# Software Manual

For 3D-Groundscanner & Metal detector

Overview

The TeroVido system consists of the software TeroVido3D and the recording hardware. It's purpose is the detection of objects in the ground. The data recorded by the hardware (the transmitter) is sent to a PC or tablet and visualized as a colored 3D terrain and a 2D colormap by the TeroVido3D software.
Before you start the program, please make sure to plug in the receiver into the USB port of your computer. Please read through this manual in order to get an overview over the look and the features of TeroVido3D.

The GUI
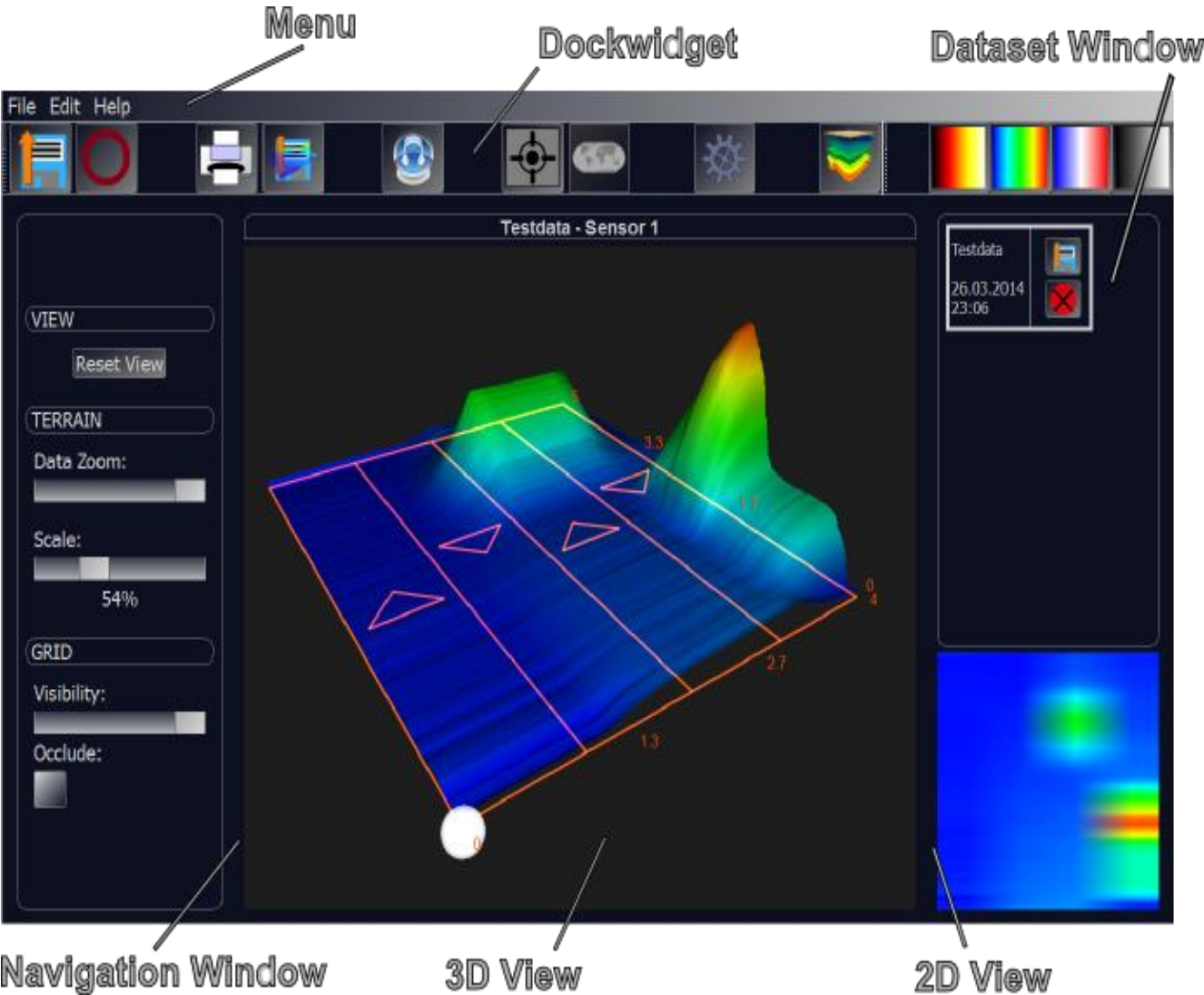
1. Menu

1.1. File Menu

1.1.1. Record Dataset

With this menu item, you are able to record a new dataset by using a TeroVido receiver.(see [Record Dataset](#))

