The MIRA 3D GPR ARRAY System – Introduction

Our supplier was the first commercial GPR manufacturer to identify the large potential in 3D array technology and shipped the first complete system in 1998. Since then, they have continuously met a world-wide growing interest for 3D array applications and therefore decided to increase research and development activities; as a result the MIRA was released last year. The acronym MIRA (**M**alå **I**maging **R**adar **A**rray) actually defines a set of sub-systems, a concept, of which the core parts comprises unique, patented, designs using the latest technology available. Altogether, a MIRA system provides the end user with a seamless package for, true, 3D radar acquisition, interpretation and reporting.

The marketplace has been (and continues to be) confused by the use of array terminology for almost any multiple antenna configuration. This introduction aims at clarifying some of the ambiguities as well as explaining in which cases a MIRA system might be an option for you.

Traditional use of the GPR technology involves both single and multi-channel systems in many types of applications e.g. utility mapping, archaeological investigations, forensic investigations etc. When deploying ordinary GPR systems, the results suffer from lack of real 3D capabilities i.e. the line spacing in the surveys will, for practical reasons, be too large, meaning that information loss are inevitable. Also, reliable positioning of detected target cannot be made easy, neither in the data acquisition process nor in the reporting phase of a typical project. The MIRA-systems are the first commercial systems designed to overcome these limitations.

As opposed to other commonly marketed multi-channel systems, which in many cases could be regarded as parallel single channel systems, the MIRA system enables fast and true 3D data acquisition. From a user perspective this means that large areas can be mapped without loss of information and that the method is suitable for almost any kind of, shallow, subsurface investigation,
i.e. targets with arbitrary shape, layers and linear objects are mapped equally well.

***Left**: Array option attached to a ProEx control unit. **Middle**: 1.3GHz Array antennas. **Right**: Vehicle mounted 400MHz array.*

MIRA-system, unique, advantages:

- Seamless integration of radar and positioning data combined with quality checks at time of data

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gathering.

- Easy-to-use 3D processing and interpretation software which enables interpretation of huge data-sets. The software is easy and straight forward without complex import schemes.
- Small channel spacing, high acquisition speed and arbitrary shooting sequences, allow data collection without loss of information. These critical criteria's have often been overseen in the past.

For large projects the MIRA system is a cost effective solution in comparison with ordinary GPR systems even if the difference in initial cost may be considered substantial. The systems do not only provide a high productivity measured in square meters/day (typically in the range 20 000- 40 000 m2), the detailed and easily interpreted results also enables applications previous not feasible using GPR.

A common experience, drawn from a multitude of commercial and other projects, is that MIRA data includes more detail and information from the site than anticipated prior to investigation. The image in Figure 2 below shows data from an archaeological investigation outside a medieval church. Even though utility lines were not the primary targets for this investigation, they appear very clearly in the data (picture below).

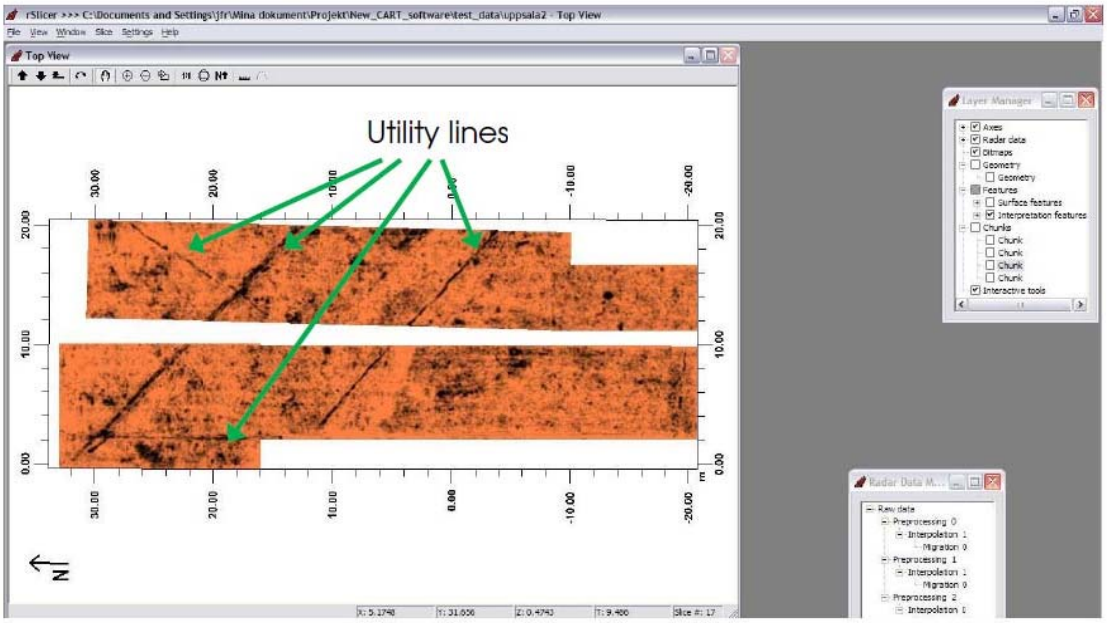

***Figure 2**: Typical top-view result from 400MHz MIRA data. Data set is showing utility lines at a depth of 0.5m. The white space in the middle is due to unreachable area (obstacles preventing surveying)*

A functional MIRA system comprises many sub-systems. The main parts of the system are listed below:

- Antennas, separate transmitter and receiver antennas with the centre frequency of 200MHz, 400MHz or 1.3 GHz. These frequencies will cover investigations ranges from zero to approximately 6m depth in non-conductive ground.
- Suitable antenna box.
  Modified ProEx control unit with the MIRA array option. The standard configuration is equipped with
- 16 channels but it can be customized for any number of data channels up to 31.
- MIRA-Acquisition software for data acquisition.
- MIRA-interpretation software package, rSlicer.

- Positioning system, robotic total station or RTK GPS.
- Windows based computer to collect, save and process data.
- Suitable vehicle or arrangement to move the antenna array.

The purchase of a MIRA system always includes training, which covers hardware handling, collection and positioning of data, post processing and reporting.