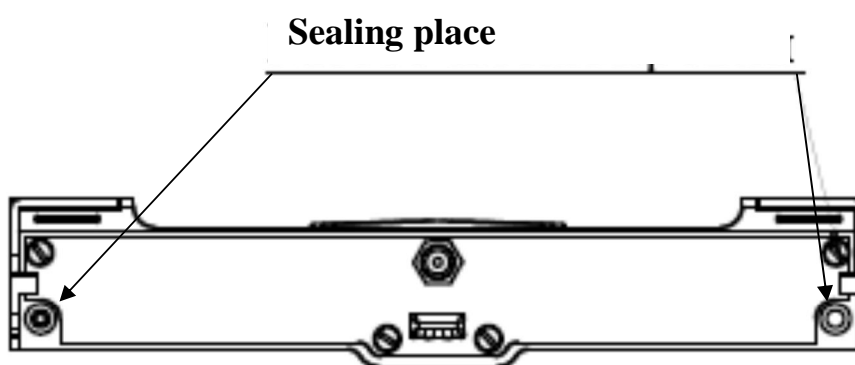
1. the device transportation should be performed in closed transport: railway cars, containers, closed motor cars, if no traces of cement, chemicals etc found in it. When transporting by plane, the devices should be located in pressurized compartment.

2. ambient air temperature during the transportation should be between -30° to +50° , pressure 84 to 106.7 P (630-800 mm of mercury).
3. Layout and anchoring of the boxes with the devices on the transport means should ensure stable position during the travel, absence of dislocation and mutual impacts.
4. When handling, the tare inscription requirements should be observed.