1.1.2. Load Dataset

By choosing this menu item, you can load a previously saved dataset.(see [Load Dataset](#)). The loaded dataset automatically shows up in the dataset window.

1.1.3 Save 3D View as Image

This feature enables you to save an image of the current 3D view to the hard drive. After clicking on this menu item a file dialog will appear. Here you can specify where on your PC/tablet the image will be saved.

Quit

Exits the programm.

1.2. Edit Menu

1.2.1 Options

When clicking on this menu item, a dialog will appear where you can specify different global options for the program. (see [Changing Options](#)) The options will be saved and are set also when restarting the program.

1.2.2. Print 3D View

By using this feature, you can print the current 3D view. According to the operating system you use (Windows/Linux/Android) a print dialog will appear. Here you can determine the printing options and eventually start the printing process.

1.2.3. Language

Here you can change the language of the program. After changing the language, the program needs to be restartet.

1.3. Help Menu

### 1.3.1. About

Shows informations about the TeroVido3D software.

1.3.2. Help

Shows this manual.

2. Dock Widget

The dock widget provides buttons for every option that you can also access in the menu. The buttons are designed appropriately large in order to simplify the handling of the software espcially on touch devices. You can undock the dock widget from the main window and redock it to other places in the GUI.
The following features are avaiable (for an explanation of the features, please refer to the section File and Edit):

- : Load Dataset
- : Record Dataset
- : Print 3D View
- : Save 3D View as Image
- : Options
- : Sound

In the extended Version of TeroVido3D, it is possible to link the recorded datasets with the positions, where they were recorded. These position data are determined by the GPS sensor of the tablet. In this version, there are additionally the following features avaiable in the dock widget:

- : Search for GPS signal
- : View the Position Data

How you can work with the position data is explained in section GPS Position Data..
Furthermore, you can change the current colormap with these four buttons
(see Section Colormap).

3. Navigation Window

In the navigation window, you can determine different options for the 3D view of the datasets:

- **Reset View:** By clicking on this button, you can reset all changes of the camera of the 3D window.

- **Scale:** With the help of this slider, you can continously adjust the height of the 3D terrain. High values in the dataset will be scaled much more than lower values. This helps to enhance the visualization of details of the recording.
- **Data Zoom:** The data zoom denotes the current minimum and maximum of the data values. Is the slider on the left, the adjusted minimum and maximum correspond to the minimum and maximum of the recording device. Is the slider on the right, the the adjusted minimum and maximum correspond to the minimum and maximum of the recorded data. The color and the height of the terrain (as well as the color of the 2D view) will change respectively. The purpose of this slider is to visualize also the smallest pertubations in the data (when the slider is on the left) or to suppress noise (when the slider is on the right). This is necessary because there exists a weaker or stronger noise depending on the examinded surface that has an influence on the results of the recording.
- **Transluency:** Here you can continously adjust the opacity of the underlying grid in the 3D View. Is the slider on the left, then the grid is not visible at all. Is the slider on the left, then the grid will be fully opaque. By combining this option with the next option ("Occlude") you can adjust how the grid will be shown together with the 3D terrain according to your personal flavor.
- **Occlude:** With this option, you can determine if the 3D terrain should occlude the grid or if the grid should shine through the 3D terrain.

