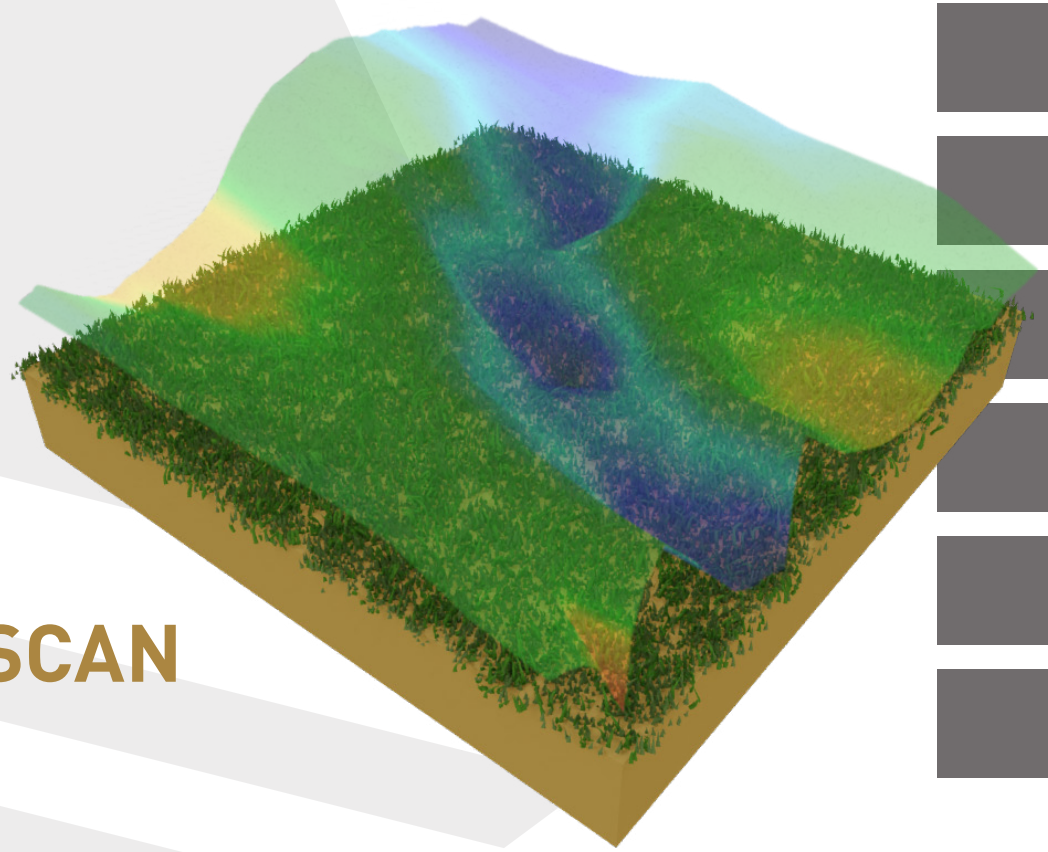
OKM

GERMAN DETECTORS



3D GROUND SCAN GUIDE

PREPARATION

SCANNING PROCEDURE

CONTROL SCANS

FINALIZATION

MAJOR RULES

EXPERT TIPS

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TABLE OF CONTENTS

1 PREPARATION 4

2 SCANNING PROCEDURE 6

2.1 SCAN MODE 6

2.2 IMPULSE MODE 7

2.3 SCANNING SPEED 8

2.4 PROBE HANDLING 8

2.4.1 Distance to the Ground 8

2.4.2 Probe Orientation and Direction 8

2.5 ADDITIONAL ADVICE 9

3 CONTROL SCANS 11

4 FINALIZATION 13

5 MAJOR RULES 15

6 EXPERT TIPS 17

PREPARATION

1 PREPARATION

Performing a 3D Ground Scan provides many information about underground objects and structures. In order to get the best results prepare your measurements carefully.