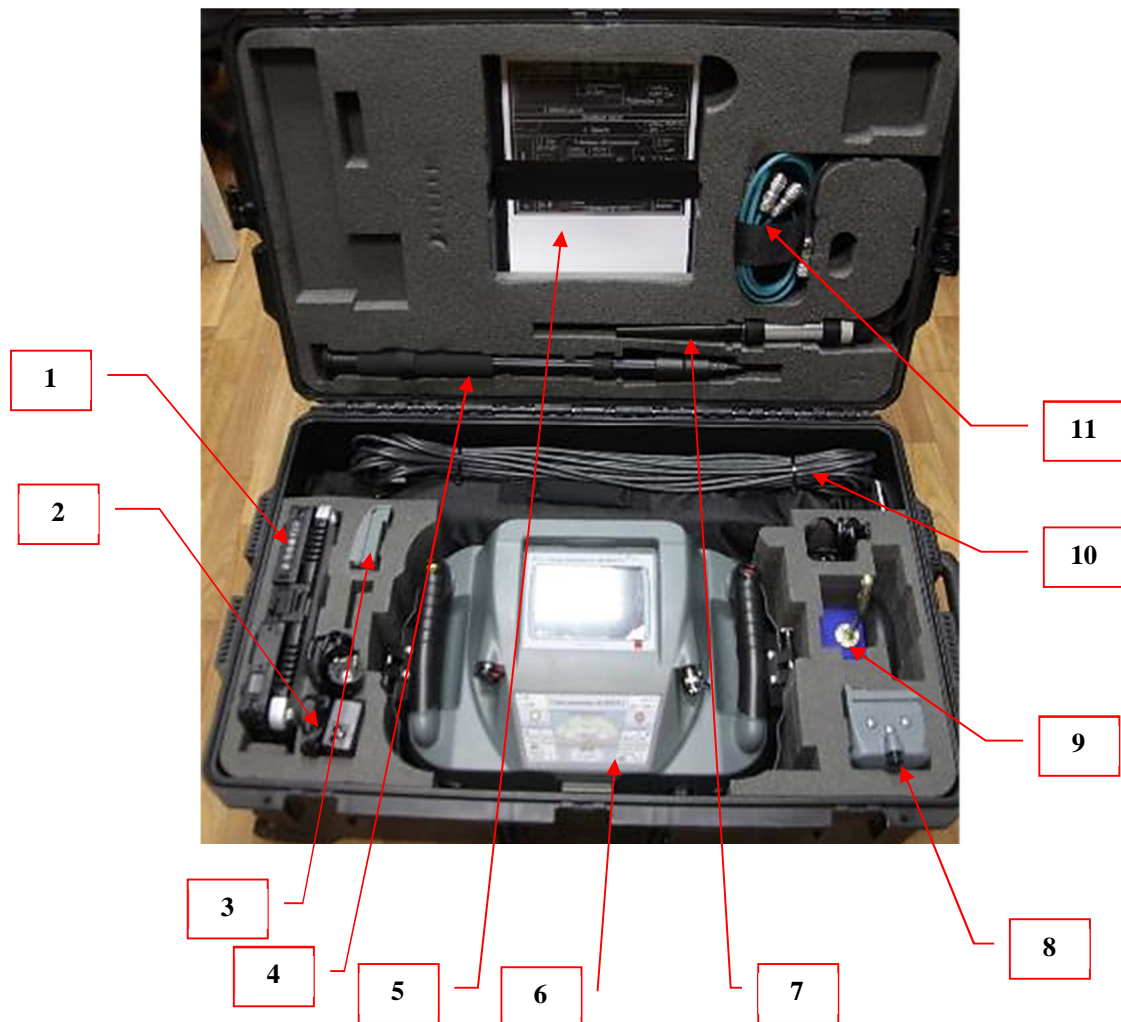
Annex 1. GPR detector sealing places



GPR detector sealing place



**BP 3,8/12 power supply unit
sealing place**

Annex 2. Placing of the complete set of the GPR-Detector in a special case**View 1**

1. Tablet PC
2. DP-CN cable
3. BP-3,8/12
4. Handle bar
5. User's Manual
6. GPR - Detector
7. Wireless router
8. Cassette for batteries
9. DP-32 D movement sensor
10. Tripod for wireless router