4. Dataset Window
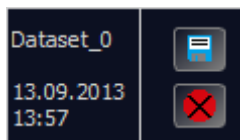
The dataset window lists all loaded and recorded datasets. They are represented by single boxes. On their left side, the name of the dataset and its recording date are shown. On the right side are two buttons. The upper one (disc symbol) enables you to save the dataset. This is mandatory if the datset has just been recorded and was not saved yet. The lower button (red cross) deletes the dataset from the program.
By double clicking (or double tapping on touch devices) the dataset will be shown in the 2D and 3D window. The corresponding box will be marked by a thicker outline.

5. 3D View

The central widget of the program diplays the currently chosen dataset as 3D terrain analogous to the currently chosen colormap. Furthermore, the rows of the scan path, that have been walked during the recording process, are shown as a grid. Inside the grid, arrows visualize the walking direction of the rows. A white sphere displays the beginning of the

recording. Additionally, numbers on the grid's edges show the dimensions of the dataset. Navigation within the 3D view is performed using the mouse. By pressing and holding the left mouse button while moving the mouse, the graphics are rotated. By pressing and holding the right mouse button while moving the mouse, the graphics are translated. By rolling the mouse wheel, you can zoom into or out of the graphics.

When using a device with touch input, the graphics can be rotated by swiping a finger over the 3D View. By swiping with two fingers, you can translate the graphics. In order to zoom into or out of the graphics, put two fingers on the 3D view and pinch or stretch.

To reset the view, press the button "Reset View" in the navigation window. Additional manipulations of the graphics can be performed with the other options in the navigation window (see Navigation Window).

6. 2D View

This window provides a quick overview of the currently selected datset as a 2D visulization. It depends on the currently chosen colrmap and data zoom.
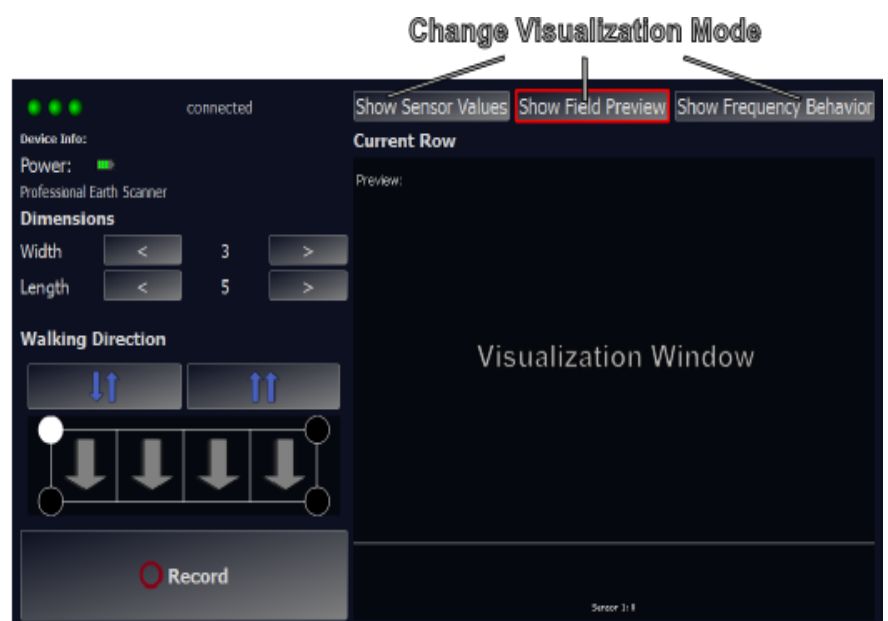
Features

1. Record Dataset

1.1. The Recording Window and its Options

To record a dataset, you have to click on the corresponding menu item in the file menu. A new window will open (see image). TeroVido3D will attempt to connect to the sender. If it fails, the program will inform you. Please make sure that the USB receiver is plugged in properly and that the transmitter is switched on. When the connection is successfully established, the program will show the name and the power status of the transmitters battery in the section "Device Info".