Please consider the following preparations before conducting any 3D Ground Scan:

1. **Research the Target Area:** There are many areas such as battle fields, ancient settlements and trading routes where 3D ground measurements can be profitable. In order to save time, it may be useful to do some research on your target area in advance: What are you looking for and are there any hints where you can find your target objects?
2. **Define the Scan Field:** Once you have defined your target area, determine your scan field. Use e.g. wooden sticks to mark out the four corners and then take its dimensions. The more precisely the length and width can be specified, the better conclusions can be drawn about the position and depth of potential finds. With the help of the staked field, the scan lines can be followed more easily and accurately.
3. **Use Accessories:** If you are not yet proficient, it might be helpful to use e.g. ropes to mark your scan lines to help you to keep your scan lines straight. The scan lines should have the same distance to each other to avoid distorting the scan data and to prevent hidden objects between the scan lines from being missed.
4. **Remove Obstacles:** Walk roughly across the scan field and remove obstacles and interfering elements such as high grass, bushes, stones, tree trunks, etc. These obstacles may prevent you from walking the scan lines consistently and thus lead to erroneous scan data. If obstacles cannot be removed, you may consider using the Manual impulse mode. For further information please refer to chapter „2.2 Impulse Mode“ on page 7.
5. **Clear the Scan Field:** Search the target area in operating mode Magnetometer or Live Sound, if available, to clear the target area from uninteresting objects such as ferrous debris. Hence, the subsequent 3D Ground Scan can provide more informative results.

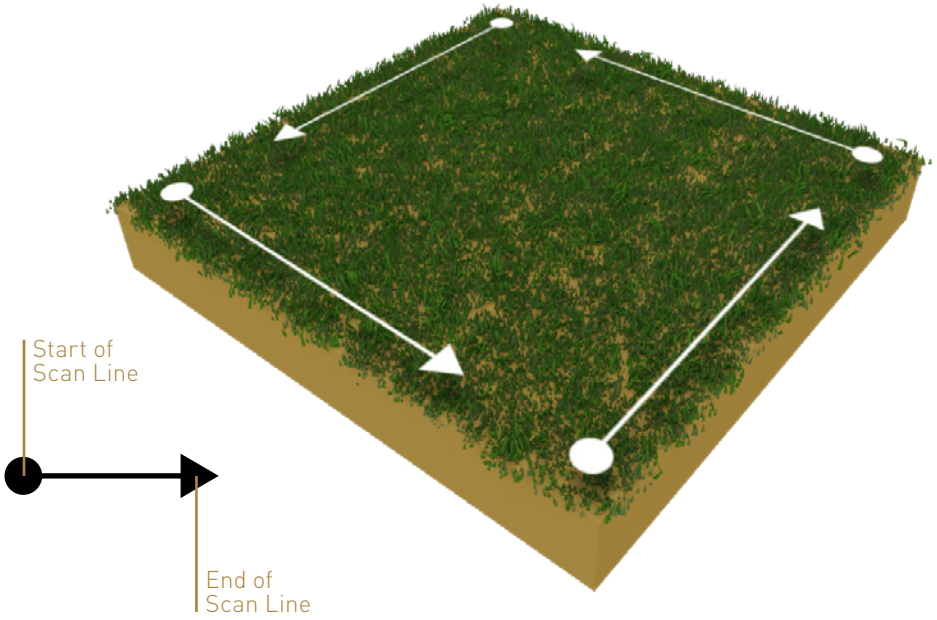
SCANNING PROCEDURE

2 SCANNING PROCEDURE

In general, every scan starts on the bottom right corner of your scan area. Starting from this point walk scan line by scan line, whereby every following line is situated on the left side of its previous line. While walking these lines, the measurement values will be recorded and depending on the selected operating mode either transferred directly to a computer or saved into the memory of the OKM detector.

The device stops at the end of each finished scan line, so that the user can find the starting point of the next line. In this way, all lines will be recorded and the area will be measured.

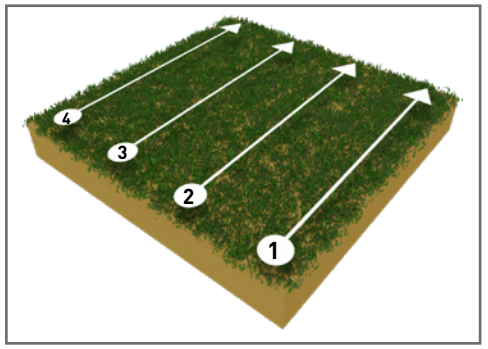
The following illustration shows all 4 possible starting points and its corresponding first scan line. Determine the optimal starting point of your measurement according to the environmental conditions of your terrain.



The scan lines may be performed in Parallel or Zigzag scan mode. The number of impulses (measure values) which are recorded during the first scan line can be adjusted individually depending on the length of your scan field.