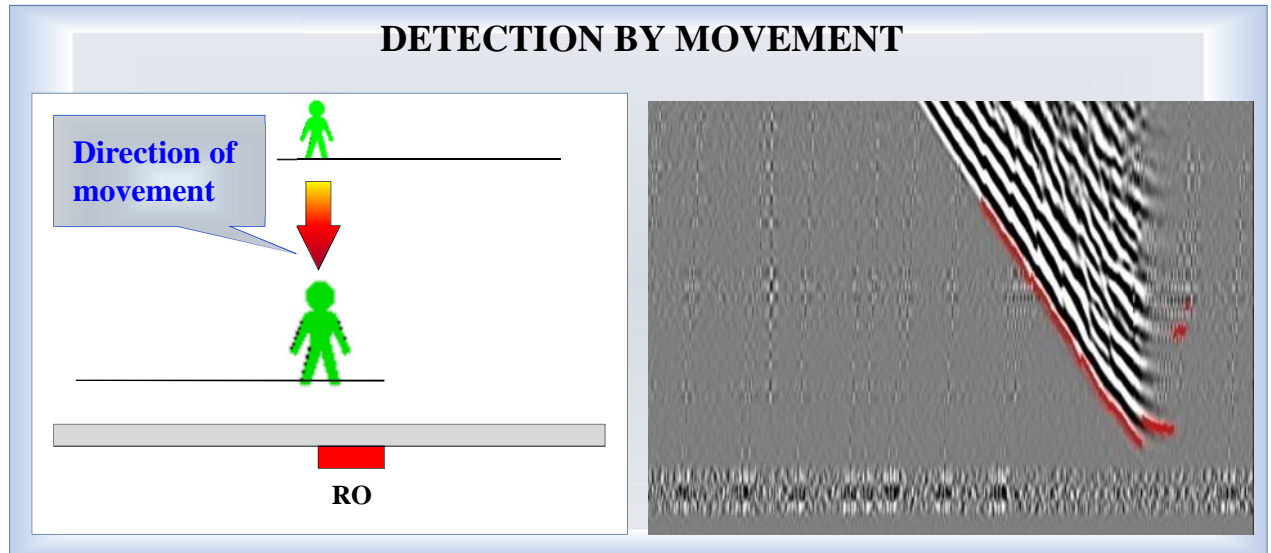
View 2



- 11. Tripod
- 12. Additional antenna
- 13. USB Cable
- 14. ZU-9 charger

APPENDIX B

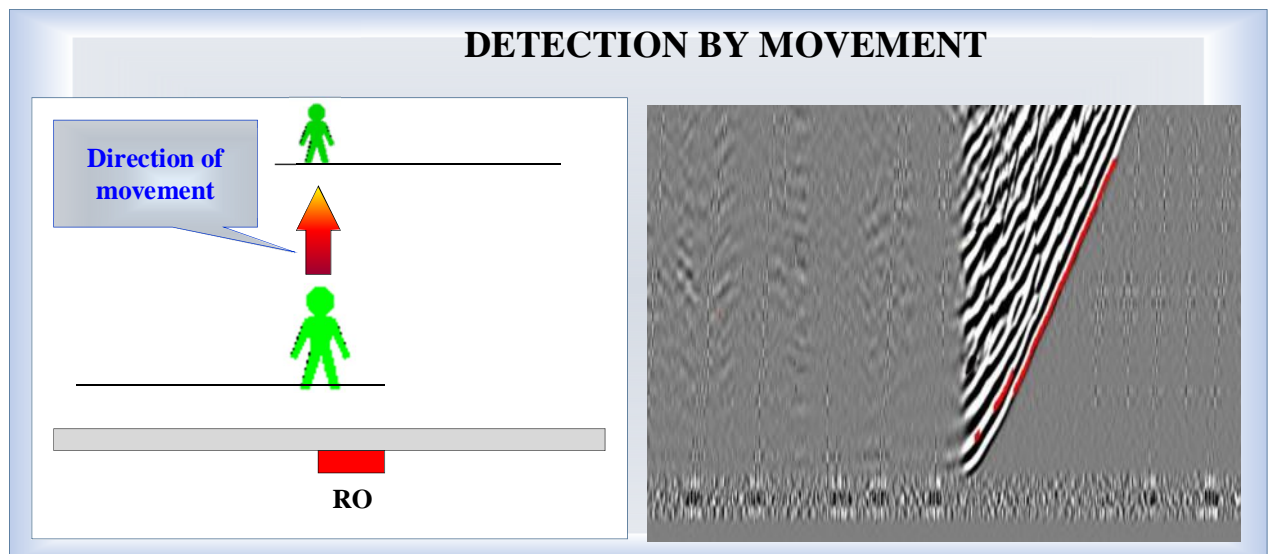
STANDARD RADARGRAMS FOR DETECTION OF OBJECT



The object appears at the detection zone, approaches to the device and stops. Further movement is not occurred.

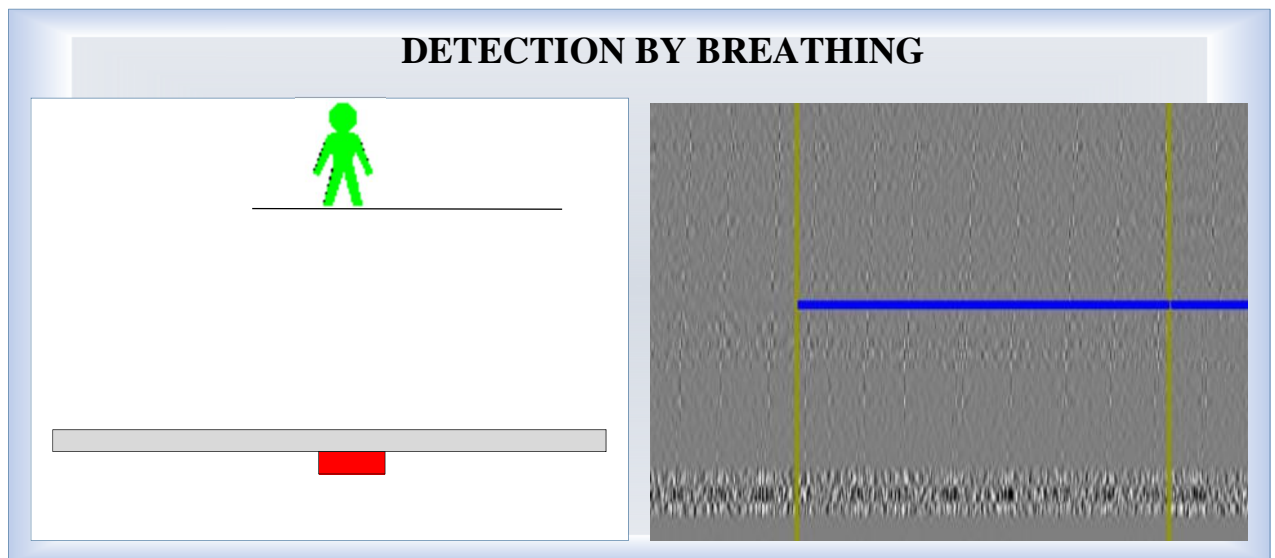
The object has been detected at the **"BY MOVEMENT"** Mode during the approach.

If the further movement of object is not occurred, the object would be detected automatically at **"BY BREATHING"** Mode after 20 seconds.