To beginn the recording, please perform the following three steps:

- **1. Enter Field Dimensions** In the section "Dimensions", you have to enter the width and the length of the field that you want to scan. The Unit (meter, inch, foot) does not matter. It is only important for your orientation, when you watch the 3D terrain later.
- **2. Enter Walking Direction:** With the two provided buttons, you can specify, if you want to walk the file in zig-zag mode (Button:) or in parallel mode (Button:). In the window lying beneath the buttons, you can specify where on the field you want to start the recording (at the front or at the back) and in which direction you want to walk (from left to right or the other way). Therefore, you have to cklick (or tap) on one of the circles in the corners of the window. The four arrows together with the white circle represent the final walking direction.

  For example, this images shows a configuration, where you will walk the scan path by beginning in the lower left corner (and walking from front to back) in a zig-zag pattern.
- **3. Start Recording:** When you entered all parameters, you can start the recording by pressing on this button. The input fields for the parameters will disappear and two new buttons will appear: one for the starting/pausing of the recording process and one for the changing the row of the scan path. How the actual recording is performed, is described in the next section.

1.2. Performing the Recording

Now you have to read the corresponding section for your specific device (horizontal or vertical)

Important: The datasets you are about to record are not saved permanently. To inform you of yet unsaved datasets, the save symbol of the dataset in the dataset window will be marked with an exclamation mark (instead of). This means you should save the datasets on your PC/tablet (see Save Dataset). The datasets will disappear when you close the program. When you saved the datasets, you can reload them into TeroVido3D (see Load Dataset). The program will inform you, if there are unsaved datasets when you want to close the TeroVido3D.

1.2.1. Horizontal Device

After everything is prepared according to the last section, move to the beginning of the first row. When you are ready, start the recording of the data by pressing the start button ▷ in the recording window. The start button will now turn into the pause button ‖ . Now walk the row slowly using equally sized steps. The recorded data values as well as the current row are shown on the right side of the recording window. The recording (i.e. the recorded data) is visualized on the right hand side of the recording window (click here for details). You can pause the recording anytime by pushing the pause button. If you push the pause button again, the recording process continues. In order to not corrupt the final visualization, it is essential that the recording continues right from the spot, where it was paused. If the connection between transmitter and receiver is interrupted, a message will appear on the right side of the recording window. If the interruption was of only short duration, the recording nevertheless can be continued. However, the recording becomes invalid when the interruption(s) will last long. In that case, it is recommended to start the recording from the beginning.

If you finished walking the row, push the pause button, to pause the recording. Then move to the beginning of the next row. Before you continue the recording with the next row, you have to push the button for changing the rows ↻ to tell the program that the recording continues with a new row. The counter "Current Row" on the right hand side of the recording window should increase by one It is very important that all rows are walked preferably in the same speed. Otherwise the recorded dataset may become invalid.

When you finished walking the complete scan path (all rows), you add the recorded dataset to the program by pushing the stop button ▢ in the recording window. You are now asked to enter a name for the dataset. The dataset will then appear in the dataset window. If you wish to record another dataset, you can do so. Otherwise you can close the recording window and analyze the recorded datasets.

1.2.1 Vertical Device

Please note that there are two buttons on the device: -- The OK button and the Arrow button.

After everything is prepared according to the last section, move to the beginning of the first row. To start the scanning process, push and hold the Arrow button. Now walk the row slowly using equally sized steps. The recorded data values as well as the current row are shown on the right side of the recording window. The recording (i.e. the recorded data) is visualized on the right hand side of the recording window (click here for details). You can pause the recording anytime by releasing the Arrow button. If you push and hold the Arrow button again, the recording process continues. In order to not corrupt the final visualization, it is essential that the recording continues right from the spot, where it was paused. If the connection between transmitter and receiver is interrupted, a message will appear on the right side of the recording window. If the interruption was of only short duration, the recording nevertheless can be continued. However, the recording becomes invalid when the interruption(s) will last long. In that case, it is recommended to start the recording from the beginning.

If you finished walking the row, release the Arrow button, to pause the recording. Then move to the beginning of the next row. Before you continue the recording with the next row, you have to push the OK button for changing the rows to tell the program that the recording

continues with a new row. The counter "Current Row" on the right hand side of the recording window should increase by one. It is very important that all rows are walked preferably in the same speed. Otherwise the recorded dataset may become invalid.

