



ELECTROMAGNETIC METAL DETECTOR

Ramboll is making use of a highly sensitive electromagnetic metal detector to map metal objects below ground.

Introduction

The electromagnetic metal detector (EM) can be used for a variety of purposes:

- Locating buried tanks
- Landfill delimitation
- Mapping of pipelines
- Munitions search
- Archaeological studies

Equipment

The instrument consists of 2 square coils of 1 m x 1 m with 0.4 meters between them. On the lower coil there is a wheel, so the metal detector can be pulled over terrain. The bottom coil acts as a source; an electric pulse is transmitted through the coil and generates a short-term magnetic field. This magnetic field generates currents in all conductive materials near the coil. After approx. 0.1 second, there will only be electro-magnetic currents left in metallic materials.

The currents generate a secondary magnetic field that can be measured as an electrical current in the coils. By measuring the electric current in the two coils after approx. 0.1 second, one can quantitatively measure the occurrence of metallic materials near the instrument. The measurement is practically independent of the geological conditions.

Data Collection

Data is collected by covering the survey area with parallel target lines. The spacing between target lines depends on the desired degree of detail. To locate single objects, data should be collected with ½ - 1 meter between the lines. By delimiting groups of objects over a larger area (for example, a landfill), larger line spacing can be used.



Figure 1: The operator carries a backpack with batteries and a control unit together with a handheld computer.

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Data is typically measured in the form of the induced electrical current for every 20 cm along the line. The position of the instrument is determined by means of traditional land survey methods, or with GPS, depending on the scope of the instrument and accuracy requirements.

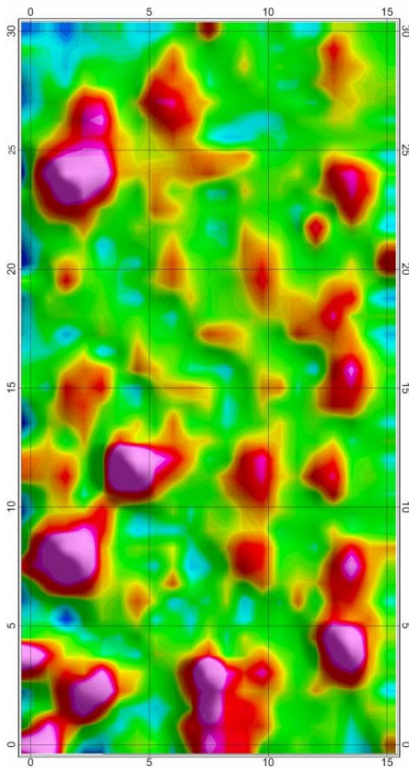


Figure 2: EM data from a military testing field. The data shows the position of unexploded grenades, detonation pipes, and shrapnel. A 5 meter grid has been drawn in.

Data processing and interpretation

Ramboll has extensive experience from solving many tasks by electromagnetic metal detector. EM data is always

interpreted by a geophysicist with experience in this field.

Applications

Buried tanks can be detected to approx. 3 meters deep. Because there will often be other metal installations at the site, it is advantageous to use an instrument with two coils. By combining and comparing data from both coils, external noise can be suppressed during data processing. This also enables objects to be differentiated depending on their distance from the surface.

Landfills, which are often incompletely mapped, are found often in Denmark. They pose a latent threat to groundwater resources. Since landfills often contain large amounts of iron scrap, they can be quickly and safely delimited by EM.

Pipelines and cables will appear as line structures when mapping with EM. Therefore, they can be interpreted with a high degree of confidence, even with strong background noise from other metal objects. Weak signals from deep pipes and cables can also be interpreted with confidence.

Munitions searches are a task well-suited to EM mapping. The EM sensitivity is comparable to the magnetometers traditionally used for these tasks, but EM data from is far easier to interpret and results in a higher

degree of horizontal accuracy in the designation of objects. By combining data from the two coils, it is also possible to estimate the depth of buried objects.

Archaeological studies can be performed quickly over a large area with EM, providing an overview of buried metals with a high degree of sensitivity, and including metals that a magnetometer would not detect, such as bronze, silver, and gold.

Detection Level

The strength of the measured response signal from metallic objects is affected by several factors, including the distance from the coil, the shape of the object, and the material itself. The detection level – that is, the response sufficient for the detection of objects – depends on the surroundings. Signal noise from other metal objects occurs frequently, which increases the required detection level for a valid response.

Ramboll has performed several full-scale tests before solving major tasks; for example, performing a munitions search in a test field with buried munitions.

In connection with archaeological research, Ramboll has measured the response from well-preserved excavations to assess the level of detection prior to a similar search for buried artifacts.