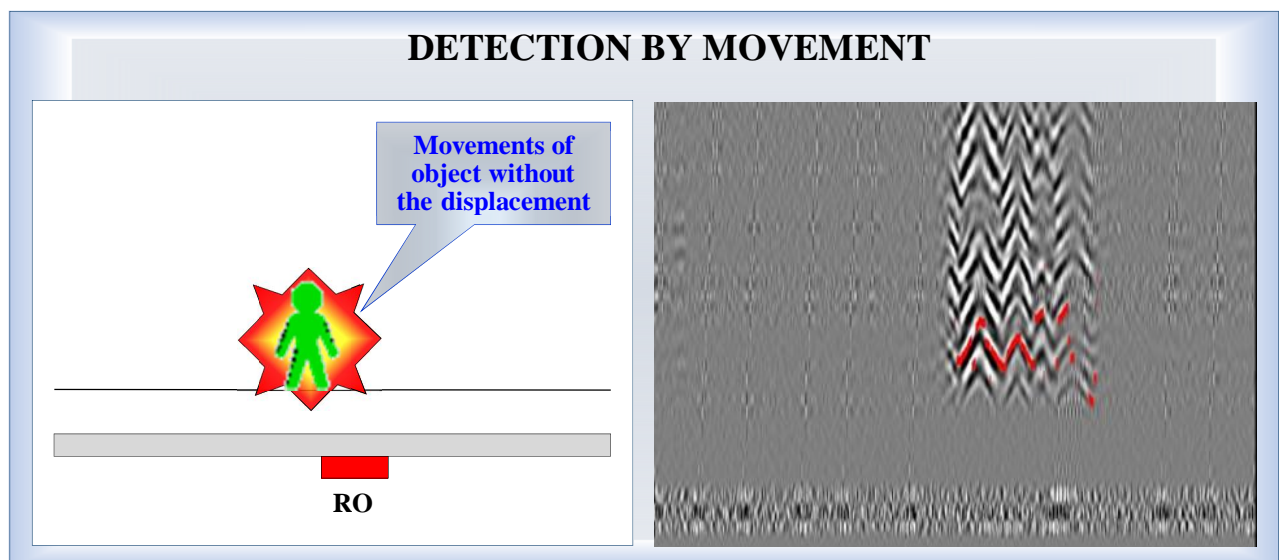


The object has been detected near the GPR-Detector during the switching-on of device.

The object begins to move away from the device that is fixed at the **"BY MOVEMENT"** Mode.

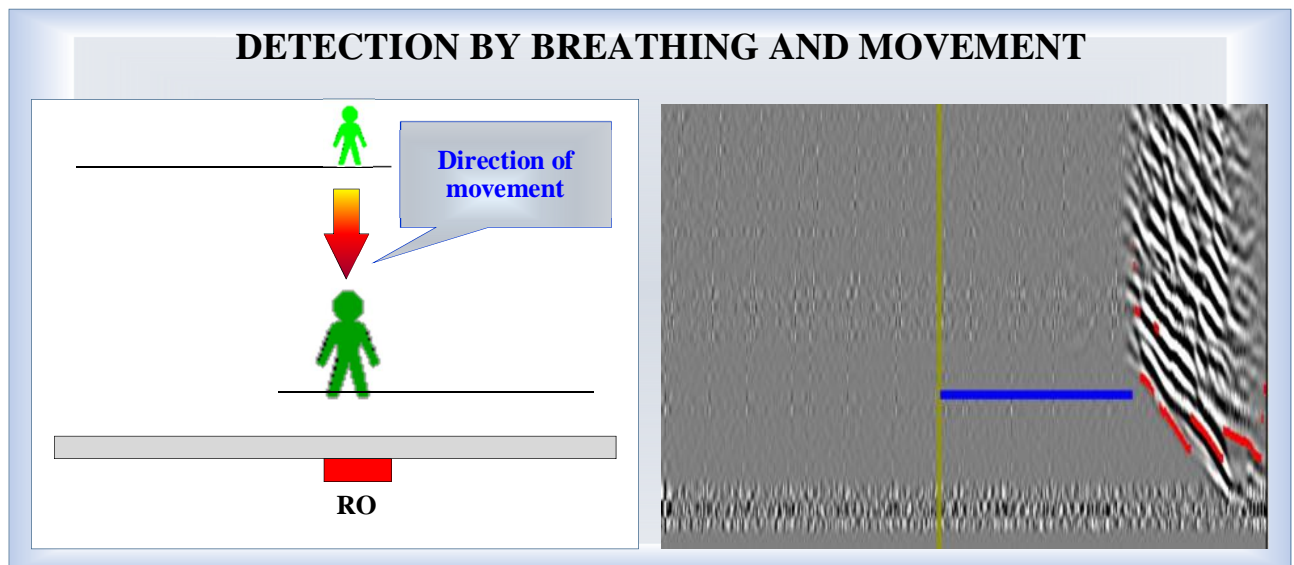


The nonmoving object has been detected using the **"BY BREATHINGö** Mode.