When you finished walking the complete scan path (all rows), you add the recorded dataset to the program by pushing the stop button ☐ in the recording window. You are now asked to enter a name for the dataset. The dataset will then appear in the dataset window. If you wish to record another dataset, you can do so. Otherwise you can close the recording window and analyze the recorded datasets.

1.3 Visualization of the Recording

TeroVido3D provides different visualizations of the recorded data (sensor values, live preview, frequency behavior) depending on which version of TeroVido3D you are using. You can switch between the visualizations by pressing the corresponding buttons on the top of the right side of the recording window

- **Show Sensor Values**: Shows the raw data that is recorded for each individual sensor.
- **Show Field Preview**: Shows a preview of the recorded scan path(s).
- **Show Frequency Behavior**: Shows the spectral analysis of the current row. This mode is especially useful to identify edges of objects.

To indicate the currently selected visualization mode, the corresponding button is marked with a red border.
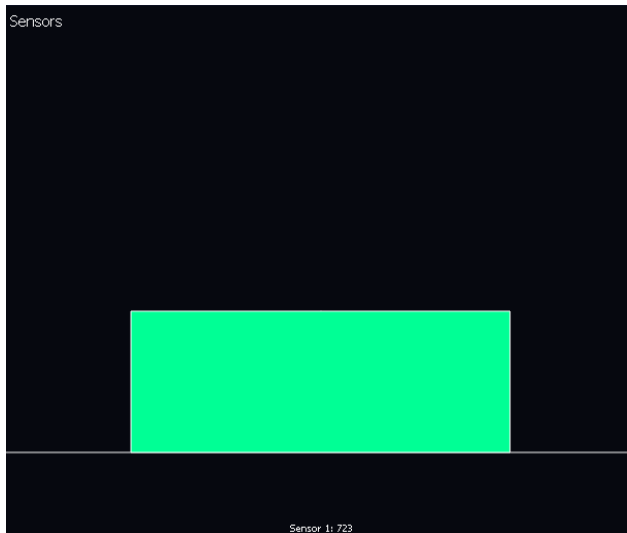
Sensor Values: in this image, there is one sensor, whose value is written and additionally depicted by a color coded bar.
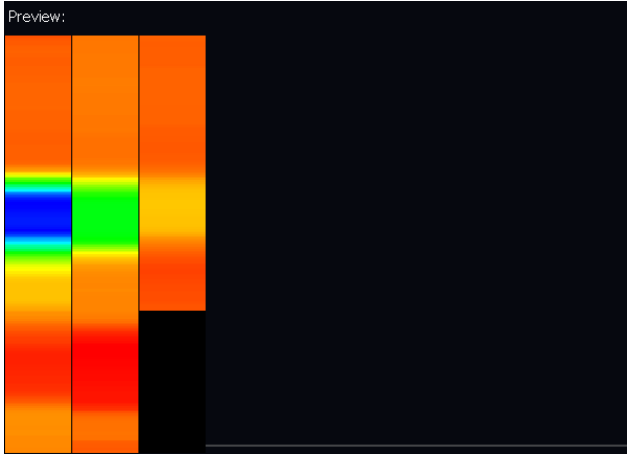
Field Preview: shows the data which is recorded so far in a layout which corresponds to the previously entered field parameters. Please note, how each individual row can be distinguished.
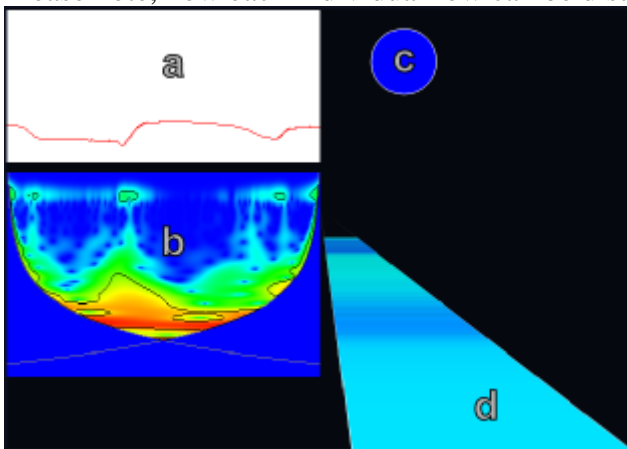
Frequency Behavior: depicts the spatial and temporal progress of the frequencies of the current row.