2.1 SCAN MODE

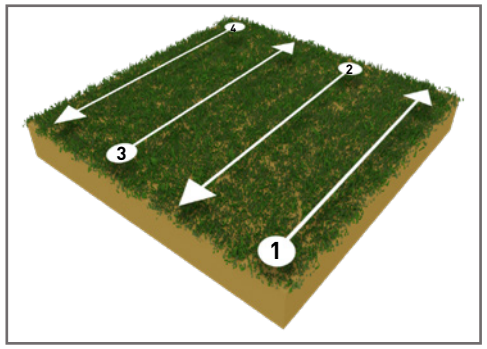
There are two general techniques to survey an area with your OKM detector: Parallel and Zigzag. For skilled users of OKM detectors both scan modes are suitable. According to experience the best graphics have been received in Parallel mode, because you are starting at the same point and walking in the same direction. It is also easier to control your walking speed and direction. Especially in uneven terrain like mountain sides or other inclines, the Parallel mode is recommended. When it comes to speed, the experienced user will very often use the Zigzag mode only for the initial scan to determine if there are anomalies in the area worth further research.



Parallel (recommended)

The starting point of all scan lines is always on the same side of the measured area. You will only record data in one way and in one direction, while you should return and walk back to the starting point of the next scan line without recording data.

When performing the scan in Parallel mode start on the bottom right corner of your scan area (1) and record a scan line towards the upper right corner of the area. After recording the first line walk back to the starting point and move one step to the left to start the second scan line (2). Repeat this procedure until you have reached the left side of your scan field.



Zigzag

The starting point of two scan lines next to each other is on the opposite sides of the measured area. You will record data on your forward as well as backward scan line.

When performing the scan in Zigzag mode start from the bottom right corner of your scan area (1) and record a scan line towards the upper right corner of the area. In contrast to the parallel mode continue recording data while walking back the second scan line. Thus, go to the starting point of the second scan line (2) and scan in the opposite direction. Continue scanning all remaining lines (even lines backwards, uneven lines forward) until you have reached the left side of your scan field.

The distance between the scan lines should be consistent during the entire measurement but can vary from scan field to scan field. If you look for small targets keep a smaller distance between the lines. A standard rule is: The smaller the distance between the lines, the more accurate your scans.

2.2 IMPULSE MODE

Large even or passable surfaces are commonly measured in Automatic mode. The Manual impulse mode is mainly used for difficult uneven terrain, areas where there is quite a bit of growth and if the measurement result needs to be very accurate. In terrains with difficult access like mountain cliffs and sides, slippery surfaces or overgrown areas, it is wise to use the Manual impulse mode. Since each impulse will be released manually, you have enough time to position the probe in the correct way and record the measured value. In this way, you can also measure previously marked spots of a predefined grid accurately.

Automatic (recommended)

Each measure value is recorded automatically and continuously without any break.

When using the Automatic impulse mode, press the start button to start your measurement and walk slowly forward until you reach the end of the first scan line.

Manual

Each measure value is only recorded after pressing the according release button.

When using the Manual impulse mode, press the start button to start your measurement and with each step towards the end of the first scan line press the release button to record a measure value.

Continue this procedure until you reach the end of the first scan line.

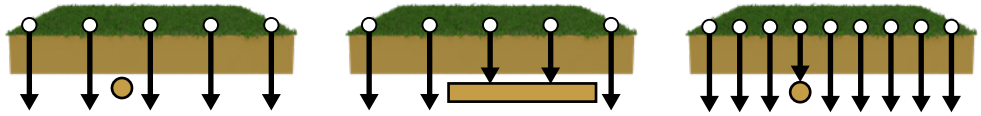
If you have defined the number of impulses (length of scan field) in advance, the detector will stop automatically at the end of the scan line, otherwise (in "Auto" mode) you have to press the approriate stop button as soon as you reach the end of the first scan line.

When the first scan line is finished, go to the starting point of the next line and press the start button again. Repeat the procedure in the same way like you recorded the first scan line. From now on, the detector will stop automatically at the end of each scan line.