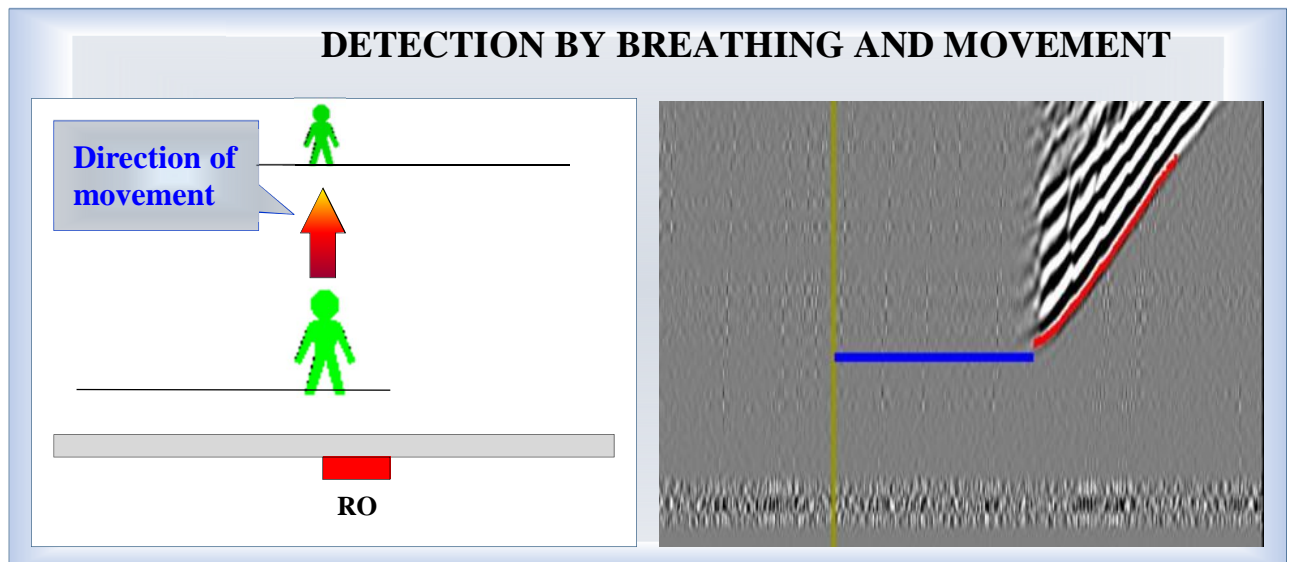


The object is located within the detection zone and without progressive movement and makes some waves of the hands.

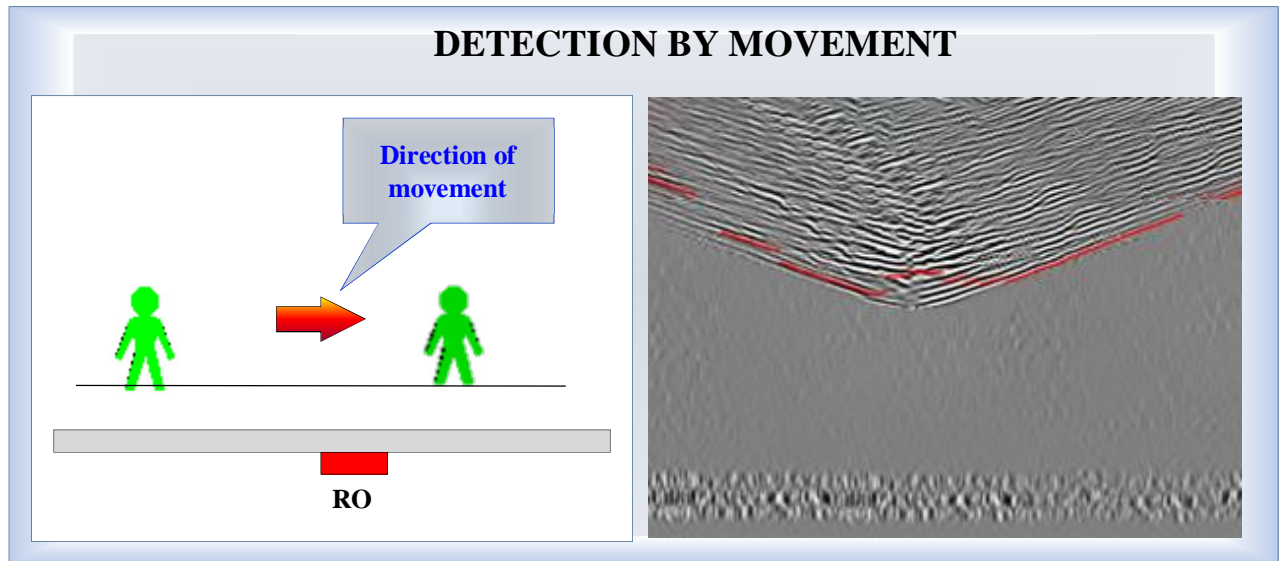
The object has been detected at the **"BY MOVEMENT"** Mode.