(a): Shows the time line of the current row.

(b) Shows the corresponding spectral analysis (by using wavelet decomposition - for details, click here.). Basically it shows (by using color coding corresponding to the currently selected colormap) where in the time line there are statistically relevant frequencies.

(c): An indicator, which shows (by using color coding corresponding to the currently selected colormap), when a possible object edge was found.

(d): This bar shows the color coded progress of the recorded sensor values.

2. Load Dataset

To load a dataset, you simply have to select the corresponding menu item. A file dialog will appear where you can choose the saved dataset. If the loading succeeded, the dataset will be added to the dataset window where it can be selected and analysed.
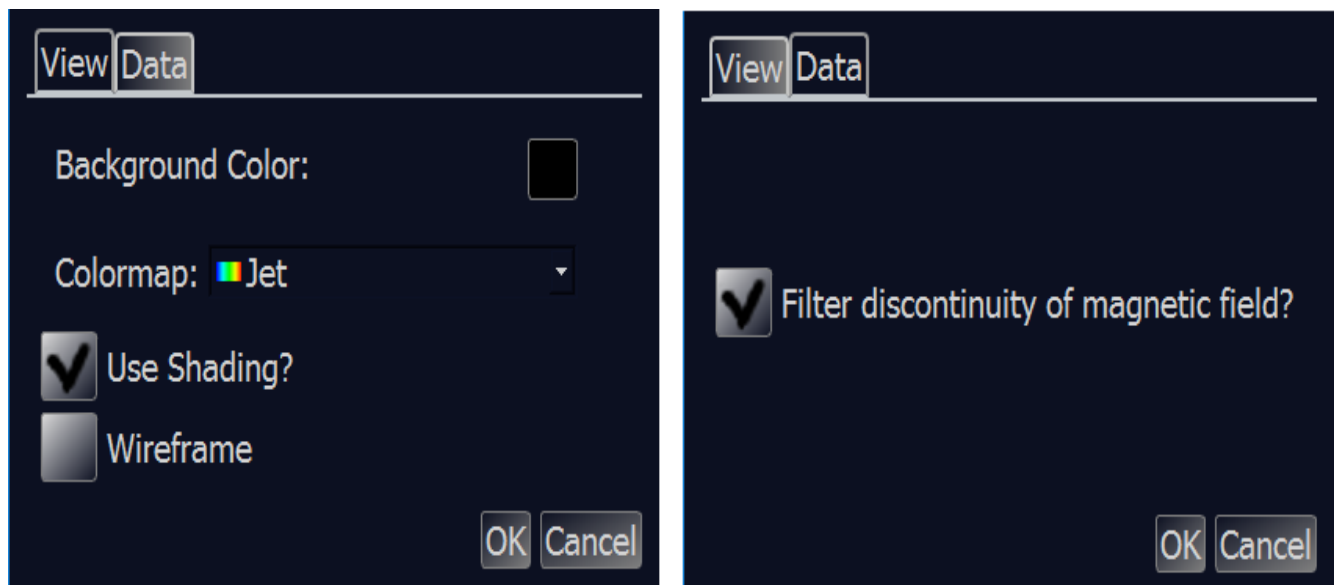
3. Save Dataset

To permanently save a dataset to disk, you have to click (or tap) on the disc symbol of the dataset in the dataset window (see Dataset Window). In following file dialog, you can specify the location and filename of the dataset.

4. Evaluate

How to identify an object in the dataset can be read in this document: Link.