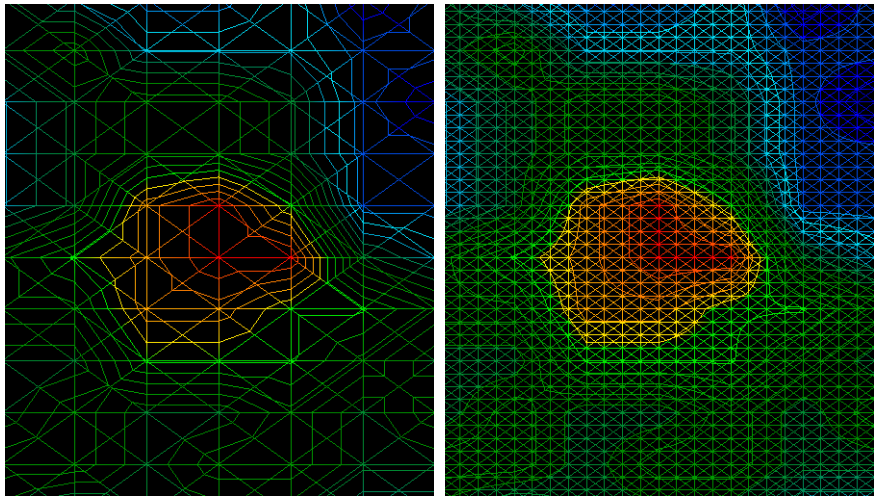
There is no special rule for selecting the right number of impulses. But there are some aspects that should be considered:

- the length of your scan area
- the size of the underground targets

A preferable distance between two impulses is about 15 to 30 cm (6 to 12"). The smaller the distance between two impulses, the higher the precision of the graphical representation. If you are looking for small objects, keep a smaller distance. You might increase the distance between the impulses for larger objects.



Effects of the distance and the number of impulses per scan line for some objects.

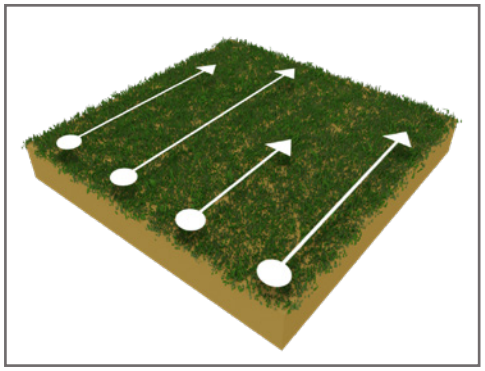


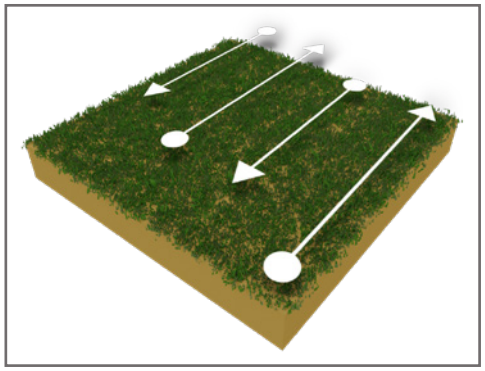
Comparison: few impulses (left) and many impulses (right) at the same length of scan line. The second scan (right) shows more details and allows to detect even smaller objects.

Do not hesitate to record more measurements with different numbers of impulses. For example you can scan a large area with fewer impulses before doing a second more detailed measurement. Especially if searching for bigger objects you can proceed like mentioned. In that way, you can measure a larger area very quickly and make additional high precision scans localizing the suspect targets afterwards.

When conducting a scan it is important to not only make note of how many impulses are being used but to get a clear picture of what you are looking for. It is also very important to watch your speed. Every scan line should be measured at the same speed as the previous line.

2.3 SCANNING SPEED





Using different walking speeds throughout the scan lines will cause displacements within the scan field. As a matter of fact, a potential target can get cut into several small pieces or completely lost because it was missed out. Later on, when the data is downloaded for further analysis, speed errors can make a target completely unidentifiable.

Keep your measurements at practical sizes where you can see the beginning and end lines and can comfortably traverse an area. Thus, your scanning speed keeps consistant over time and distance.

2.4 PROBE HANDLING

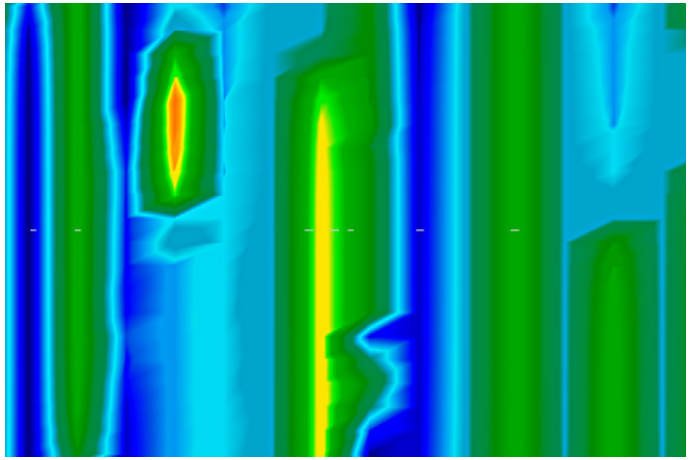
2.4.1 Distance to the Ground

During a measurement the probe should always have the same distance to the ground. Generally we recommend a height of about 5 to 10 cm (2 to 6") from the surface of the ground if possible. If you are walking over stones, wood or high grass, start your scan with the sensor held higher from the beginning. In circumstances like these you need to start the scan with the probe at a height of 50 cm (2 ft) and keep it at that level for the entire scan.