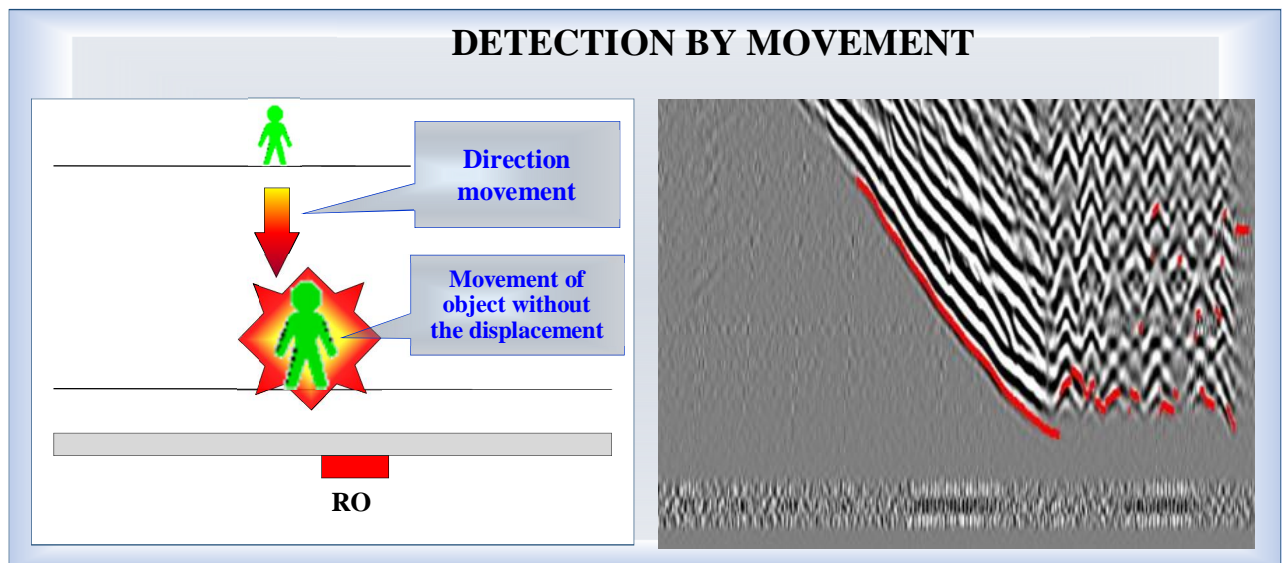
The nonmoving object has been detected at the **"BY BREATHINGö** Mode.
Then, the object is moved to the **DEVICE**.
The detection of object is implemented at the **"BY MOVEMENT"** Mode.



The nonmoving object has been detected at the **"BY BREATHING"** Mode.
Then, the object is moving away from the **DEVICE**.
The detection of object is implemented at the **"BY MOVEMENT"** Mode.