5. Change Options

The option windows consits of two tabs. In the first tab ("view"), you can change options regarding the view. The upper option changes the background color of the 3D view. The preset is black.
In the menu below, you can determine the colormap that is used to visualize the dataset.
When clicking on the check box "Use Shading", you can specifiy, if the terrain is to be lit and shaded with a light source. The light source is always placed in the camera. If you enable the shading, the terrain is visualized with a stronger 3D effect. On the other hand, the computation of the terrain will last slightly longer.
When enabling the check box "Wireframe", you can specify, if the 3D terrain is visualized as a grid. When leaving unchecked, the 3D terrain will be shown as a solid surface.
By activating the checkbox "Live Sound", you can trigger an repetitive acoustic signal during the recording process for an auditive feedback. During the recording, a high pitched sound indicates high recorded values whereas the pitch level will decrease, when the recorded values will decrease.
In the second tab ("data"), you can determine, if you want to filter out the magnetic discontinuities that reside in the recordings. The magnetic field is in general not equally valued at every point where you will perform your recordings. That means they can distort the

recording. Therfore, you have the option to filter them out. If you want to see the actual values of your field, you have to disable this option. The preset is on.

6. GPS Position Data

In TeroVido3D it is possible to save the position of the recorded datasets. The position will be identified with the GPS sensor of your tablet.
**Please note**: If your tablet/PC does not have a GPS sensor, this feature will not be activated.

To activate the GPS sensor, hit the button in the dock widget. The button will now start to blink yellow. That means it is searching for a GPS signal. Please note that it can last up to several minutes until a GPS signal is found depending on your environment. You can still use TeroVido3D while it is searching for the GPS Signal. When the signal is found, the button

will start to shine green: . If you hit the button anew, you can disconnect the GPS signal again.

When you record a dataset when on the same time a GPS signal was found, the position data of the dataset will be recorded and saved automatically. To view the position data of a dataset, you have to select the dataset in the dataset window by double clicking on it. The button to view the position data in the dock widget () is now colored (). If the dataset has no position data, the button will remain grey.

If you hit the button now, a website will be opened which shows the position of the recording using Google Maps. Please note that you have to be connected to the internet during this procedure.

7. Depth Analysis
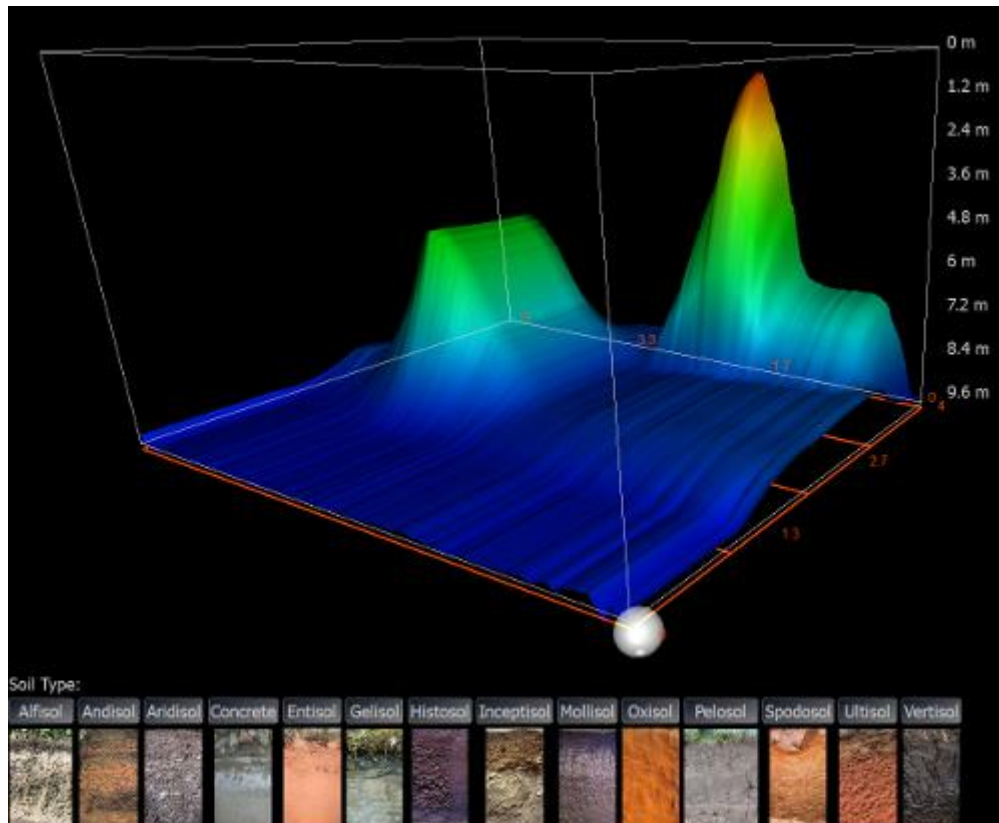
If your TeroVido recording device is capable of measuring the depth component of a signal,