Do not change the height during the scan for it may create errors.

2.4.2 Probe Orientation and Direction

Another important aspect is the physical orientation of the probe. During the Parallel scan mode the orientation of the probe does not change since you are always measuring in the same direction. Even in Zigzag scan mode the orientation of the probe must not be changed. That means you are not allowed to turn yourself with the detector and the probe at the end of the scan line. Instead, walk backwards and continue scanning. Otherwise your obtained graphic includes red or blue stripes. These stripes throughout a scan are commonly referred to as Rotational Errors.



Example of erroneous scan in Zigzag scan mode (rotational errors).

2.5 ADDITIONAL ADVICE

In principle, a scan is only as good as the line that was taken. Making errors while scanning will show up in the final graphical representation also as an error. This will cause frustration and lost time.

Before you start with a measurement in the field, you should think of what you are looking for and if the selected area is suitable. Measuring without a plan will usually produce unacceptable results. Please consider the following advice:

- What are you looking for (graves, tunnel, buried objects, ...)? This question has direct effects on how a scan is conducted. If you are looking for large targets, the distance between the single impulses and scan lines can be larger, as if you are looking for small targets.
- Inform yourself about the area, where you are searching. Does it make sense to detect here? Are there historical references which confirms your speculation? What type of soil is on this area? Are there good conditions for data recording? Is it allowed to search at this place (e.g. private property)?
- Your first measurement in an unknown area has to be large enough to get representative values. All further measurements should be adjusted individually.
- What is the shape of the object you are looking for? If you are looking for an rectangular metal box, the identified object in your graphic should have a form according to this.
- To get better values concerning depth measurements, the object has to be in the center of the graphic, which means it has to be framed by normal reference values (normal ground). If the object is at the edge of the graphic and not totally visible an estimated depth measurement is not possible and also measuring the size and shape are limited. In this case, repeat the scan and change the dimensions of your scan area, to receive an optimal position of the anomaly inside of the graphic.
- There should not be more than one object in a scan. This will influence the depth measurement. It is useful to scan partial areas over such targets.
- You should do at least two control scans to confirm the correctness of your results. This is also important to recognize areas of mineralization.
- Most important rule when dealing with mineralization: Real targets don't move. If your target moves then it is most likely mineralization.

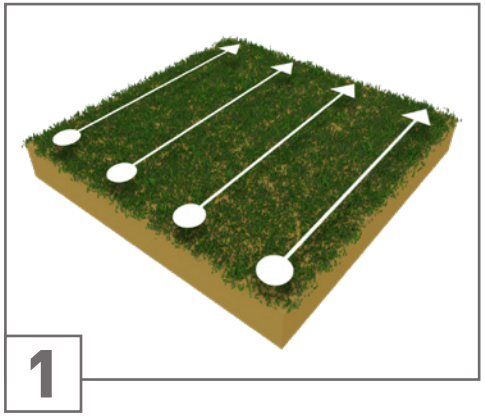
CONTROL SCANS

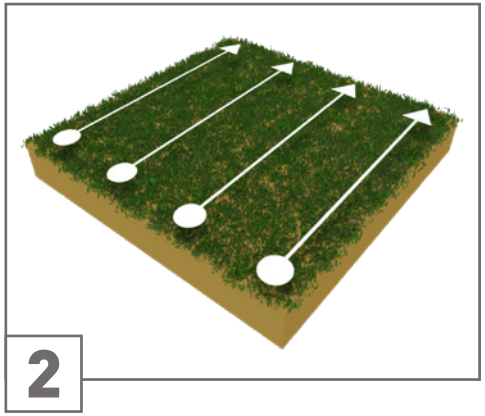
3 CONTROL SCANS

Always perform a set of Control Scans prior to excavation. A Control Scan is a very accurate measurement to ensure that the area being prospected is a viable area and to verify that the target is real. This is done by doing additional scans.