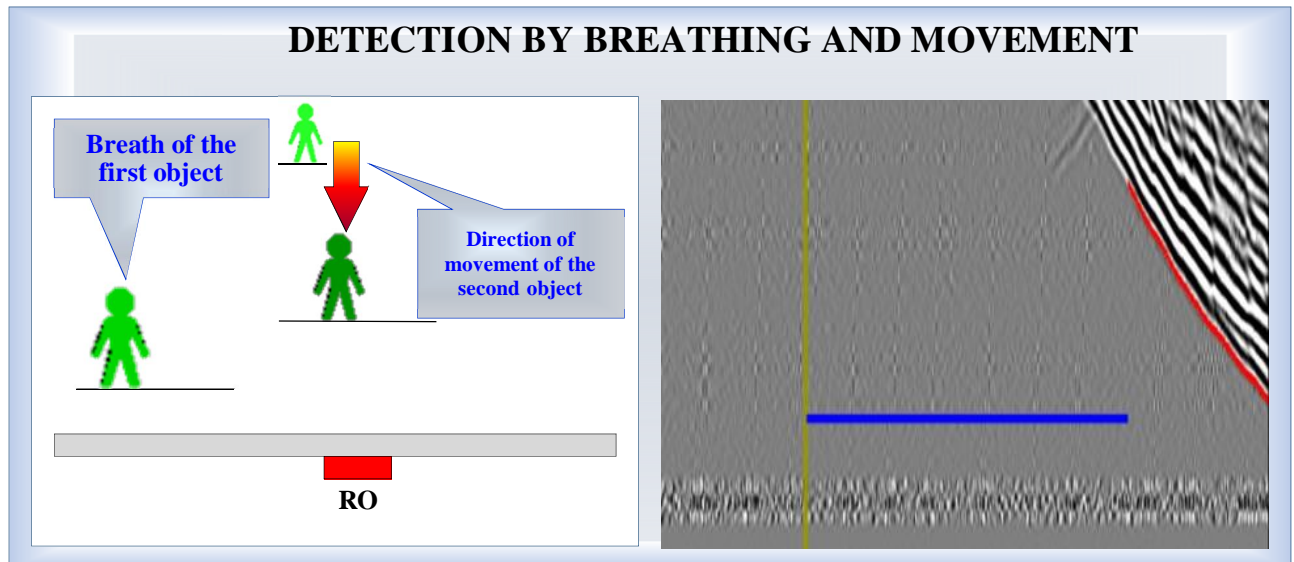


The object is moving by the **DEVICE** (parallel to the antenna).
The detection of object is implemented at the **"BY MOVEMENT"** Mode.



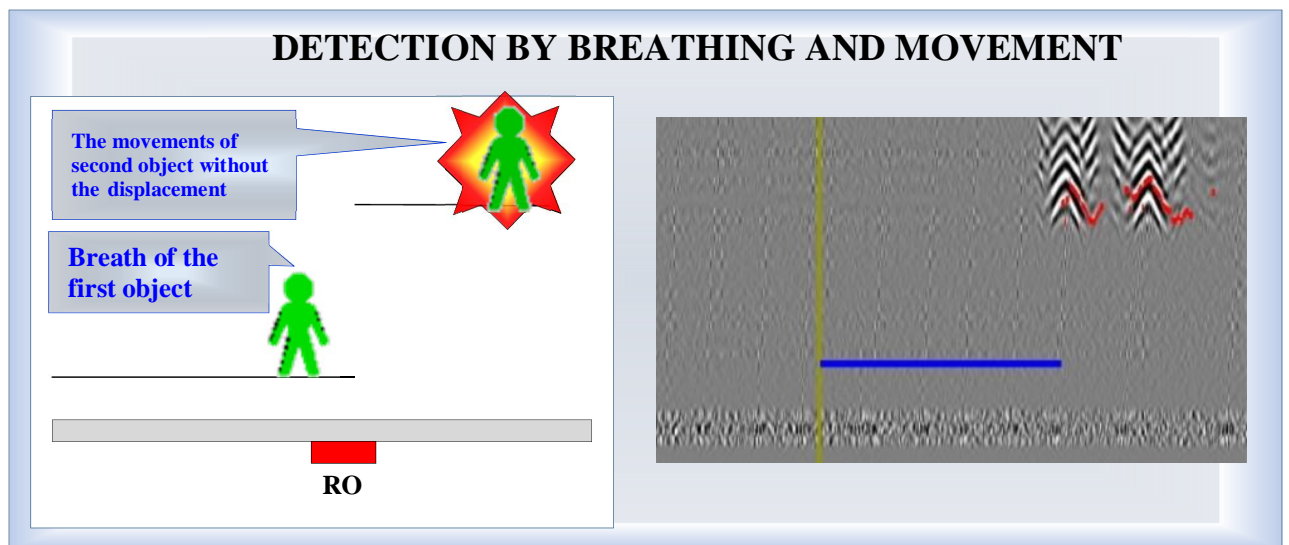
The object comes into the detection zone, approaches to the **DEVICE**, stops and makes some waves of the hands.

The object has been detected at the **"BY MOVEMENT"** Mode.



The first object has been detected at the area of **DEVICE** at the **"BY BREATHINGö** Mode.

Then, the second object appears at the detection zone. The **DEVICE** is switched automatically and demonstrates the detection of second object at **"BY MOVEMENT"** Mode.