you can perform a depth analysis on your recorded data by clicking on the symbol ![icon] in the dock widget. A new window will open. The window displays a 3D visualization of your currently choosen data set. You can navigate the view (zoom, scroll, pane) just like in the 3D View. Your data set is now enclosed in a 3D box. On the right hand side of the box, you can see the measured depth of the recordings.

TeroVido3D has to compute the depth individually for different soil types. Therefore, you have the option to choose from different soil types by clicking on the corresponding button in the lower area of the window. Underneath each button, there is an example image of the soil type to ease the selection process.

Please note that a precise computation of the depth component is nearly impossible due to many factors regarding the soil types (for example the humidity of the soil, or is there a mixture of different soil types etc.).

8. Live Sound

If you are interested in an acoustic signal during the recording process for an auditive

feedback, you can enable this feature by clicking on the earphone button ![icon] . A red border

around the button ![icon] indicates that this feature is now enabled. During the recording, a high pitched sound indicates high recorded values whereas the pitch level will decrease, when the recorded values will decrease. By clicking again on this button, this feature can be disabled.

Feature List

Feature	Description
Load Dataset	Click here.
Record Dataset	Click here.
Save 3D View as Image File	This feature enables you to save an image of the current 3D view to the hard drive. After clicking on this menu item a file dialog will appear. Here you can specify where on your PC/tablet the image will be saved.
Print 3D View	By using this feature, you can print the current 3D view. According to the operating system you use (Windows/Linux/Android) a print dialog will appear. Here you can determine the printing options and eventually start the printing process.
Live Sound	Click here.
Search GPS Signal	Click here.
View GPS Position Data	Opens a browser window and shows the position, where the currently selected dataset was recorded. Click here.
Open Options	Click here
Depth Analysis	Click here.
Black Body Radiation Colormap	Changes the current colomap to "Black Body Radiation" Colormap
Jet Colormap	Changes the current colomap to "Jet" Colormap
Temperature Colormap	Changes the current colomap to "Temperature" Colormap
Grayscale Colormap	Changes the current colomap to "Grayscale" Colormap

Glossary

1. Dataset

A Dataset always consists of a recording which was performed by walking the field in rows equally fast. In TeroVido3D a dataset can be visualized as a colored 3D terrain.

2. Colormap

A colormap is a function, which turns the values of a dataset into colors. In TeroVido3D, the colormaps are represented by buttons depicting a color gradient. These color gradients correspond to the colormap. That means, the left color on the button corresponds to the smallest value which is shown. Accordingly the largest value is mapped to the color on the right. At the time, there are four different colormaps: jet (see the image), black body radiation, temperature, grey values.

3. Transmitter and Receiver

The hardware component of TeroVido3D usually consists of two components: the transmitter and the receiver. The receiver must be plugged into the PC/tablet, where the TeroVido3D software is installed. Please make sure that the receiver is plugged in before you start the software. Otherwise the software will not be able to start.

When you initiate a new recording using the software, the receiver will attempt to connect to the transmitter. The transmitter then starts to transmit the data of the recording to the receiver and thus to the software.