> **Control Scans are very important!**
> **It is much easier to conduct an additional set of scans rather than dig a hole with nothing in it.**

To ensure consistency of the scans the same person should perform the Control Scans and they should be done using the same starting and stopping points. The Control Scans should have the same amount of impulses and the same amount of scan lines in every measurement. If the above mentioned conditions are not true, the Control Scans will potentially have errors from the beginning.





Control Scans are very important and useful, because

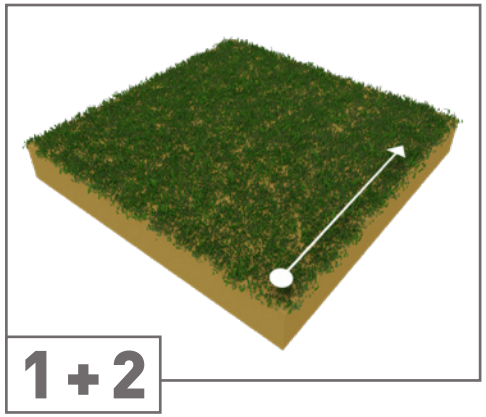
- if the target moves, it is most likely an area without a valid target and
- you get a much better perception of the actual size and position of the target.

Having the same person performing all measurements (Initial Scan and Control Scan) is essential. In this way, the scans will be done exactly the same, with the same speed and the same amount of impulses. It is important that others watch the operator as the scans are being performed to ensure that no mistakes are being made and the scan lines are straight. The other users need to ensure that the utilized Probe does not rotate or tilt while scanning and that it remains at the same height over the ground at all times.

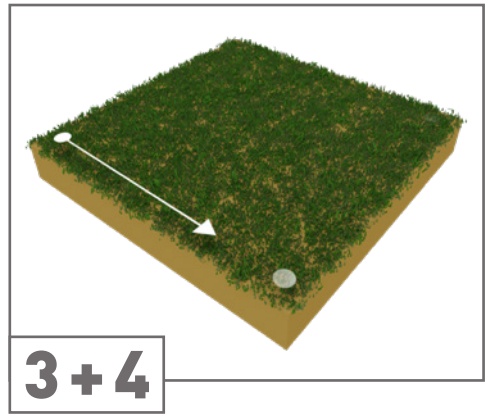
If multiple operators are going to perform scans, then it should be noted in the Characteristics window of the Visualizer 3D Studio software as to which operator performed the scan. This way, subtle differences between the operators can be noted.

When looking for buried objects the method of using Control Scans also ensures that the located items are real. Only with a Control Scan you will see if targets move. As you already know: Real targets don't move!

It is also good practice to perform a Perpendicular Scan against your Initial Scan to avoid missing potential objects. Especially longish objects such as pipelines, weapons (riffles, spears, swords, etc.) and tunnels should be traversed perpendicular to its underground orientation. Then it is more likely to not miss that objects between the scan lines.



Perform your Initial Scan (1) and the first Control Scan (2) using the exact same starting and stopping points.



Perform a Perpendicular Scan (3) by starting from an adjacent starting point and its Control Scan (4) using the exact same starting and stopping points.

Please keep in mind that any graphical Scan Analysis, as offered by OKM Detectors, is not possible without proper Control Scans.

FINALIZATION

4 FINALIZATION

Finish your scan, save and transfer it to your notebook for further analysis.

1. **Analyze Scan Images:** Have a look at your scan images and control scans in ***Visualizer 3D Studio***. By analyzing your 3D Ground Scans in the detection software you are able to discover the existence of underground target as well as determine the size, position and depth of potential objects and structures. For further information refer to the Visualizer 3D Studio Documentation at www.okmdetectors.com/v3ds-documentation.
2. **Pinpoint Targets:** Use the Pinpointer operating mode (if available) to determine the precise position of your detected object or structure in your target area.
3. **Prepare Excavation:** Prior to excavating the located objects and structures, make sure you have permissions to dig your target area. Choose the appropriate digging tools according to the prevailing underground and soil type.
4. **Excavate Carefully:** Dig carefully without destroying your targets. The detected objects may comprise unexploded ordnance (UXO) such as bombs, mines, ammunition or other hazardous materials and underground utilities such as cables and pipelines. Leave ammonition where it is, do not touch it and, most importantly, do not take any of it home with you. If you excavated UXO, inform the local authorities!

MAJOR RULES

5 MAJOR RULES

Following these primary rules will increase your chances of success with OKM detectors.