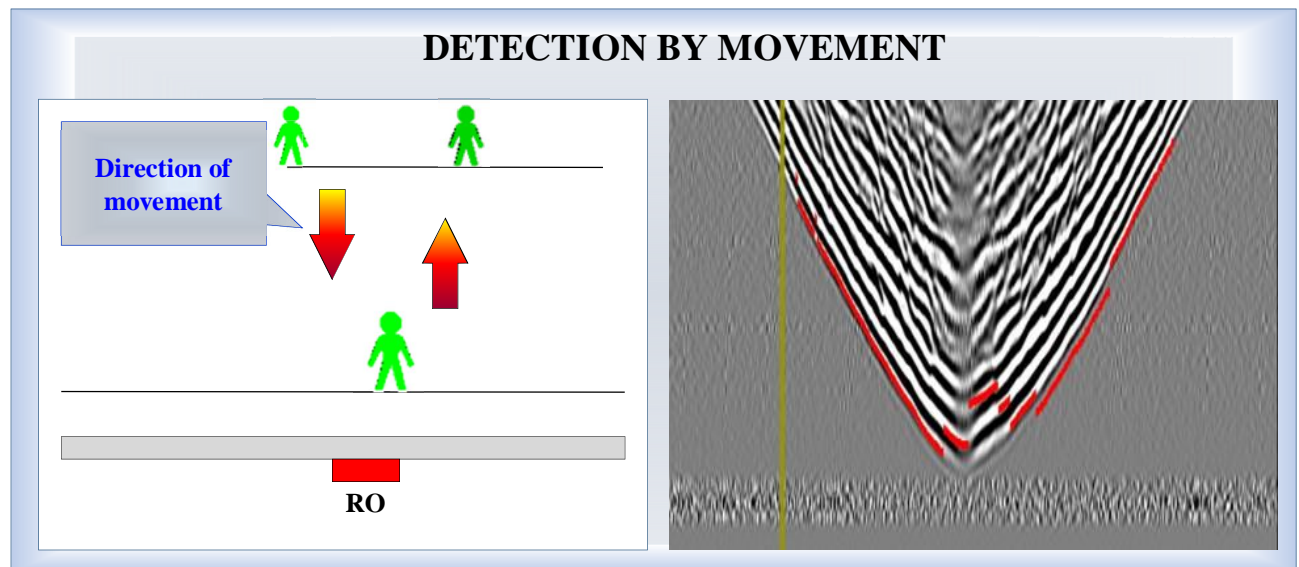


There are two objects at the detection zone:

1-st (the nearest) object at the operation area of the **DEVICE** has been detected at the **"BY BREATHING"** Mode.

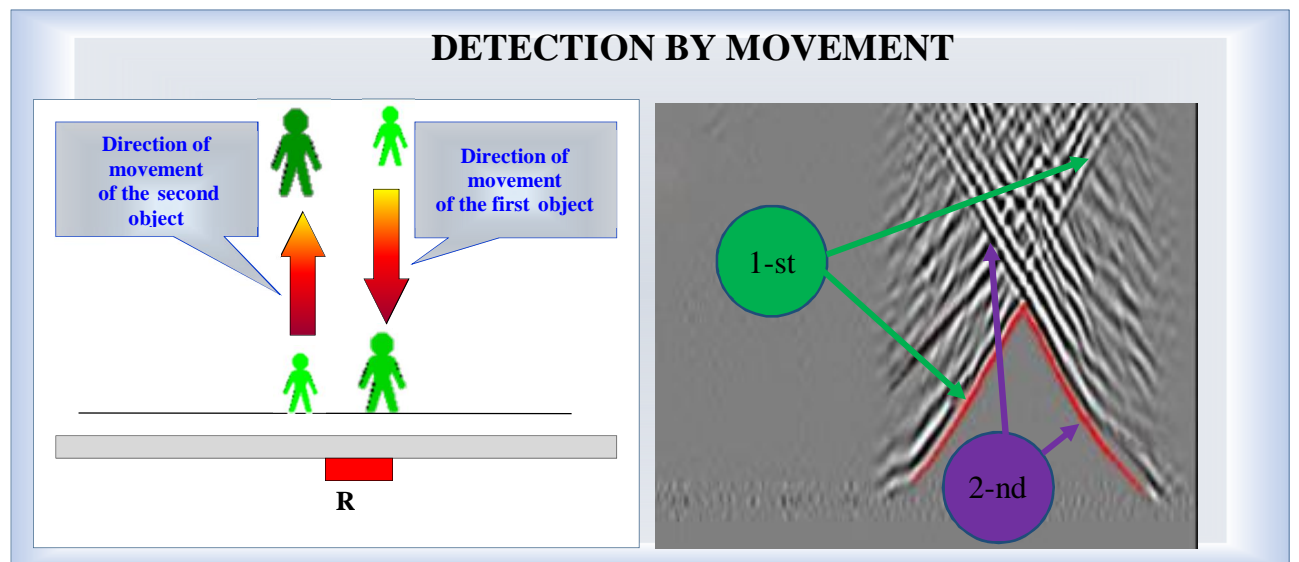
Then, the second object makes some movements of hands without the progressive motion.

The **DEVICE** switches automatically and demonstrates the detection of second object at **"BY MOVEMENT"** Mode.



The object comes into the detection zone, approaches to the **DEVICE**; then the object moves from the **DEVICE** and goes out of the detection zone.

The object has been detected at the **"BY MOVEMENT"** Mode.



Two objects are at the detection zone during the switching-on of the device:

- First object is moving to the device (at first, the red marks; then, the lines of the radargram);
- Second object moves from the device (at first, the lines of the radargram; then, the red marks).

The detection of objects is occurs at the **"BY MOVEMENT"** Mode.