1. **Preparation of the Scan Field: Apply Magnetometer first!** Search the target area in operating mode Magnetometer or Live Sound, if available. In this way, ferromagnetic objects near the surface can be located and the ground can be cleared from ferrous waste.
2. **Direction of the Scan Lines:** Experience shows that scans in north-south (or south-north) orientation produce better scan image results. If you can, follow the natural magnetic field of the earth when measuring.
3. **Orientation of the Probe: Do not turn, pivot, tilt or rotate the probe!** Make sure that you keep the probe straight while measuring.
4. **Distance to the Ground: Hold the probe at the same relative height!** Keep the probe at the same distance above the ground throughout your entire scan (between 5 to 10 cm / 2 to 4" above the ground is recommended). If there are obstacles in the scan field, lift the sensor higher to ensure a constant distance to the ground.
5. **Scanning Speed during the Scan: Move the probe at the same speed!** For each scan line, walk slowly to collect enough measure values (impulses). In Automatic mode, the speed of the probe during a scan line must remain the same. The distance between the impulses must be the same.
6. **Number of Scan Lines and Impulses: Scan more lines to collect many measure values!** The more impulses are collected, the more detailed the scan image. In this way, even smaller objects can be detected.
7. **Distance between Scan Lines: Scan the lines always at the same distance to each other!** In this way you avoid scan errors and do not miss objects hidden between the scan lines.
8. **Accuracy of the Measurement: Keep each scan line straight!** Walk straight, not in a curve. Do not look at the probe or the unit, but at a target that is further away. Constantly watching the probe or unit will make you walk in circles.
9. **Be sure that your scans are large enough.** Initial scans should not be smaller than 4x4 m (13x13 ft). If the scan is too small, the overall size of the target can not be determined and errors in the analysis may occur.
10. **Check Your Scan Image with Control Scans!** Repeat the scan at least once to ensure that the field does (or does not) have a target. Lack of control scans has made users dig in areas where there was no target.

EXPERT TIPS

6 EXPERT TIPS

When performing scans, there are some important hints that need to be noted.

- **Be relaxed**. When you are tense, you are putting too much pressure on yourself to perform the scan correctly; often resulting in errors.
- **Newly buried targets are difficult to see.** Many users receive the equipment and the first thing they do is go out and bury an object. When an object is buried in the ground it changes the natural signature of the soil and creates some kind of "noise". Usually, the buried object has a weaker signature than the unnatural noise and therefore is not detectable. Initial scan images will not show the buried item but visualize the noisy area in blue or green colors. After the item has been seasoned, meaning it has been in the ground for a complete cycle of seasons (usually a year), the noise is reduced and the signature of the buried object becomes visible again.
- **Train on known targets.** In the training course at OKM in Germany we have several objects that have been buried for years, just like real targets in the field. These targets can be identified fast and easily because they are not natural to the soil. Other targets that you can use in your own area are buried utilities such as pipes, tanks, sewers, graveyards etc. Most of these items can be found in every community, town or city. This is where you need to begin your training if you are going to self-train.
- **Get professional training.** When you take advantage of receiving the training, either from the factory or a qualified dealer, you will understand not only the use and operation of the OKM detector but also the software so much easier and be able to identify targets as well as errors.
- **Do not rely on just one measurement.** Many users go out into the field and perform a scan and see a target. Instead of repeating the scan and reproducing it several times, they get a shovel and dig. On very rare occasion will the first scan be perfect. Even the trainers perform multiple scans to ensure that they are not looking at areas of mineralization or an error.
- **Soil mineralization can be very frustrating.** When you are in an area that is known to have pockets of high ground mineralization, be prepared to perform more scans than usual.
  - **Clay** is probably the number one foe: The iron content of the clay will determine how strong the attenuation will be. A fast analysis of the iron content is achieved by looking at the color of the clay: it can vary from a light gray up to a dark orange. The darker the clay, the more iron it contains.
  - **Sand** is usually very clear and easy to hunt in. There are two factors of sand that need to be noted: Sand where the ground water is very shallow, meaning that the ground water is usually just a couple of meters from the surface or desert sand where it is very arid. In desert sand, the targets can be situated 3x deeper than indicated.
  - **Farmland** is another area to take note of. In modern farms so many nutrients and fertilizers are introduced creating an unnatural area of mineralization.
  - **Rocky mountainous areas** are also riddled with patches of mineralization. Mountainous areas are created from faults in the earth and this is probably the biggest area for natural treasures as well as mineralization.
- **All scans have a red ... and a blue.** When you analyze the scans in the Visualizer 3D Studio software every scan has a red spot. Scan images include the strongest signals (red) as well as the weakest signals (blue). In fact, not every red or blue spot indicates a hidden object. Real objects have a defined structure, shape or size.
  - A real target will usually have a much stronger signal than that of a mineralized field. It will also not move. If you think that a red spot in the software is a real target, conduct a set of control scans and see if the target remains in the same place, or moves. If it moves, then it is not real.

REMEMBER: Real targets don't move!

OKM GERMAN DETECTORS

Based in Altenburg, Germany, we are developing and manufacturing geophysical detectors since 1998. Our unique detection technology helps to visualize buried objects and structures.

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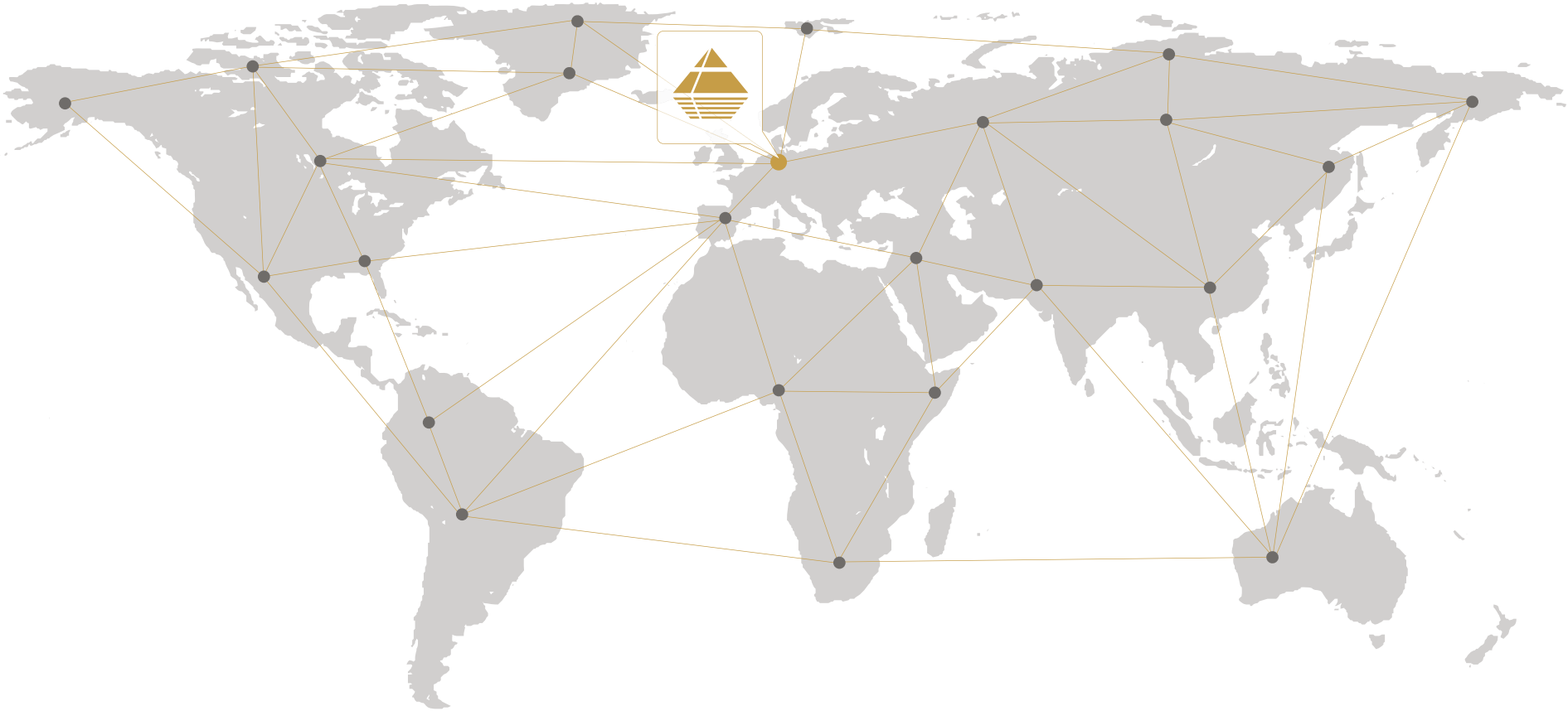

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